Contract No. DE-FC22-90PC90548

Baseline Environmental Monitoring Report

LIFAC Sorbent Injection Desulfurization Demonstration Project

Presented By

LIFAC North America

A Joint Venture Between

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Presented To

U.S. Department of Energy

Pittsburgh Energy Technology Center
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October 13, 1993

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Subject: LIFAC Sorbent Injection Desulfurization Demonstration Project
Agreement No. DE-FC22-90PC90548
ICF Kaiser Engineers Project No. 91001-001
Baseline Environmental Report

Dear Mr. Evans:

Please find enclosed the Baseline Environmental Report which summarizes testing performed during 1992 at Richmond Power and Light Whitewater Valley Generating Station Unit No. 2. As required by the Environmental Monitoring Plan (EMP), gaseous emissions and liquid and solid process samples were measured for their respective parameters. Gaseous emissions included the measurement of particulate matter (PM), nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2), and oxygen (O_2). Analyses of solid and aqueous samples included the determination of alkalinity, pH, sulfate content, and any detectable quantities of metals, organic compounds, and volatile organic compounds (VOC).

If we can be of any further assistance, please call me.

Very truly yours,

ICF KAISER ENGINEERS, INC.

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1.0 INTRODUCTION

In 1988, the Department of Energy (DOE) was provided with federal funding to cost-share the design, construction, and operation of the Clean Coal Technology (CCT) projects. The intention of these projects is to demonstrate the feasibility and effectiveness of technologies capable of retrofitting or repowering existing coal-burning power plants so as to reduce air emissions of sulfur dioxide (SO_2) and oxides of nitrogen (NO_x). Under Round III of the CCT project, the Limestone Injection into the Furnace with Activation of Unreacted Calcium (LIFAC) project of LIFAC-North America (LIFAC NA) was chosen from among 48 other proposals to demonstrate its innovative technology to reduce SO_2. The Richmond Power and Light (RP&L) Whitewater Valley Generating Station Unit #2 is the host for the LIFAC demonstration project.

LIFAC NA, on behalf of RP&L, sought and received from Indiana Department of Environmental Management (IDEM) a variance to operate Unit #2 for the testing performed during the different project stages. The variance requires specific compliance tests to be conducted at milestones identified in the variance request. In addition to the compliance testing, the project also requires supplemental monitoring to be performed. As defined by the Environmental Monitoring Plan (EMP) for the LIFAC project, the supplemental monitoring is performed to identify and characterize potential environmental and health impacts of the project, both on-site and off-site. This monitoring may include, yet is not limited to, measurement of processes, feedstocks, operating conditions, discharges, and ambient environmental conditions. This supplemental monitoring focused on the measurement of coal feedstocks, boiler and generator operating conditions, gaseous and particulate discharges, and solid and aqueous process by-products. Measurement of coal feedstocks included coal analysis and feed rate to boiler. Boiler and generator operating conditions were recorded on operator log sheets. Measured discharges included total particulate matter, nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2), and oxygen (O_2). Determinations of alkalinity, pH, sulfate content, and any quantities of specified metals, organic compounds, and volatile organic compounds (VOC) present in the process liquid and solid by-products were made.

Supplemental testing was performed on September 2, 1992 only, and concurrently with the compliance testing for that day. Testing was performed during the baseline operation of the process, that is, during the post-construction phase and before any on-line application of hardware or limestone absorbent that would normally be utilized by the LIFAC process.

The September 2 test program fell within the third quarter, however, no quarterly report was submitted for this quarter. This baseline report serves as a summary for both the third and fourth quarters and for the 1992 year.

LIFAC NA is a joint venture between ICF Kaiser Engineers (ICF KE), located in Pittsburgh PA, and Tampella Power based in Marietta, GA. Keystone Environmental Resources (KER) of Monroeville, PA was retained for the execution of the testing conducted at the ESP outlet. Project personnel conducted the simultaneous testing at the ESP inlet. Although contacted as directed by permit and test protocol conditions, a representative from IDEM was not present for the testing.

2.0 PROCESS DESCRIPTION

The LIFAC project involves the installation and testing of the LIFAC system on Unit No. 2, a 60 MW tangentially-fired, coal-burning boiler. A schematic of the system is included as Figure 2-1. LIFAC is a retrofit flue gas desulfurization technology capable of reducing SO_2 emissions in the range of 75 to 85 percent. The system utilizes limestone injection and a unique activation reactor with a humidification process for effective SO_2 removal. Various types of limestone will be used throughout the demonstration project. The pulverized limestone is pneumatically injected into the upper regions of the furnace using the already existing injection system. Here, the calcium carbonate ($CaCO_3$) in the limestone breaks down to form calcium oxide (CaO) and carbon dioxide (CO_2). A portion of the sulfur dioxide (SO_2) and sulfur trioxide (SO_3) present in the flue gas chemically reacts with the limestone constituents to form calcium compounds calcium sulphite ($CaSO_3$) and calcium sulphate ($CaSO_4$). Subsequently, the flue gas, carrying along with it the calcium compounds and unreacted CaO, then continues to a unique piece of equipment known as the activation reactor, a cylindrically-shaped vertical tower located between the Unit 2 air preheater and the ESP. Further removal of the SO_2 is achieved by the humidification of the flue gas as it enters and passes through the activation reactor. The addition of the water mists in the reactor causes the remaining untreated CaO to form calcium hydroxide (CaOH). The calcium hydroxide then reacts with additional sulfur dioxide, nearly completing the removal process. The purpose of initiating reductions of SO_2 emissions is to minimize generation of acid rain, as SO_2 is a precursor to its occurrence.

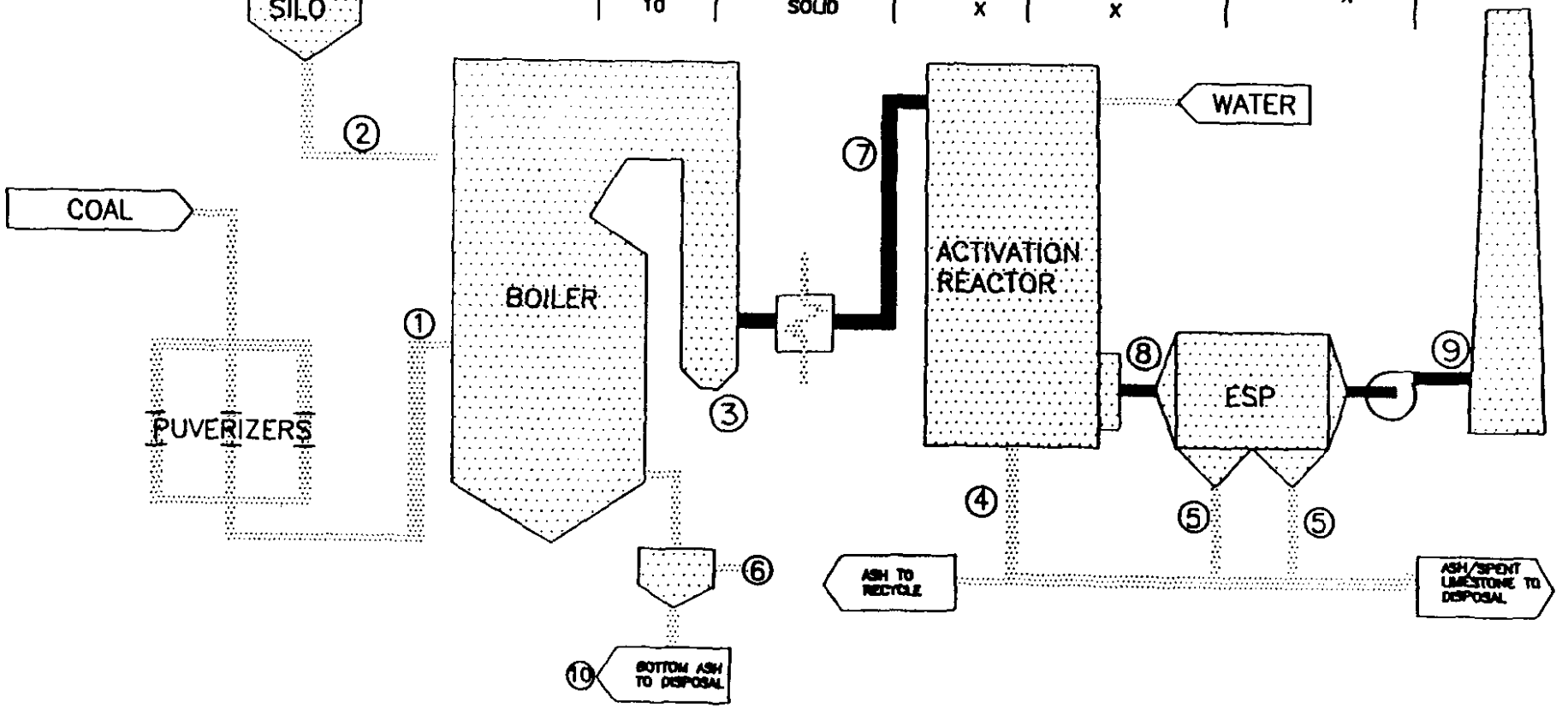
In addition to the boiler bottom ash and fly ash normally produced by coal combustion, there are other "new" by-products associated with the LIFAC system. The addition of limestone to the process and the subsequent reactions create a dry, powdery material referred to as LIFAC solid waste and by-product. Approximately 75 percent of the solid waste and by-product is collected by the ESP (and the ESP hoppers). The remainder of the waste exits as a slag through hoppers at the bottom of the activation reactor. A small fraction of LIFAC solid waste and by-product may collect in the air preheater ash hopper. Wastes captured by the process vessels and equipment will be collected using a new, dry mechanical exhauster system and transported to an off-site, permitted landfill. The carbon dioxide leaves with the flue gas in the stack emissions.

There will be no change to the amount of coal fired at the plant. Different varieties of coal will be tested ranging from a high sulfur to a low sulfur bituminous coal. When the LIFAC system is fully operational, the additional electrical energy requirements for LIFAC equipment and the introduction of limestone into the boiler is expected to reduce the net output of Unit 2 from 60 MW to 59.5 MW.

Testing was performed during the baseline operation of the power plant, as scheduled by the EMP. Baseline operation is defined as the time period during post-construction of the LIFAC system, and before any LIFAC system hardware is brought on line and limestone sorbent is injected into the furnace. During baseline operation, process operating conditions represent normal firing conditions practiced by RP&L. This testing provides initial information for plant operation as it pertains to compliance and supplemental parameters.

FIG. 2-
WHITEWATER VALLEY UNIT 2
SCHEMATIC WITH LIFAC SYSTEM INSTALLED

LOCATION	MEDIA	MONITORING PURPOSE: TEST PROGRAM	EMP: SUPPLEMENTAL	EMP: COMPLIANCE
1	SOLID	X		
2	SOLID	X		
3	SOLID	X	X	
4	SOLID	X	X	
5	SOLID	X	X	
6	AQUEOUS			X
7	GASEOUS	X		
8	GASEOUS	X	X	
9	GASEOUS			X
10	SOLID	X	X	



3.0 METHODOLOGIES

The majority of this supplemental program centered around the testing of particulate matter and gaseous parameters present in the exhaust duct. The test program utilized methodologies promulgated in 40 CFR 60, Appendix A, for the particulate matter and duct gas determinations necessary for the test program. EPA Methods 1, 2, 3A, and 4 were used for the determination of the sampling points locations, gas velocities and volumetric flow rates, gas molecular weight on a dry basis, and percent moisture content, respectively. Particulate matter was determined using EPA Method 5. Gas concentrations of NO_x, SO_2, and CO were determined utilizing EPA Methods 7E, 6C, and 10, respectively.

Analyses of the solid and aqueous LIFAC by-products followed EPA methods and ASTM extraction methods. The specific EPA methods which were referenced are sited in the footnotes of Tables C-1 through C-6 in Appendix C. Total alkalinity of both the aqueous and solid samples were determined by EPA Method 310.2. Before the alkalinity of the solid samples could be measured, they were extracted using ASTM extraction methods. The remaining analyses of the solid wastes performed using the following EPA Methods: pH, 9045; sulfate, 9038 (using ASTM extraction method); metals, Toxicity Characteristics Leaching Procedures (TCLP) 1311, 6010, 7470, and 7740; organic materials, TCLP 8260 and 8270; and VOC, TCLP 8260.

4.0 RESULTS

A summary of results for particulate matter testing for the ESP inlet and outlet locations are presented in Tables 3-1 and 3-2. Soot was not blown during any of these tests. Only two test runs were executed at the ESP inlet. Note that the comparison of solid loading at the ESP inlet and outlet indicate an ESP efficiency of approximately 99.5. Pertinent process conditions have been presented in these tables such as power generation in units of megawatts (MW), coal feed rate (lb/hr), and firing rate (MMBtu/hr). Baseline coal data is summarized in Table 2 below.

The particulate matter mass loadings are expressed in grains per dry standard cubic feet (gr/dscf), pounds per hour (lb/hr), and mass per heat input, expressed as pounds million Btu (lb/MMBtu). Mass emission per heat input was calculated using two different methods. The first method was based on actual process parameters such as coal feed rate to the boiler and coal heating value. The second method utilized EPA Method 19, F factor method. The following equation, extracted from the method, calculates a theoretical mass emission per heat input based volume of the components of coal combustion, measured pollutant concentration, and the measured percent oxygen.

$$E = F_d \, C_d \, [20.9/(20.9 - \%O_{2d})]$$

where
- E = Emission rate (lb/MMBtu)
- F_d = Oxygen-based F factor, dry basis (9780 dscf/MMBtu for bituminous coal)
- C_d = Pollutant concentration (lb/dscf)
- $\%O_{2d}$ = Percent oxygen, dry basis

An example calculation using the F factor method can be found in Appendix D. Actual calculations were performed with computer spreadsheets, which were used to produce these summary tables. Duct conditions have been presented in the tables. Flow rates have been expressed in three different formats: actual cubic feet per minute (acfm), standard cubic feet per minute (scfm), and dry standard cubic feet per minute (dscfm). Other duct gas parameters such as temperature and percent moisture have also been included. Certain sampling conditions have been included in the table such as test run clock times, actual sampling time, and sample volume collected for each test run. The sample volume is expressed in units of dry standard cubic feet (dscf). Percent isokinetics have been calculated for each test run. The percent isokinetic value represents a ratio of the gas velocity through the sampling probe nozzle to the gas velocity in the duct. An isokinetic value is acceptable if it falls within the range of 90 to 110 percent. All isokinetic values are within the acceptable limits. Particulate matter sampling data sheets and calculations for the test runs at the ESP inlet and outlet can be found in Appendix B and D, respectively. All particulate matter sampling equipment was operated in accordance with EPA Methods 2 through 5. Copies of equipment calibrations can be found in Appendix F.

Based on prior compliance testing data provided by RP&L, the particulate matter loading (mass emission/Heat Input) provided in Table 3-2 appears to be low. Therefore, we have provided additional particulate testing data which was conducted in December 1992, in Table 3-4 attached (see Appendix G for back-up information).

Continuous emissions monitoring (CEM) results have been summarized in Table 3-3. Three CEM test runs were executed for this test program. Test runs 1 and 3 were one hour in duration, while test run 2 was slightly less than one hour. Concentrations for all constituents were very consistent

TABLE 2

RICHMOND POWER AND LIGHT
RICHMOND, IN
WHITEWATER VALLEY GENERATING STATION UNIT #2

BASELINE COAL DATA

	Sample # 1 pm to 4pm RP&L 9/2/93	Sample # 5 pm to 8 pm RP&L 9/2/93	Sample # 8pm to Midnight RP&L 9/2/93	Sample # BA-CF-65-090212 STD Labs 9/2/93	Sample # BA-CF-65-09220 STD Labs 9/2/93
BTU's Received	11,352	11,245	11,271	11,343	11,366
BTU's Dry	13,104	13,020	12,975	13,049	13,118
Moisture % (as received)	13.37	13.63	13.13	13.08	13.35
Ash (as received)	8.38	9.25	9.03	8.90	9.09
Ash % (Dry)	--	--	--	10.24	10.49
Sulfur % (as received)	2.19	2.30	2.30	2.38	2.53
Sulfur % (Dry)	2.52	2.66	2.65	2.73	2.92

Note: RP&L's coal data (from 1 pm to midnight) was analyzed and used in the calculations. Coal data analysis from Standard Laboratories for the 9/2/92 testing period is included for comparison purposes (see Appendix E).

for all three test runs. All SO_2 concentrations have been corrected for percent O_2 and CO_2 present in the flue gas. Also note that SO_2 concentrations were measured on a dry basis and have been adjusted to reflect the percent moisture in the duct. Actual CEM data gathered during testing, stripcharts, equipment calibrations, and SO_2-flue gas correction calculations can be found in Appendix A.

PM_{10} was to be determined employing EPA Method 201A, however no sampling was conducted due to sampling equipment access difficulties with the test ports. With Method 201A an in-stack, stainless steel PM_{10} sizing head is attached to the probe. Unfortunately, the sizing head was larger in physical size than the port opening; therefore, it could not be inserted into the port.

Analyses of the aqueous effluent and solid waste were conducted by Antech Ltd. The aqueous effluent sample was collected from sample location 6 (Pond Effluent Outfall 001). Solid samples were collected from sampling location 3 (boiler bottom) and sampling location 5 (ESP hoppers). A summary of the analytical results for solid and liquid samples are presented in Table 4 with Antech's actual analytical results for both liquid and solid samples can be located in Appendix C, Tables C-1 through C-6. Total alkalinity for the aqueous and solid samples, and pH and sulfate content for the solid samples can be found in Tables C-1 and C-2. Table C-2 also displays metals analysis for solid samples. All metals were below detectable limits except for arsenic at sampling location 5; the arsenic was measured at 1.3 mg/L which is below the regulatory level of 5.0 mg/L. With regard to the TCLP organic analyses in Table C-3, all organic parameters were below detectable limits for both locations 3 and 5. Table C-4 shows results of the method blank ran for TCLP organic analyses. VOC analyses are presented in Table C-5. There were three VOC parameters above detectable limits: methylene chloride at location 3 (46 μg/kg), carbon disulfide and toluene at location 5 (730 μg/kg and 2200 μg/kg, respectively). Table C-6 shows results of a method blank ran for VOC analysis.

TABLE 3-1

RICHMOND POWER AND LIGHT
RICHMOND, IN
WHITEWATER VALLEY GENERATING STATION UNIT #2

SAMPLING LOCATION #8: ESP INLET
PARTICULATE MATTER TEST DATA

	Test Run Test Date Test ID Number Units	2 9/2/93 PE3BE	3 9/2/92 BE4BE	Average
Process Conditions				
Power Generation	(MW)	65.5	65.1	65.3
Coal Feed Rate	(lb/hr)	608.10	61080	60945
Heat Input	(MMBtu/hr)	686.5	689.5	688.0
Particulate Matter Loadings				
Concentration	(gr/dscf)	2.886	2.882	2.884
Mass Flow Rate	(lb/hr)	3601.5	3603.1	3602.3
Mass Emission/Heat Input[1]	(lb/MMBtu)	5.246	5.226	5.236
Mass Emission/Heat Input[2]	(lb/MMBtu)	5.472	5.465	5.468
Duct Conditions				
Average flow Rate	(acfm)	25800	253200	255600
Standard Flow Rate	(scfm)	162800	160722	161750
Dry Standard Flow Rate	(dscfm)	145600	145800	145700
Temperature	(°F)	329	329	329
Percent Moisture	(%)	10.6	9.2	9.9
Percent O_2	(%)	5.5	5.5	5.5
Percent CO_2	(%)	12.9	12.9	12.9
Duct Pressure	(in. Hg)	28.41	28.37	28.39
Sampling Conditions				
Test Clock Times		10:55 to 12:16	14:11 to 15:33	
Sampling Time	(minutes)	72	72	
Sampling Volume	(dscf)	34.626	36.056	
Isokinetics	(%)	95.2	98.9	
Ambient Pressure	(in. Hg)	29.1	29.0	

Notes: [1] Based on measured coal feed rates and heating values.
[2] Based on EAP Method 19 (F factor method).
Sample location number was taken from Figure 2-1 (LIFAC process diagram of this report).
ESP Inlet sampling was performed by project personnel.
Only two test runs were performed at the ESP inlet.

TABLE 3-2

RICHMOND POWER AND LIGHT
RICHMOND, IN
WHITEWATER VALLEY GENERATING STATION UNIT #2

SAMPLING LOCATION #9: ESP OUTLET
PARTICULATE MATTER TEST DATA

	Test Run	1	2	3	
	Test Date	9/2/93	9/2/92	9/2/92	Average
	Test ID Number	ICF-BRE-C1	ICF-BRE-C2	ICF-BRE-C3	
	Units				
Process Conditions					
Power Generation	(MW)	64.8	65.5	65.1	65.1
Coal Feed Rate	(lb/hr)	61770	60810	61080	61220
Heat Input	(MMBtu/hr)	697.3	686.5	689.5	691.1
Particulate Matter Loadings					
Concentration	(gr/dscf)	0.0165	0.0110	0.0130	0.0135
Mass Flow Rate	(lb/hr)	20.95	14.07	16.81	17.28
Mass Emission/Heat Input[1]	(lb/MMBtu)	0.030	0.020	0.024	0.025
Mass Emission/Heat Input[2]	(lb/MMBtu)	0.029	0.019	0.023	0.024
Duct Conditions					
Average flow Rate	(acfm)	255800	257000	258700	247167
Standard Flow Rate	(scfm)	164100	164400	167200	165600
Dry Standard Flow Rate	(dscfm)	148500	149000	150300	149267
Temperature	(°F)	342	338	335	338
Percent Moisture	(%)	9.5	10.0	10.1	9.9
Percent O_2	(%)	4.5	4.4	4.2	4.4
Percent CO_2	(%)	15.0	14.7	14.7	14.8
Duct Pressure	(in. Hg)	29.14	29.14	29.14	29.14
Sampling Conditions					
Test Clock Times		8:45 to 10:04	10:45 to 12:18	14:12 to 15:31	
Sampling Time	(minutes)	72	72	72	
Sampling Volume	(dscf)	40.960	41.635	41.324	
Isokinetics	(%)	102.5	103.8	102.1	
Ambient Pressure	(in. Hg)	29.06	29.06	29.06	

Notes: [1] Based on measured coal feed rates and heating values.
[2] Based on EAP Method 19 (F factor method).
Sample location number was taken from Figure 2-1 (LIFAC process diagram of this report).
ESP Inlet sampling was performed by project personnel.

TABLE 3-3

RICHMOND POWER AND LIGHT
RICHMOND, IN
WHITEWATER VALLEY GENERATING STATION UNIT #2

SAMPLING LOCATION #9: ESP OUTLET
SUMMARY OF CONTINUOUS EMISSIONS MONITORING

	Test Run	1	2	3	
	Test Date	9/2/93	9/2/92	9/2/92	Average
	Test ID Number	ICF-BRE-C1	ICF-BRE-C2	ICF-BRE-C3	
Condition	Units				
Nitrogen Oxides (NO_x)	(ppmv)	386.3	385.6	354.9	375.6
Sulfur Dioxide (SO_2d)	(ppmv)	1957	1998	1962	1972
Sulfur Dioxide (SO_2w)	(ppmv)	1787	1816	1782	1795
Carbon Monoxide (CO)	(ppmv)	12.9	15.6	31.2	19.9
Carbon Dioxide (CO_2)	(%)	15.0	14.7	14.7	14.8
Oxygen (O_2)	(%)	4.5	4.4	4.2	4.4
Percent Moisture	(%)	9.5	10.0	10.1	9.9
CEM Test Clock Times		9:45 to 10:45	11:11 to 12:05	14:40 to 15:40	

Why so high

Notes: ppmv = parts per million volume
Reported SO_2 concentrations are corrected for flue gas O_2 and CO_2.
SO_2d = sulfur dioxide on dry basis
SO_2w - sulfur dioxide on wet basis
CEM performed by Keystone Environmental Resources.

TABLE 3-4

RICHMOND POWER AND LIGHT
RICHMOND, IN
WHITEWATER VALLEY GENERATING STATION UNIT #2

SAMPLING LOCATION #9: ESP OUTLET (BREECHING LOCATION)
PARTICULATE MATTER AND SO_x TEST RESULTS

	Test Run	1	2	3	
	Test Date	12/18/92	12/18/92	12/18/92	Average
	Test ID Number	ICF-BRE-1	ICF-BRE-2	ICF-BRE-3	
	Units				
Process Conditions					
Power Generation	(MW)	64.5	66.3	66.6	65.8
Coal Feed Rate	(lb/hr)	58,304	60,441	60,286	59,677
Heat Input	(MMBtu/hr)	652.0	683.8	681.0	672.3
Particulate Matter Loadings					
Particulate Matter					
Concentration	(gr/dscf)	0.1136	0.0553	0.1048	0.0912
Mass Flow Rate	(lb/hr)	139.6	78.5	142.7	120.3
Mass Emission/Heat Input[1]	(lb/MMBtu)	0.214	0.115	0.210	0.180
Mass Emission/Heat Input[2]	(lb/MMBtu)	0.223	0.108	0.192	0.174
Duct Conditions					
Average flow Rate	(acfm)	243,155	282,614	272,049	265,939
Standard Flow Rate	(scfm)	156,326	181,694	174,071	170,697
Dry Standard Flow Rate	(dscfm)	143,398	165,596	158,909	155,968
Temperature	(°F)	341	341	345	342
Percent Moisture	(%)	8.3	8.9	8.7	8.6
Percent O_2	(%)	6.0	6.0	5.0	5.7
Percent CO_2	(%)	14.0	14.0	14.5	14.2
Duct Pressure	(in. Hg)	29.19	29.19	29.18	29.19
Sampling Conditions					
Test Clock Times		6:50 to 7:59	14:45 to 15:49	17:00 to 18:03	
Sampling Time	(minutes)	60	60	60	
Sampling Volume	(dscf)	36.203	39.952	37.225	
Isokinetics	(%)	112.5	107.5	104.4	
Ambient Pressure	(in. Hg)	29.22	29.22	29.22	

Notes: [1] Based on measured coal feed rates and heating values.
[2] Based on EAP Method 19 (F factor method).
Sample location number was taken from Figure 2-1 (LIFAC process diagram of this report).

TABLE 4
Analysis of Aqueous Effluent and Solid Waste Samples
Baseline Environmental Report

Parameter	Units	Econ. Hopper #3 Ash (9-2-92)	ESP Hopper #5 Ash (9-2-92)	Pond Effluent (9-2-92)
Alkalinity (Total)	mg/l CaCO3	87.0	299	111
pH	pH units	11.90	11.60	-
Sulfate (ASTM)	mg/l	100	260	-
TCLP Metals : (3)				
Silver (TCLP)	mg/l	<0.10	<0.10	-
Arsenic (TCLP)	mg/l	<0.10	1.3	-
Barium (TCLP)	mg/l	<10	<10	-
Cadmium (TCLP)	mg/l	<0.10	<0.10	-
Chromium (TCLP)	mg/l	<0.10	<0.10	-
Mercury (TCLP)	mg/l	<0.01	<0.01	-
Lead (TCLP)	mg/l	<0.10	<0.10	-
Selenium (TCLP)	mg/l	<0.10	<0.10	-
TCLP Extraction Fluid Data:				
Extraction Fluid				
pH with Deionized Water	pH units	11.05	11.50	-
pH After Addition of 1 Normal HCL	pH units	1.55	1.90	-
pH of TCLP Extract	pH units	5.15	5.20	-
Amount of Sample Extracted	g	100	100	-
TCLP Volatile Organic Analysis: (8260) (3)				
Benzene	ug/l	<50	<50	-
2-Butanone	ug/l	<5000	<5000	-
Carbon tetrachloride	ug/l	<50	<50	-
Chlorobenzene	ug/l	<1000	<1000	-
Chloroform	ug/l	<500	<500	-
1,2 - Dichloroethane	ug/l	<50	<50	-
1,1 - Dichloroethene	ug/l	<50	<50	-
Tetrachloroethene	ug/l	<50	<50	-
Trichloroethene	ug/l	<50	<50	-
Vinyl chloride	ug/l	<50	<50	-
TCLP Base/Neutral Extractables: (8270) (3)				
1,4 - Dichlorobenzene	ug/l	<500	<500	-
2,4 - Dinitrotoluene	ug/l	<50	<50	-
Hexachlorobutadiene	ug/l	<50	<50	-
Hexachlorobenzene	ug/l	<100	<100	-
Hexachloroethane	ug/l	<500	<500	-
Nitrobenzene	ug/l	<100	<100	-
Pyridine	ug/l	<500	<500	-

TABLE 4 (cont.)
Analysis of Aqueous Effluent and Solid Waste Samples
Baseline Environmental Report

Parameter	Units	Econ. Hopper #3 Ash (9-2-92)	ESP Hopper #5 Ash (9-2-92)	Pond Effluent (9-2-92)
TCLP Acid Extractables: (8270) (3)				
Total Cresol (TCLP)	ug/l	<5000	<5000	-
Pentachlorophenol	ug/l	<5000	<5000	-
2,4,5 - Trichlorophenol	ug/l	<5000	<5000	-
2,4,6 - Trichlorophenol	ug/l	<100	<100	-
Acetone	ug/kg	<500	<13000	-
Benzene	ug/kg	<25	<630	-
Bromodichloromethane	ug/kg	<25	<630	-
Bromoform	ug/kg	<25	<630	-
Bromomethane	ug/kg	<50	<1300	-
2 - Butanone (MEK)	ug/kg	<500	<13000	-
Carbon disulfide	ug/kg	<25	730	-
Carbon tetrachloride	ug/kg	<25	<630	-
Chlorobenzene	ug/kg	<25	<630	-
Chlorodibromomethane	ug/kg	<25	<630	-
Chloroethane	ug/kg	<50	<1300	-
Chloromethane	ug/kg	<50	<1300	-
Chloroform	ug/kg	<25	<630	-
1,1 - Dichloroethane	ug/kg	<25	<630	-
1,2 - Dichloroethane	ug/kg	<25	<630	-
1,1 - Dichloroethene	ug/kg	<25	<630	-
cis - 1,2 - Dichloroethene	ug/kg	<25	<630	-
trans - 1,2 - Dichloroethene	ug/kg	<25	<630	-
1,2 - Dichloropropane	ug/kg	<25	<630	-
cis - 1,3 - Dichloropropene	ug/kg	<25	<630	-
trans - 1,3 - Dichloropropene	ug/kg	<25	<630	-
Ethylbenzene	ug/kg	<25	<630	-
2 - Hexanone	ug/kg	<250	<6300	-
Methylene chloride	ug/kg	46	<630	-
4 - Methyl - 2 - pentanone (MIBK)	ug/kg	<250	<6300	-
Styrene	ug/kg	<25	<630	-
1,1,2,2 - Tetrachloroethane	ug/kg	<25	<630	-
Tetrachloroethene	ug/kg	<25	<630	-
Toluene	ug/kg	<25	2200	-
1,1,1 - Trichloroethane	ug/kg	<25	<630	-
1,1,2 - Trichloroethane	ug/kg	<25	<630	-
Trichloroethene	ug/kg	<25	<630	-
Vinyl chloride	ug/kg	<50	<1300	-
Xylenes (Total)	ug/kg	<25	<630	-

APPENDIX A

CEM DATA AND EQUIPMENT CALIBRATIONS

LIFAC NA DEMONSTRATION PROJECT
RICHMOND POWER AND LIGHT
WHITEWATER VALLEY GENERATING UNIT #2

BASELINE ENVIRONMENTAL REPORT
SUMMARY OF SUPPLEMENTAL MONITORING

ICF KAISER ENGINEERS, INC.
PITTSBURGH, PA

ICF Kaiser Engineers, Inc.
Richmond Power and Light
Richmond, Indiana
September 2, 1992

Test Run No. 1

File Source ICFR4.DAT
Avg ICFR1.WR1

Test Start 09:45
End 10:45

Test Run Average

NOx	SO2	SO2	CO	CO2	O2
PPM	PPM	PPM (Corrected)	PPM	%	%
386.3	1492	1957	12.9	15.0	4.5

Minute Average

NOx	SO2	CO	CO2	O2	TIME			SO2 COR.
PPM	PPM	PPM	%	%				PPM
387.4	1376.2	9.4	14.9	4.8	0	9	46	1812.8
386.9	1390.1	15.1	14.9	4.7	0	9	47	1828.2
387.6	1421.6	13.0	14.8	4.7	0	9	48	1867.6
385.5	1441.0	17.8	14.9	4.6	0	9	49	1892.0
387.0	1455.7	15.0	14.8	4.6	0	9	50	1909.2
385.4	1468.5	19.6	14.8	4.6	0	9	51	1926.0
387.2	1463.3	8.5	14.8	4.6	0	9	52	1919.2
387.0	1446.9	14.5	14.8	4.6	0	9	53	1897.7
385.6	1465.9	11.3	14.8	4.5	0	9	54	1919.5
388.4	1465.7	7.5	14.8	4.6	0	9	55	1922.4
387.0	1473.7	13.5	14.8	4.5	0	9	56	1929.7
385.9	1489.0	14.6	14.9	4.5	0	9	57	1951.9
386.4	1484.4	16.2	14.9	4.5	0	9	58	1945.8
384.5	1490.3	9.4	14.8	4.5	0	9	59	1951.4
388.3	1482.0	7.2	14.8	4.6	0	10	0	1943.7
386.5	1484.8	13.1	14.9	4.6	0	10	1	1949.5
387.6	1499.3	11.7	14.9	4.5	0	10	2	1965.4
387.6	1503.7	6.0	14.9	4.5	0	10	3	1971.1
386.8	1504.7	9.1	14.9	4.5	0	10	4	1972.5
385.2	1509.4	8.8	14.9	4.5	0	10	5	1978.6
386.0	1508.9	11.5	14.9	4.5	0	10	6	1978.0
384.9	1506.8	7.7	15.0	4.5	0	10	7	1977.4
384.5	1512.4	9.8	15.0	4.4	0	10	8	1981.5
382.1	1513.1	13.4	15.1	4.4	0	10	9	1984.6
383.3	1512.0	8.3	15.0	4.4	0	10	10	1981.0
389.0	1512.1	10.4	15.1	4.4	0	10	11	1983.3
383.7	1510.8	13.4	15.0	4.4	0	10	12	1979.4
381.9	1509.0	14.5	15.1	4.4	0	10	13	1979.2
384.3	1503.6	13.3	15.0	4.4	0	10	14	1970.0
384.1	1503.2	9.7	15.0	4.5	0	10	15	1972.6
383.2	1507.0	13.8	15.1	4.4	0	10	16	1976.6
382.2	1517.6	15.1	15.1	4.4	0	10	17	1990.5
383.5	1515.9	12.0	15.0	4.4	0	10	18	1986.1
384.4	1522.0	12.1	15.1	4.4	0	10	19	1996.3
384.3	1539.9	31.1	15.1	4.4	0	10	20	2019.7
385.2	1539.2	12.7	15.1	4.4	0	10	21	2018.8
385.7	1534.2	12.5	15.0	4.4	0	10	22	2010.0
390.3	1528.5	5.6	15.0	4.5	0	10	23	2005.9
390.9	1508.6	8.5	15.0	4.5	0	10	24	1979.7
386.9	1498.5	16.1	15.1	4.4	0	10	25	1965.4
388.6	1491.3	12.7	15.0	4.4	0	10	26	1953.8
391.8	1483.6	5.2	15.0	4.5	0	10	27	1946.9
388.9	1485.0	13.7	15.0	4.5	0	10	28	1948.8
387.3	1488.7	11.9	15.0	4.4	0	10	29	1950.4
389.6	1482.0	10.5	15.0	4.4	0	10	30	1941.7
388.1	1490.2	12.9	15.0	4.4	0	10	31	1952.4

389.0	1485.6	9.8	15.0	4.5	0	10	32	1949.6
386.4	1486.0	9.8	15.0	4.4	0	10	33	1946.9
383.9	1493.6	18.2	15.1	4.4	0	10	34	1959.0
386.5	1494.9	10.0	15.1	4.4	0	10	35	1960.7
386.4	1505.6	18.5	15.2	4.3	0	10	36	1973.7
387.4	1503.0	12.4	15.1	4.4	0	10	37	1971.3
385.8	1501.3	16.7	15.1	4.4	0	10	38	1969.1
386.1	1503.7	11.9	15.1	4.4	0	10	39	1972.3
385.4	1499.9	15.8	15.1	4.4	0	10	40	1967.3
387.2	1504.7	9.6	15.1	4.4	0	10	41	1973.6
385.8	1504.9	23.3	15.1	4.4	0	10	42	1973.8
384.7	1507.8	26.1	15.2	4.3	0	10	43	1976.6
384.9	1504.2	21.1	15.1	4.3	0	10	44	1969.7
388.0	1500.4	9.9	15.1	4.4	0	10	45	1967.9

ICF Kaiser Engineers, Inc.
Richmond Power and Light
Richmond, Indiana
September 2, 1992

Test Run No. 2

File Source ICFR6.DAT
Avg ICFR2.WR1

Test Start 11:11
End 12:05

Test Run Average

NOx	SO2	SO2	CO	CO2	O2
PPM	PPM	PPM (Corrected)	PPM	%	%
385.6	1529.3	1997.5	15.6	14.7	4.4

Minute Average

NOx	SO2	CO	CO2	O2	TIME			SO2 COR.
PPM	PPM	PPM	%	%				PPM
390.4	1485.7	7.4	14.6	4.5	0	11	11	1941.1
388.8	1484.3	13.3	14.6	4.5	0	11	12	1939.3
387.0	1487.1	10.2	14.7	4.4	0	11	13	1941.9
386.2	1498.9	15.3	14.7	4.4	0	11	14	1957.3
389.8	1495.4	11.6	14.7	4.4	0	11	15	1952.8
387.2	1498.7	15.1	14.7	4.4	0	11	16	1957.1
382.8	1503.2	15.5	14.7	4.5	0	11	17	1966.2
386.2	1507.1	10.0	14.7	4.4	0	11	18	1968.0
388.7	1500.6	7.6	14.7	4.5	0	11	19	1962.8
388.0	1501.4	10.2	14.7	4.4	0	11	20	1960.6
387.3	1503.9	17.3	14.7	4.4	0	11	21	1963.9
386.9	1512.2	16.1	14.7	4.4	0	11	22	1974.7
386.5	1510.8	18.4	14.7	4.4	0	11	23	1972.9
387.4	1516.1	26.3	14.8	4.4	0	11	24	1982.0
386.5	1516.0	13.2	14.7	4.4	0	11	25	1979.7
386.8	1514.5	19.1	14.7	4.4	0	11	26	1977.7
382.9	1519.2	25.6	14.8	4.4	0	11	27	1986.0
381.4	1509.0	18.3	14.6	4.5	0	11	28	1971.6
387.4	1513.0	12.2	14.7	4.5	0	11	29	1979.0
386.2	1524.7	14.2	14.8	4.4	0	11	30	1993.2
388.0	1522.4	18.0	14.7	4.4	0	11	31	1988.0
386.9	1523.3	13.2	14.7	4.4	0	11	32	1989.2
387.7	1520.8	15.0	14.7	4.5	0	11	33	1989.2
387.0	1526.1	22.3	14.8	4.4	0	11	34	1995.0
384.5	1533.9	13.0	14.8	4.3	0	11	35	2002.0
385.4	1531.6	7.6	14.7	4.4	0	11	36	2000.0
386.8	1530.6	15.8	14.7	4.4	0	11	37	1998.7
384.1	1533.3	17.5	14.7	4.4	0	11	38	2002.2
381.4	1527.7	17.4	14.6	4.5	0	11	39	1996.0
388.3	1530.6	11.7	14.7	4.4	0	11	40	1998.7
388.7	1534.2	9.6	14.7	4.4	0	11	41	2003.4
388.9	1537.3	10.3	14.7	4.4	0	11	42	2007.5
383.0	1545.6	14.8	14.8	4.4	0	11	43	2020.5
381.8	1547.5	16.6	14.7	4.3	0	11	44	2017.5
385.2	1544.7	10.8	14.6	4.4	0	11	45	2014.9
383.8	1544.3	18.1	14.7	4.4	0	11	46	2016.6
383.2	1552.2	21.4	14.7	4.3	0	11	47	2023.6
385.5	1550.4	12.7	14.7	4.4	0	11	48	2024.6
382.5	1546.2	11.6	14.6	4.5	0	11	49	2020.2
385.9	1547.9	17.9	14.7	4.4	0	11	50	2021.3
385.2	1555.3	16.7	14.7	4.4	0	11	51	2031.0
384.8	1559.0	18.6	14.7	4.4	0	11	52	2035.8
384.5	1558.3	10.9	14.7	4.4	0	11	53	2034.9
383.8	1564.0	20.3	14.8	4.4	0	11	54	2044.6
384.9	1560.1	14.4	14.8	4.3	0	11	55	2036.1
383.7	1557.8	18.3	14.8	4.3	0	11	56	2033.1

382.2	1562.8	25.7	14.8	4.3	0	11	57	2039.7
388.1	1547.6	10.4	14.7	4.4	0	11	58	2020.9
382.9	1546.1	19.3	14.7	4.4	0	11	59	2019.0
383.7	1541.6	11.2	14.7	4.5	0	12	0	2016.4
383.9	1546.5	17.8	14.8	4.4	0	12	1	2021.7
380.4	1548.8	27.3	14.8	4.3	0	12	2	2021.4
386.6	1544.9	16.9	14.7	4.4	0	12	3	2017.4
386.5	1542.1	15.3	14.8	4.4	0	12	4	2016.0
383.7	1543.5	21.7	14.8	4.4	0	12	5	2017.8

ICF Kaiser Engineers, Inc.
Richmond Power and Light
Richmond, Indiana
September 2, 1992

Test Run No. 3

File Source ICFR9.DAT
Avg ICFR3.WR1

Test Start 14:40
End 15:40

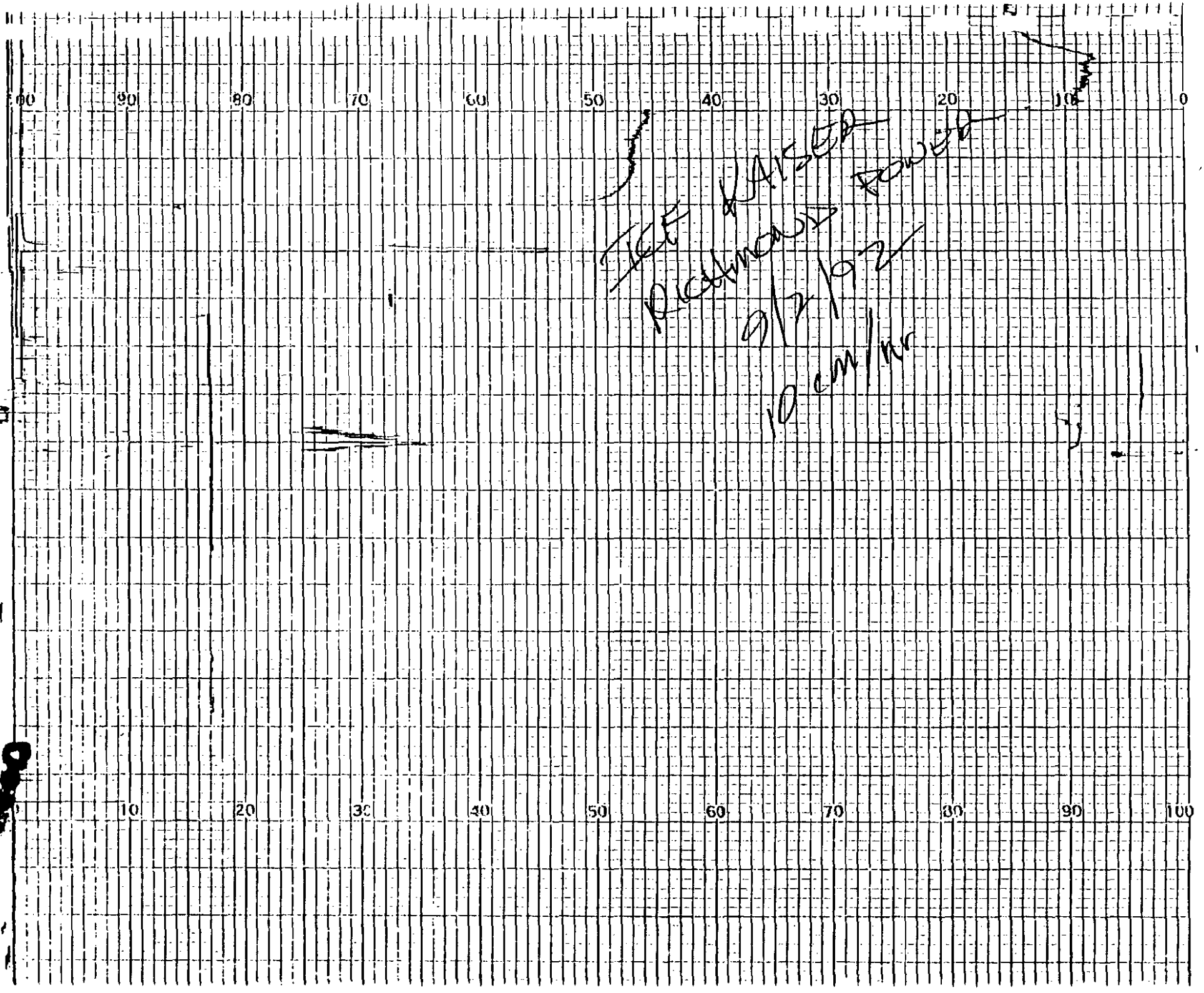
Test Run Average

NOx	SO2	SO2	CO	CO2	O2
PPM	PPM	PPM (Corrected)	PPM	%	%
354.9	1505	1962	31.2	14.7	4.2

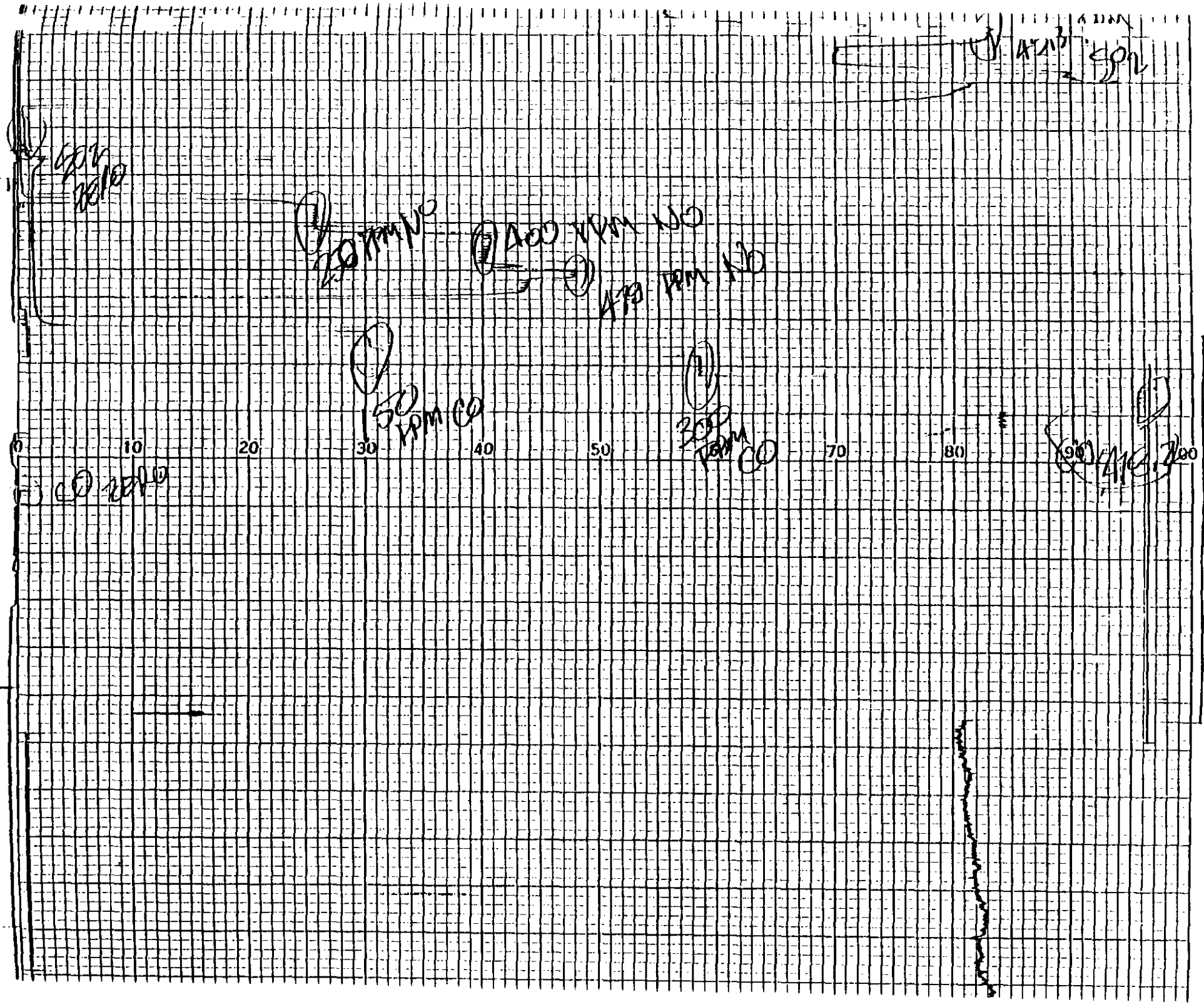
Minute Average

NOx	SO2	CO	CO2	O2	TIME			SO2 COR.
PPM	PPM	PPM	%	%				PPM
355.1	1490.9	27.0	14.7	4.3	0	14	41	1943.7
357.6	1489.9	23.8	14.7	4.4	0	14	42	1945.6
352.4	1486.7	23.9	14.7	4.4	0	14	43	1941.4
351.8	1480.9	22.2	14.7	4.4	0	14	44	1933.8
358.4	1483.1	23.0	14.7	4.3	0	14	45	1933.5
354.6	1464.5	20.0	14.7	4.4	0	14	46	1912.4
355.3	1470.4	23.2	14.7	4.4	0	14	47	1920.1
354.2	1480.8	29.7	14.8	4.3	0	14	48	1932.7
355.6	1464.1	24.3	14.7	4.2	0	14	49	1905.6
356.1	1465.7	25.2	14.7	4.2	0	14	50	1907.7
355.9	1475.5	31.3	14.7	4.2	0	14	51	1920.5
357.4	1500.2	33.5	14.8	4.2	0	14	52	1954.8
353.7	1505.4	34.8	14.7	4.2	0	14	53	1959.4
354.7	1506.5	19.3	14.6	4.4	0	14	54	1965.1
356.3	1502.3	17.8	14.7	4.4	0	14	55	1961.8
355.2	1501.2	20.0	14.8	4.3	0	14	56	1959.3
357.2	1518.7	21.9	14.7	4.3	0	14	57	1979.9
359.1	1506.2	21.4	14.7	4.3	0	14	58	1963.6
358.5	1499.4	30.3	14.7	4.3	0	14	59	1954.8
355.2	1523.8	48.6	14.8	4.2	0	15	0	1985.5
356.3	1523.8	28.4	14.8	4.2	0	15	1	1985.5
358.3	1524.7	17.3	14.8	4.3	0	15	2	1989.9
359.3	1520.9	24.0	14.8	4.3	0	15	3	1985.0
355.4	1501.9	41.5	14.8	4.2	0	15	4	1957.0
353.3	1487.0	19.1	14.7	4.2	0	15	5	1935.4
358.4	1495.9	16.1	14.7	4.4	0	15	6	1953.4
357.6	1509.7	24.1	14.7	4.3	0	15	7	1968.2
353.6	1499.4	33.4	14.8	4.2	0	15	8	1953.7
352.4	1508.6	37.1	14.8	4.2	0	15	9	1965.7
354.4	1513.2	28.6	14.7	4.2	0	15	10	1969.5
355.6	1510.2	25.2	14.7	4.2	0	15	11	1965.6
356.3	1503.8	35.7	14.8	4.2	0	15	12	1959.5
353.4	1512.0	37.0	14.8	4.2	0	15	13	1970.1
353.3	1519.0	35.1	14.8	4.2	0	15	14	1979.3
351.6	1512.1	34.9	14.7	4.2	0	15	15	1968.1
349.7	1515.1	39.1	14.6	4.4	0	15	16	1976.3
353.5	1525.9	30.7	14.7	4.3	0	15	17	1989.3
354.4	1509.9	30.9	14.7	4.2	0	15	18	1965.2
355.1	1526.2	22.3	14.7	4.3	0	15	19	1989.7
351.6	1524.4	30.6	14.8	4.2	0	15	20	1986.3
350.9	1534.6	32.2	14.8	4.1	0	15	21	1996.3
353.1	1523.7	43.3	14.7	4.2	0	15	22	1983.2
352.0	1525.1	47.1	14.8	4.2	0	15	23	1987.2
351.4	1526.1	32.4	14.9	4.2	0	15	24	1990.7
350.0	1515.3	49.5	14.8	4.1	0	15	25	1971.2
351.4	1514.9	36.8	14.8	4.1	0	15	26	1970.7

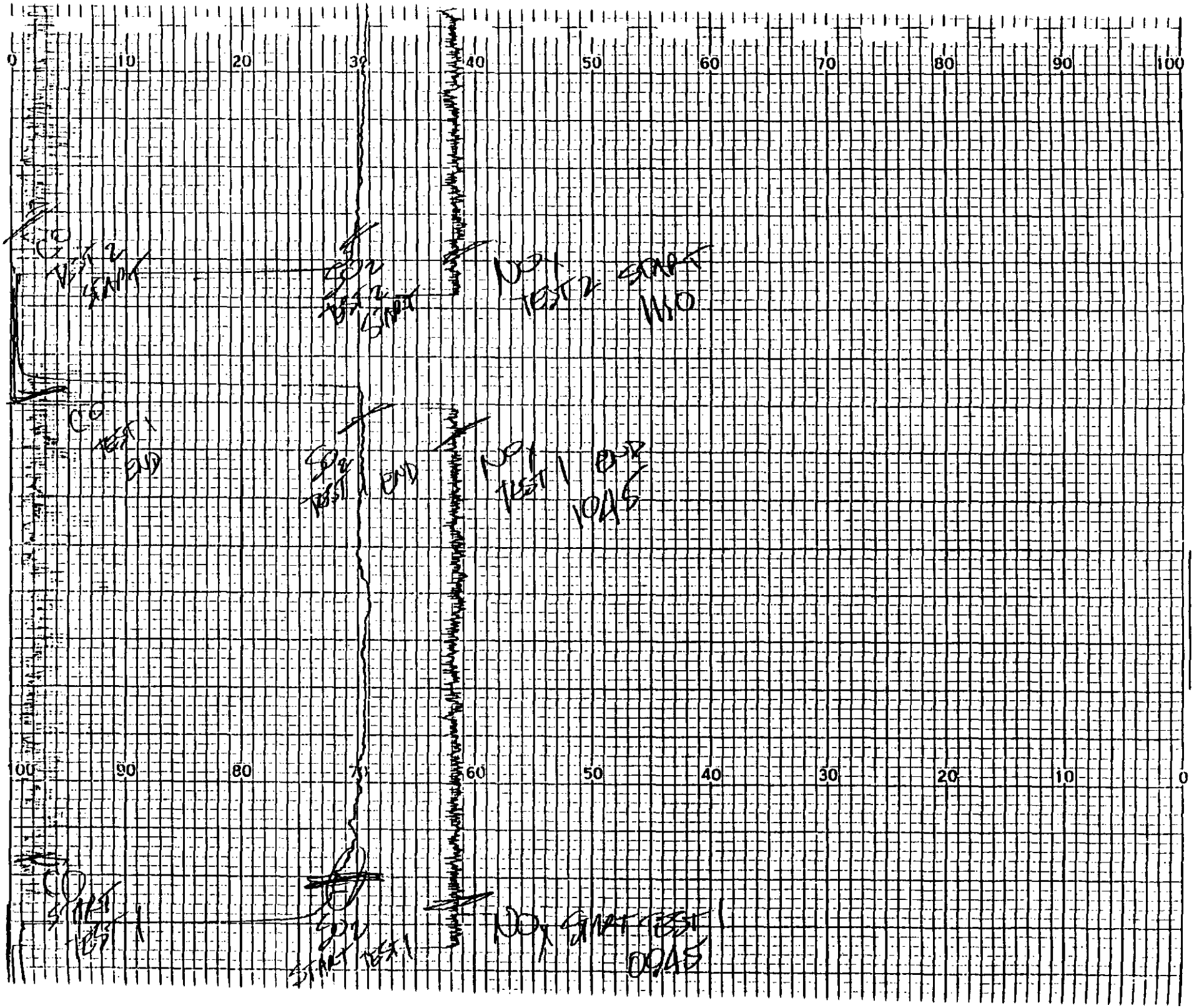
353.6	1508.8	26.5	14.7	4.3	0	15	27	1967.0
356.2	1513.1	34.2	14.8	4.2	0	15	28	1971.6
351.8	1522.4	57.0	14.8	4.2	0	15	29	1983.7
346.4	1533.1	69.1	14.9	4.1	0	15	30	1996.6
357.2	1541.6	25.3	14.7	4.2	0	15	31	2006.5
360.3	1536.7	23.5	14.6	4.3	0	15	32	2001.2
357.9	1527.0	34.0	14.7	4.2	0	15	33	1987.5
358.3	1513.2	23.8	14.7	4.2	0	15	34	1969.5
357.6	1489.7	40.1	14.8	4.2	0	15	35	1941.1
355.4	1496.9	32.1	14.7	4.2	0	15	36	1948.3
354.7	1497.7	41.1	14.7	4.2	0	15	37	1949.3
354.7	1480.6	29.8	14.7	4.2	0	15	38	1927.1
359.0	1470.6	35.4	14.7	4.3	0	15	39	1917.2
354.5	1482.9	48.6	14.9	4.2	0	15	40	1934.4

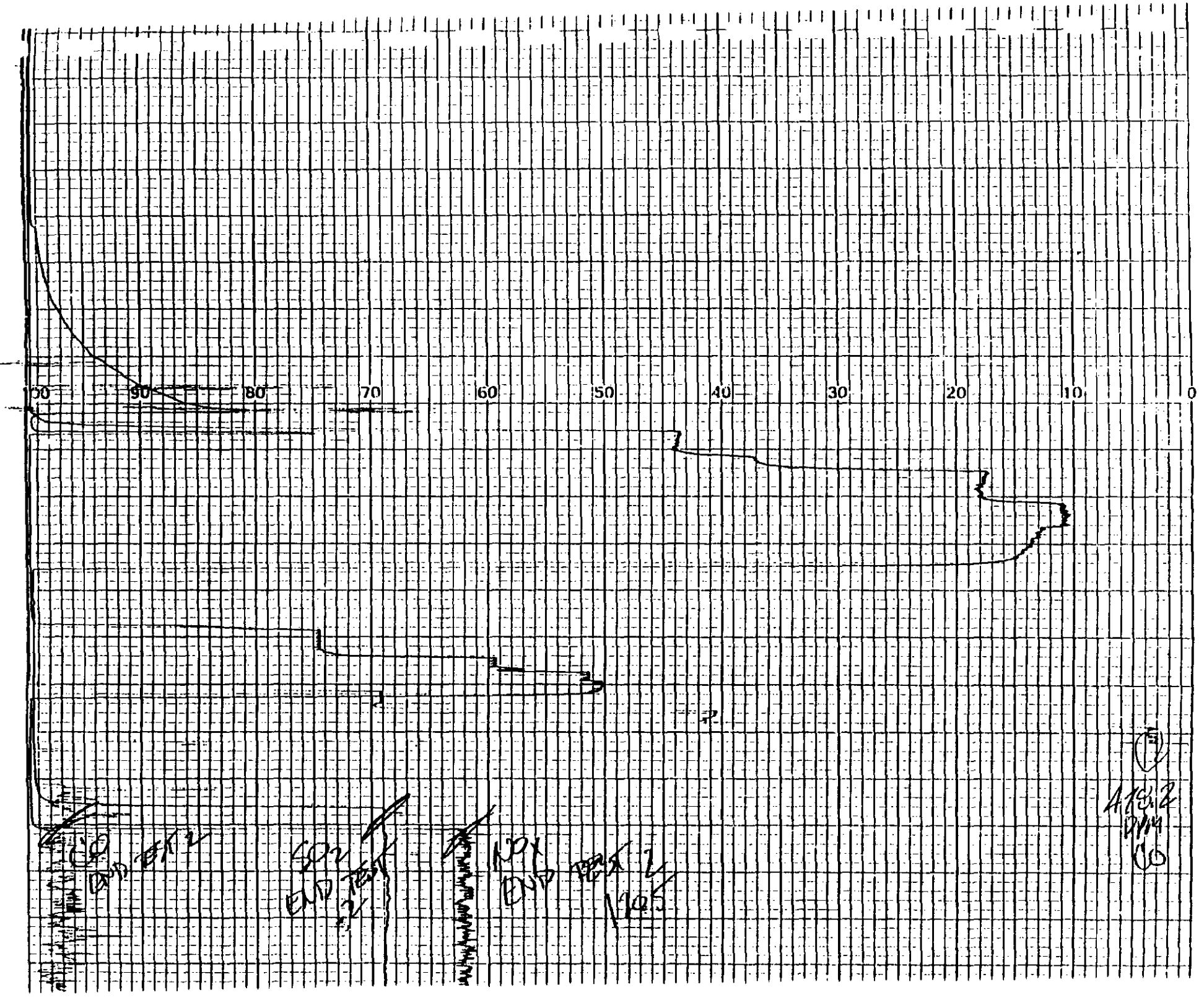


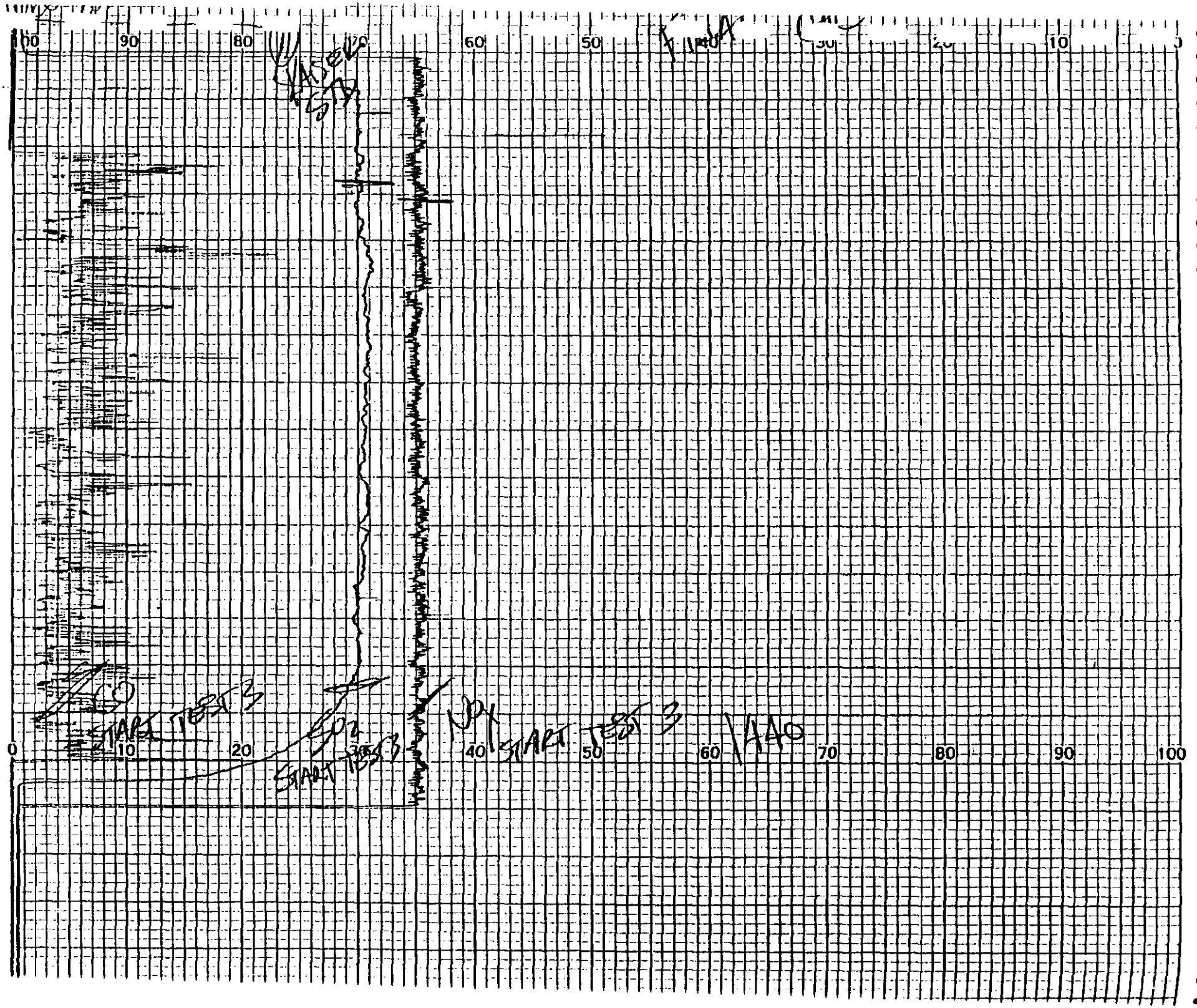
100 90 80 70 60 50 40 30 20 10 0
10 20 30 40 50 60 70 80 90 100
ICE KAISER
RICHMOND POWER
9/2/92
10 cm/hr

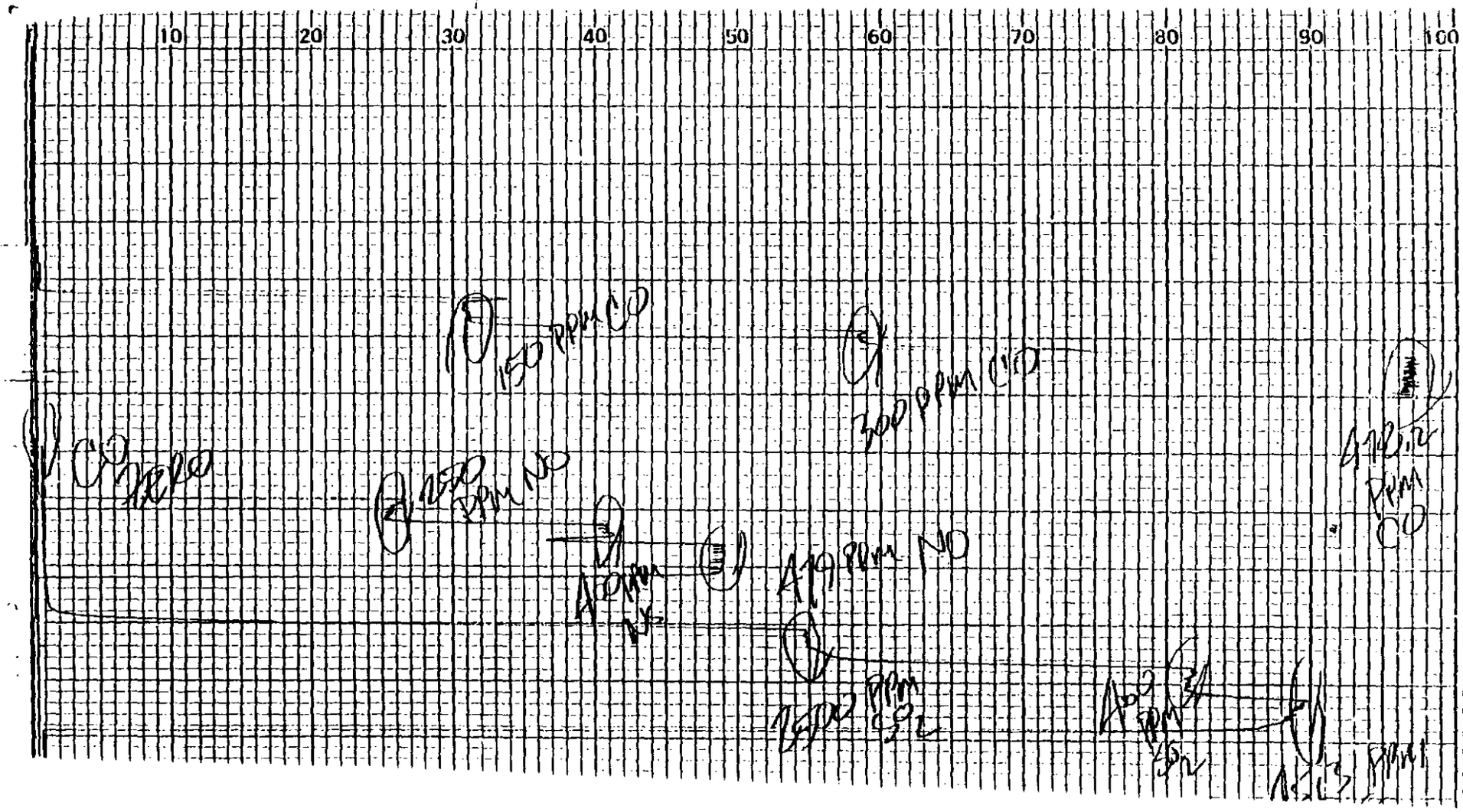


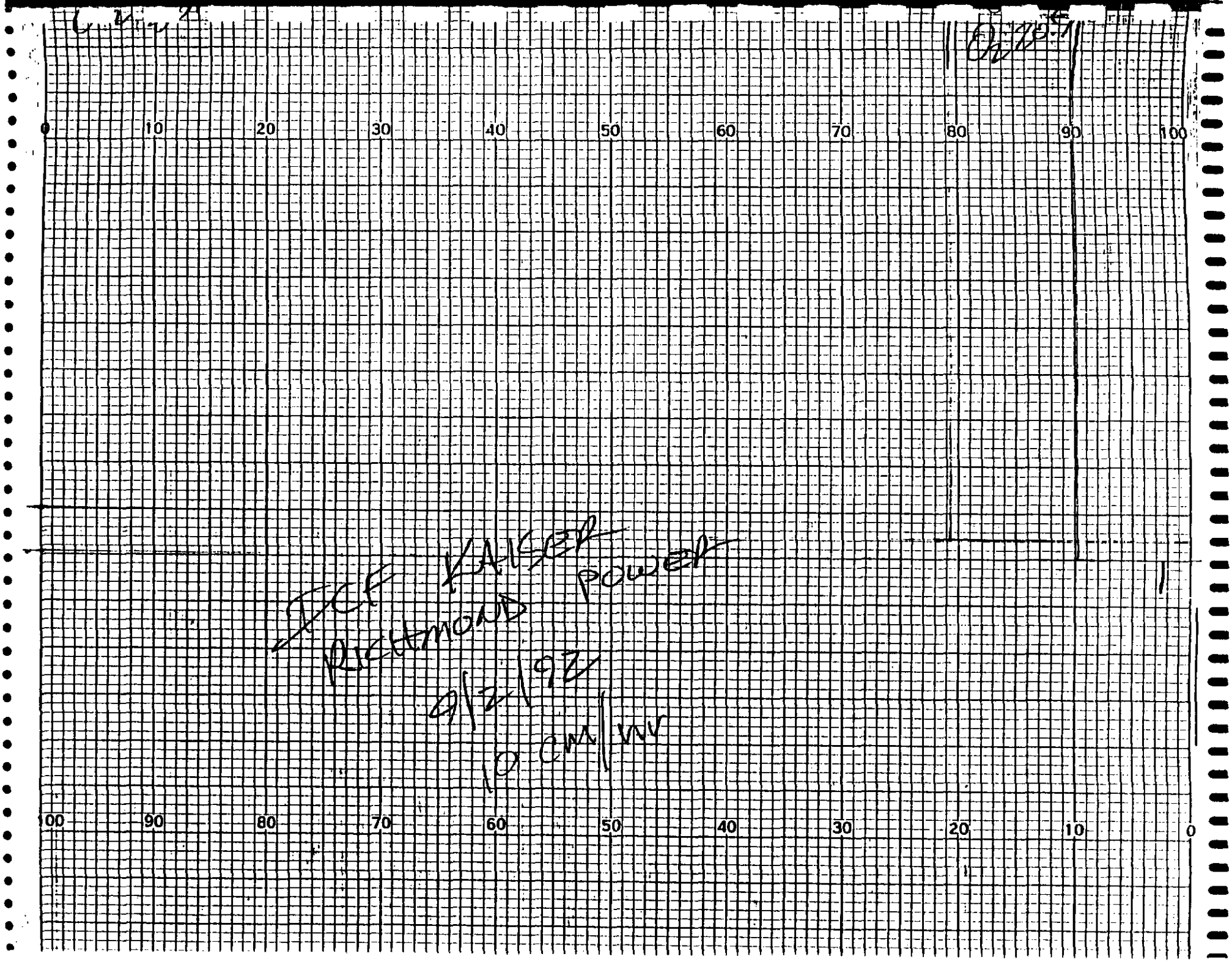
0
10
20
30
40
50
70
80
90
100
400 PPM NO
150 PPM CO
300 PPM CO


0
10
20
30
40
50
60
70
80
90
100
CO TEST 2 START
CO2 TEST 2 START
NOx TEST 2 START
H2O
CO TEST 1 END
CO2 TEST 1 END
NOx TEST 1 END
100%
100
90
80
70
60
50
40
30
20
10
0
CO START TEST 1
CO2 START TEST 1
NOx START TEST 1
0045

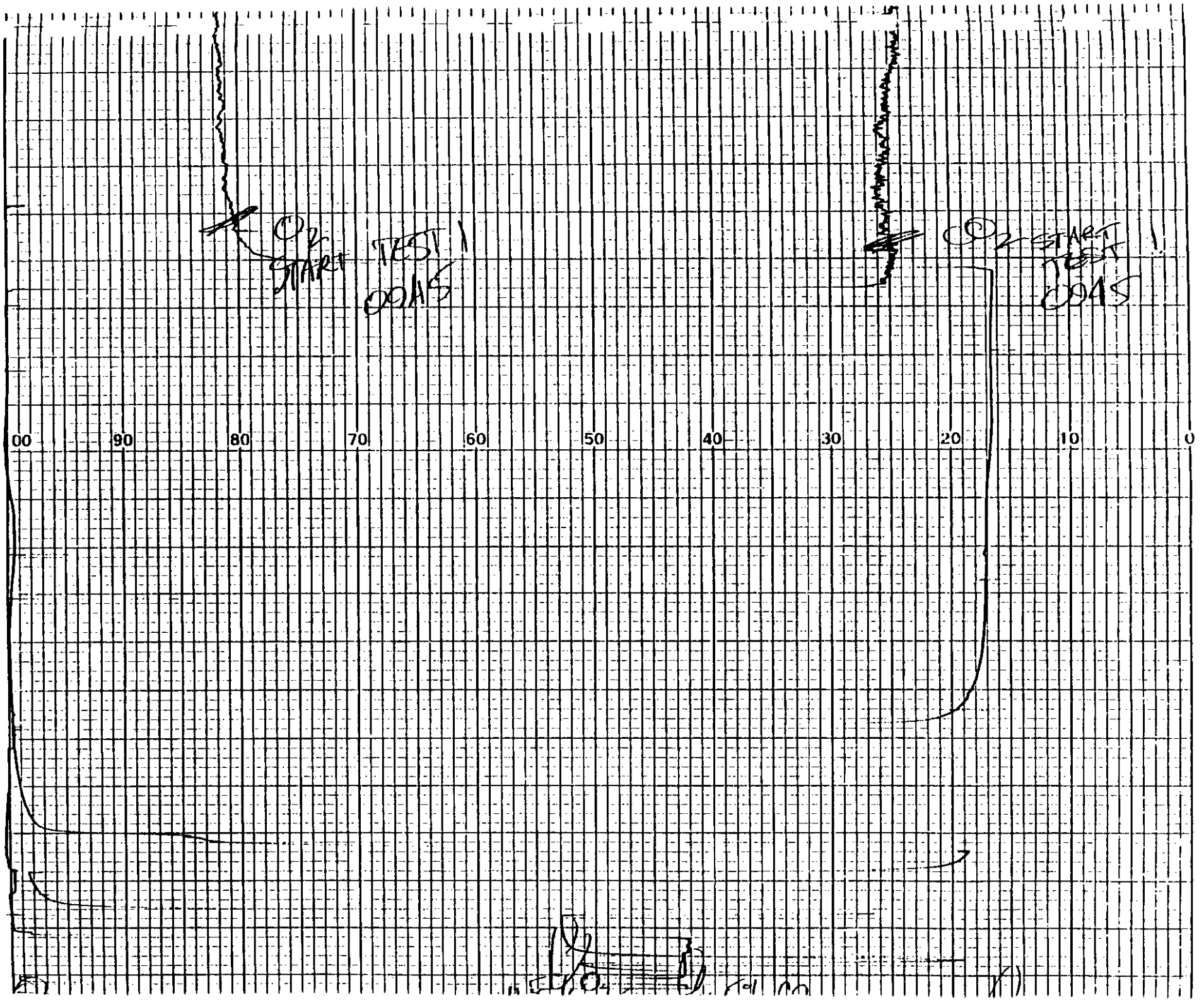

100
90
80
70
60
50
40
30
20
10
0
END TEST
END TEST

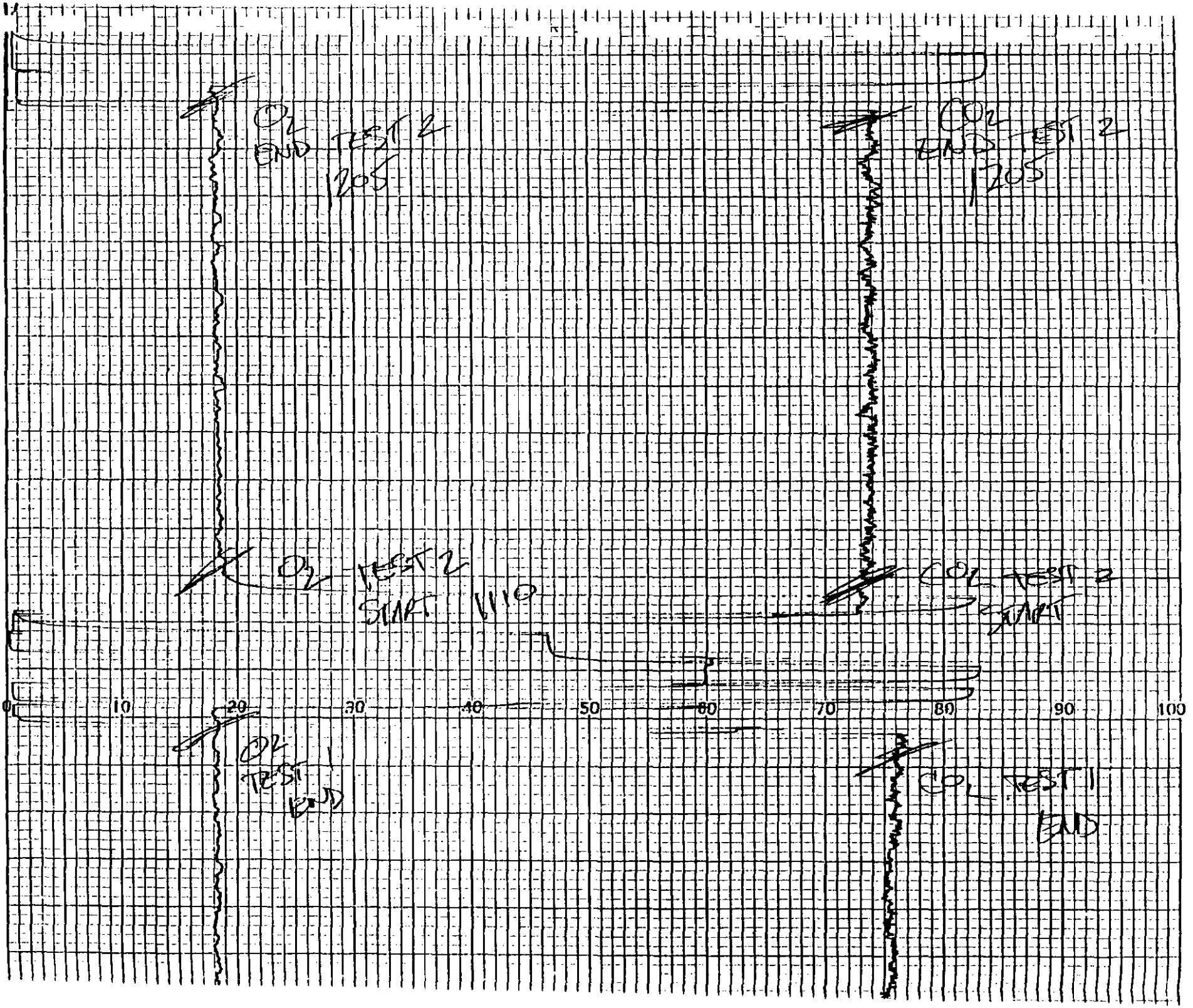

START TEST 3
START TEST 3
START TEST 3

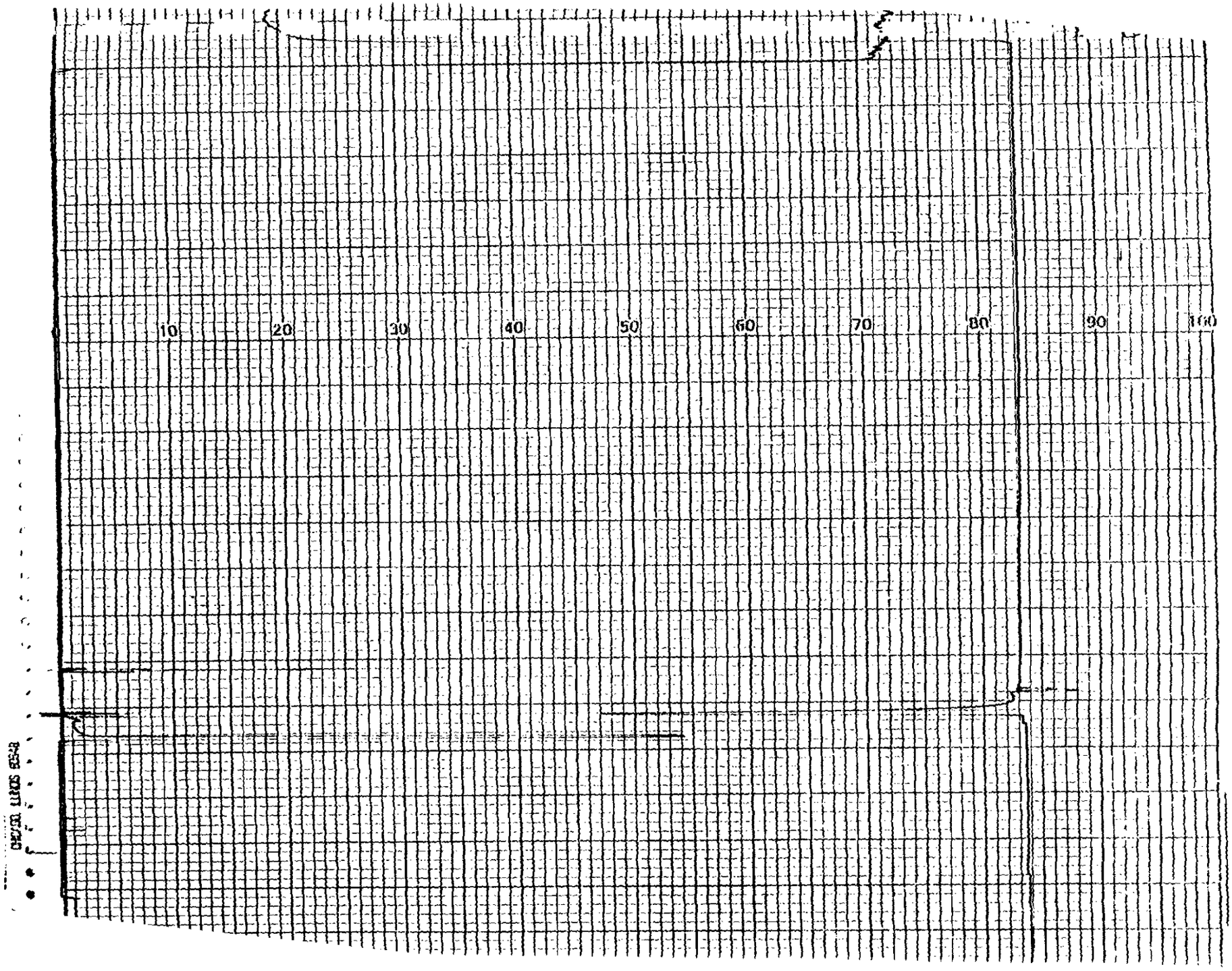

10
20
30
40
50
60
70
80
90
100
150 PPM CO
300 PPM CO
CO ZERO
250 PPM NO
400 PPM NO
419 PPM NO
2500 PPM SO2
400 PPM SO2
PPM CO

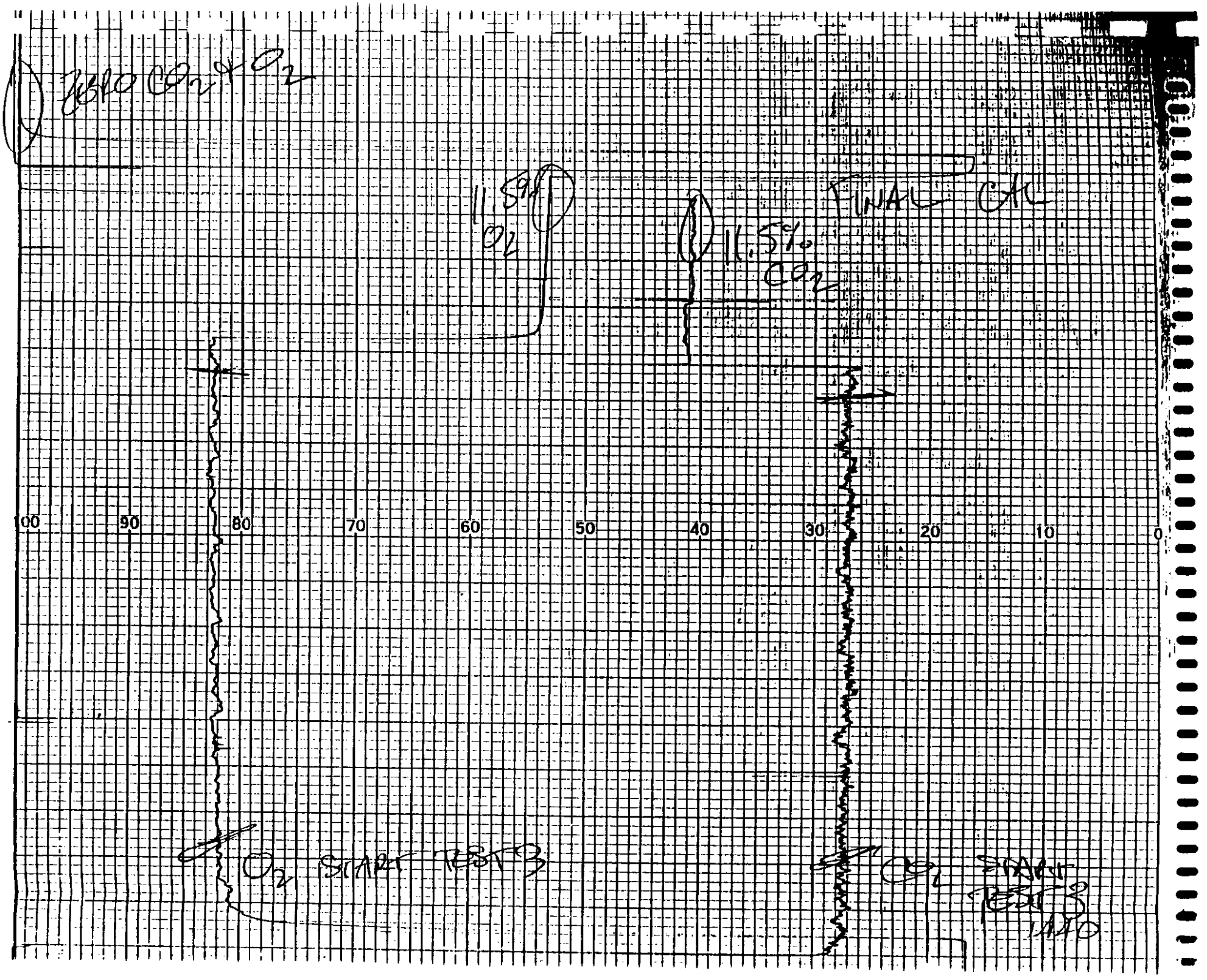


0 10 20 30 40 50 60 70 80 90 100
100 90 80 70 60 50 40 30 20 10 0
ICF KAISER
RICHMOND POWER
9/2/92
10 cm/hr


CO2 START TEST 0045
CO2 START TEST 0045
00
90
80
70
60
50
40
30
20
10
0


O2 END TEST 2 1205
CO2 END TEST 2 1205
O2 TEST 2 START 1110
CO2 TEST 2 START
0
10
20
30
40
50
60
70
80
90
100
O2 TEST 1 END
CO2 TEST 1 END


10
20
30
40
50
60
70
80
90
100


ZERO CO2 + O2
11.5% O2
11.5% CO2
FINAL CAL
100
90
80
70
60
50
40
30
20
10
0
O2 START TEST 3
O2 FINAL TEST 3

CONTINUOUS INSTRUMENT CALIBRATION DATA

PLANT ICF KAISER
LOCATION RICHMOND
PROJ. NO#
TESTERS JR
COMMENTS: CYL NO. ~~T188587~~ 11.5% O_2 CERTIFIED 92947

DATE 9/2/92
TEST # 1 & 2
PRE/POST TEST
REGULATORS

GAS ANALYZED O_2
INSTRUMENT CE 705A
SERIAL # 25% RANGE
CALIBRATOR M_2

	CYLINDER #	CONCENTRATION % OR PPM	ANALYZER RESPONSE	RECORDER OUTPUT	ADJUSTED VALUE	PERCENT DEVIATION
	UNITS					
TIME:						
0805	AIR	20.9	20.9	20.9	20.9	Ø%
~~92947~~	92947	11.5	11.7	11.7	NO	+1.7
	T188587	Ø	0.1	0.1	NO	—
TIME:						
1050	AIR	20.9	20.9	20.9	NO	Ø
	~~92947~~	11.5	11.7	11.7	NO	+1.7
	T188587	Ø	0.1	0.1	NO	—
TIME:						
1545	AIR	~~Ø~~ 20.9	21.0	21.0	NO	+0.5
	92947	11.5	11.6	11.6	↓	+0.9
	T188587	Ø	0.0	0.0	↓	—

KEYSTONE ENVIRONMENTAL RESOURCES, INC.

CONTINUOUS INSTRUMENT CALIBRATION DATA

PLANT ICF KAISER
LOCATION RICHMOND IND
PROJ. NO#
TESTERS
COMMENTS: CYL. NO. 92947 11.5% CO_2 CERTIFIED

DATE 9/2/92
TEST # 192
PRE/POST TEST
REGULATORS

GAS ANALYZED CO_2
INSTRUMENT IR 702
SERIAL # 20% RANGE
CALIBRATOR M2

	CYLINDER #	CONCENTRATION % OR PPM	ANALYZER RESPONSE	RECORDER OUTPUT	ADJUSTED VALUE	PERCENT DEVIATION
	UNITS					
TIME: 0805						
	AIR	Ø	Ø	Ø	YES	—
92	92947	11.5	11.5	11.5	YES	Ø
	T188587					
TIME: 1050						
	AIR	Ø	0.1	0.1	NO	—
	T188587	11.5	12.0	12.0	NO	+4.3
	92947					
	T188587	Ø	Ø	Ø	NO	—
TIME:						
	AIR	Ø	0.1	0.1	NO	—
	92947	11.5	11.9	11.9		+3.5
	T188587	Ø	0.1	0.1		—

KEYSTONE ENVIRONMENTAL RESOURCES, INC.

CONTINUOUS INSTRUMENT CALIBRATION DATA

PLANT JCF KAISER
LOCATION Richmond
PROJ. NO#
TESTERS JB
COMMENTS:

DATE 9/2/92
TEST # 192
PRE/POST TEST
REGULATORS

GAS ANALYZED CO
INSTRUMENT IR 730
SERIAL #
CALIBRATOR M2

500 PPM RANGE

CYN. AA-12343 956.4 PPM CERTIFIED

	CYLINDER #	CONCENTRATION % OR PPM	ANALYZER RESPONSE	RECORDER OUTPUT	ADJUSTED VALUE	PERCENT DEVIATION
	UNITS					
TIME:						
0820	T188587	∅	∅	0.0	NO	—
	2.00/2.00	478.2	478.2	478.2	YES	∅
	2.00/4.37	300.0	292.7	292.7	NO	42.4
	1.50/7.56	150.0	151.2	151.2	NO	+0.8
TIME:						
1050	T188587	∅	0.4	0.4	NO	—
1210	2.00/2.00	478.2	481.4	481.4	NO	+0.7
	2.00/4.37	300.0	297.7	297.7	↓	-0.8
	1.50/7.56	150.0	153.3	153.3	↓	+2.2
TIME:						
	T188587	∅	0.0	0.0	NO	—
	2.00/2.00	478.2	485.7	485.7	↓	+1.6
	2.00/4.37	300.0	298.6	298.6	↓	-0.5
	1.50/7.56	150.0	153.6	153.6	↓	+2.4

KEYSTONE ENVIRONMENTAL RESOURCES, INC.

CONTINUOUS INSTRUMENT CALIBRATION DATA

PLANT ICF KAISER
LOCATION RICHMOND
PROJ. NO#
TESTERS
COMMENTS: CYL # SX-10752 479 PPM CERTIFIED
T188557 N_2

DATE 9/2/92
TEST # 1 & 2, +3
PRE/POST TEST
REGULATORS

GAS ANALYZED NOx
INSTRUMENT TECO M10
SERIAL # 1000 PPM RANGE
CALIBRATOR N_2

	CYLINDER #	CONCENTRATION % OR PPM	ANALYZER RESPONSE	RECORDER OUTPUT	ADJUSTED VALUE	PERCENT DEVIATION
	UNITS					
TIME: 0845						
	000/2.00	∅	0.0	0.0	YES	—
	200/000	479.0	478.0	478	YES	∅
	2.00/0.40	400.0	408.0	402.0	NO	+2.0
	2.00/1.83	250.0	256.0	256.0	NO	+2.4
TIME: 1220						
	000/2.00	∅	1.7	1.7	NO	—
	2.00/0.00	479.0	486.3	486.3		+1.5
	2.00/0.40	400.0	407.5	407.5		+1.9
	2.00/1.83	250.0	255.6	255.6		+2.2
TIME: 1629						
	0.00/2.00	∅	2.2	2.2	NO	~~+2.3~~
	2.00/0.00	479.0	490.2	490.2		+2.3
	2.00/0.40	400.0	409.2	409.2		+2.3
	2.00/1.83	250.0	257.1			+2.8

KEYSTONE ENVIRONMENTAL RESOURCES, INC.

CONTINUOUS INSTRUMENT CALIBRATION DATA

PLANT ICF KAISER
LOCATION Richmond
PROJ. NO#
TESTERS KS
COMMENTS: CYL. NO. 48928-T 4513 PPM CERTIFIED
T188527 N_2

DATE 9/2/92
TEST # 1, 2, & 3
PRE/POST TEST
REGULATORS

GAS ANALYZED SO_2
INSTRUMENT TECO M40
SERIAL #
CALIBRATOR MZ

	CYLINDER #	CONCENTRATION % OR PPM	ANALYZER RESPONSE	RECORDER OUTPUT	ADJUSTED VALUE	PERCENT DEVIATION
	UNITS					
TIME: 0910						
	0.00/4.00	Ø	0.0	0.0	NO	—
	4.00/0.00	4513	4513	4513	YES	Ø
	4.00/0.51	4000	4089	4089	NO	+2.2
	4.00/3.22	2500	2601	2601	↓	+4.0
TIME: 1233						
	0.00/4.00	Ø	0	0	NO	—
	4.00/0.00	4513	4410	4410	YES/4513	~~-2.3~~/Ø
	4.00/0.51	4000	4079	4079	NO	+2.0
	4.00/3.22	2500	2618	2618	↓	+4.7
TIME: 1610						
	0.00/4.00	Ø	Ø	Ø	NO	—
	4.00/0.00	4513	4523	4523		+0.2
	4.00/0.51	4000	4052	4052		+1.3
	4.00/3.22	2500	2577	2577	↓	+3.1

KEYSTONE ENVIRONMENTAL RESOURCES, INC.

THERMO ENVIRONMENTAL INSTRUMENTS INCORPORATED
Eight West Forge Parkway
Franklin, MA 02038 USA
TEL: (508) 520-0430
FAX: (508) 520-1460

FACSIMILE TRANSMITTAL

COMPANY: Keystone Environmental
ATTENTION: Mark Grunebach
FAX NUMBER: 412-825-9841.
FROM: Dirk Appel.
DATE: 9/3/92
SUBJECT: SO_2 quenching.
TOTAL NUMBER OF PAGES BEING TRANSMITTED: ____ (INCLUDING COVER)

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Mark,

If the M40 is calibrated with SO_2 in a nitrogen background, then monitoring in flue gas will yield low readings due to quenching.

The correction factor is :—

$$F = 1 + \Sigma \phi_i [M_i].$$

where ϕ_i = quenchin coefficient for molecule M_i.
$[M_i]$ = concentration in % of molecule M_i.

M_i	ϕ_i
N_2	0
O_2	0.0214
CO_2	0.0144
H_2O	0.160

Example: Flue gas has
5% O_2 + 15% CO_2 + ~~Bal~~ Bal. N_2

Correction factor

$$F = 1 + 0.107 + 0.216 = 1.323.$$

ICF KAISER ENGINEERS

PROJECT [illegible] PROJECT NO.

CO_2 quenching coefficient PAGE ___ OF ___

MADE BY [illegible] DATE 11-12-92 CHECKED BY ___ DATE ___

quenching coefficent

$$F = 1 + \sum_{i=1}^{n} \phi_i (M_i)$$

$$= 1 + \phi_{O_2} M_{O_2} + \phi_{CO_2} M_{CO_2}$$

$$F_{RUN1} = 1 + (0.0214)(4.5) + (0.0144)(15) = 1.3123$$

$$F_{RUN2} = 1 + (0.0214)(4.4) + (0.0144)(14.7) = 1.3058$$

$$F_{RUN3} = 1 + (0.0214)(4.2) + (0.0144)(14.7) = 1.3016$$

APPENDIX B

PARTICULATE MATTER
DATA SHEETS AND CALCULATIONS
ESP INLET LOCATION

LIFAC NA DEMONSTRATION PROJECT
RICHMOND POWER AND LIGHT
WHITEWATER VALLEY GENERATING UNIT #2

BASELINE ENVIRONMENTAL REPORT
SUMMARY OF SUPPLEMENTAL MONITORING

ICF KAISER ENGINEERS, INC.
PITTSBURGH, PA

TAMPELLA POWER CORP. 10-Sep-92
Juha Nääppä 03:32 PM

****

RESULTS OF PARTICULATE EMISSION MEASUREMENTS

****

Date / Time		09-02-92 / 10:55 - 12:16 pm
Test no:		PE3BE
Nozzle		0.251 IN
Avg. stack temp.		328.5 F
Avg. meter temp.		110.7 F
Particulate		6.4759 G
Gas meter corr.		0.9915
Static press.		-9.40 IN H2O
Condensate vol.		87 ML
Absorbed H2O		0 ML
Metered gas		38.63 CF
Bar. press.		29.1 IN HG
Avg. delta H		0.93 IN H2O
Stack dim.	72	198 IN
Pitot corr.		0.84

STACK SAMPLING CALCULATIONS

Meter press.	29.20 IN HG
Static press.	-0.6932501 IN HG
Stack press.	28.41 IN HG
Stack area	99.00 SQ FT
Nozzle area	0.000344 SQ FT
Avg. stack temp.	788.2 DEG. R
Avg. meter temp.	570.4 DEG. R
Total H2O	87.0 ML
Corr. metered gas	38.302 CF
H2O gas volume	4.537 CF
Total sampled volume	42.839 CF
Percent H2O	10.59 %
SCFD gas sampled	34.626 SCFD
Mol. weight of stack gas	29.13 ?/MOL
Average corrected vel.	43.10 FPS
Avg. Flow rate	256011 CFM
Stack flow rate	162825 SCFM
Stack flow rate	145579 SCFMd
Sample time	4320 SEC
Percent isokinetics	95.2 %

Particulate			2.88624	GR/SCFD
			3801.50659	LB/HR

GAS ANALYZES (dry basis)

	Vol%	(Moist.)	Mol. weight	Weight per Mole
CO2	12.9	11.5	44.000	5.07
CO	0.0	0.0	28.000	0.00
O2	5.5	4.9	32.000	1.57
N2	81.6	73.0	28.200	20.57
H2O		10.6	18.000	1.91
YHT.	100.0	100.0	150.200	29.13

==========

FIELD DATA AND VELOCITY CALC.

[IN H2O] Delta P	[F] Stack T.	[FPS] Velocity	[F] Meter in	[F] Meter out	[IN H2O] Delta H
0.600	300	53.3	108	98	1.4
0.200	300	30.8	109	98	0.45
0.150	304	26.7	110	98	0.35
0.700	313	58.1	115	98	1.6
0.370	324	42.5	115	98	0.85
0.210	255	30.6	115	99	0.5
0.400	323	44.2	116	100	0.9
0.450	332	47.1	118	100	1.05
0.300	326	38.3	118	101	0.7
0.420	328	45.4	119	101	0.95
0.440	340	46.8	120	102	1
0.250	293	34.2	119	103	0.6
0.500	343	50.0	121	103	1.15
0.360	350	42.6	121	103	0.8
0.310	336	39.2	121	104	0.7
0.700	357	59.7	123	104	1.6
0.320	360	40.4	121	105	0.75
0.300	334	38.5	122	105	0.7
0.700	362	59.9	123	106	1.6
0.550	383	53.1	124	106	1.25
0.270	336	36.6	123	106	0.6
0.700	0	44.8	124	107	1.6
0.360	354	42.7	124	108	0.8
0.170	323	28.8	124	108	0.4
0			0	0	0

TAMPELLA POWER CORP. 10-Sep-92
Juha Naappä 03:36 PM

****

RESULTS OF PARTICULATE EMISSION MEASUREMENTS

****

Date / Time		09-02-92 / 02:11 - 03:33 pm	
Test no:		PE4BE	
Nozzle		0.251	IN
Avg. stack temp.		329.3	F
Avg. meter temp.		119.0	F
Particulate		6.7344	G
Gas meter corr.		0.9915	
Static press.		-8.60	IN H2O
Condensate vol.		75	ML
Absorbed H2O		2.8	ML
Metered gas		40.81	CF
Bar. press.		29	IN HG
Avg. delta H		0.90	IN H2O
Stack dim.	72	198	IN
Pitot corr.		0.84	

STACK SAMPLING CALCULATIONS

Meter press.	29.20	IN HG
Static press.	-0.6342501	IN HG
Stack press.	28.37	IN HG
Stack area	99.00	SQ FT
Nozzle area	0.000344	SQ FT
Avg. stack temp.	788.9	DEG. R
Avg. meter temp.	578.7	DEG. R
Total H2O	77.8	ML
Corr. metered gas	40.463	CF
H2O gas volume	4.117	CF
Total sampled volume	44.580	CF
Percent H2O	9.23	%
SCFD gas sampled	38.056	SCFD
Mol. weight of stack gas	29.30	?/MOL
Average corrected vel.	42.63	FPS
Avg. Flow rate	253226	CFM
Stack flow rate	160673	SCFM
Stack flow rate	145836	SCFMd
Sample time	4320	SEC
Percent isokinetics	98.9	%

Particulate			2.88242	GR/SCFD
			3603.08448	LB/HR

GAS ANALYZES (dry basis)

	Vol%	(Moist.)	Mol. weight	Weight per Mole
CO2	12.9	11.7	44.000	5.15
CO	0.0	0.0	28.000	0.00
O2	5.5	5.0	32.000	1.60
N2	81.6	74.1	28.200	20.89
H2O		9.2	18.000	1.66
YHT.	100.0	100.0	150.200	29.30

FIELD DATA AND VELOCITY CALC.

[IN H2O] Delta P	[F] Stack T.	[FPS] Velocity	[F] Meter In	[F] Meter out	[IN H2O] Delta H
0.700	299	57.4	120	109	1.6
0.210	314	31.8	120	109	0.5
0.170	300	28.3	121	109	0.4
0.700	309	57.8	125	109	1.6
0.390	316	43.3	125	110	0.85
0.200	300	30.7	124	110	0.45
0.420	319	45.0	125	111	0.95
0.450	327	46.9	126	111	1.05
0.280	306	36.5	118	112	0.65
0.440	328	46.3	126	112	1
0.470	336	48.2	127	113	1.1
0.230	319	33.3	128	113	0.55
0.200	341	31.5	126	113	0.45
0.400	347	44.7	124	113	0.95
0.390	314	43.3	127	113	0.9
0.470	355	48.7	128	113	1.1
0.400	355	45.0	128	114	0.95
0.230	329	33.5	129	114	0.55
0.600	359	55.2	127	114	1.4
0.450	357	47.8	129	114	1.05
0.170	332	28.9	129	114	0.4
0.700	354	59.5	127	114	1.6
0.460	349	48.0	129	115	1.05
0.200	339	31.5	130	115	0.45
0			0	0	0

(29.1 mol) -> L. CO

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT TPC	TEST DATE 9-02-92	ORIFICE CORRECTION (ΔH@) 1.618	HOT/COLD BOX NO. 3
TEST UNIT RPQL #2	TEST NO. PE 3 BE	METER CORRECTION (Y) 0.9915	PROBE NO. Short
PROJECT NO. LIFAC	NOZZLE (SIZE,#) 0.251	CALIBRATION DATE 05-05-92	FILTER NO. 7
TEST CREW Rich / John	STATIC PRESSURE -9.4	PITOT CORRECTION 0.84	STACK DIA.
BAROMETRIC PRESSURE 29.1	PORT DIRECTION After preheat	CONTROL BOX NO. 3	PORT SIZE

Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
1.1	10.55	579.29	0.6	1.37	1.40	108	98	4.0	300	240	69	—	3 min./point
1.2	10.58		0.20	0.46	0.45	109	98	1.0	300				3 point/port
1.3	11.01		0.15	0.34	0.35	110	98	1.0	304				8 port.
2.1	11.06	583.34	0.70	1.60	1.60	115	98	5.0	313	140	68		
2.2	11.09		0.37	0.84	0.85	115	98	4.0	324				
2.3	11.12		0.21	0.48	0.50	115	99	2.0	255	128	-		
3.1	11.17	588.33	0.40	0.91	0.90	116	100	3.5	323				
3.2	11.20		0.45	1.03	1.05	118	100	4.5	332	240			
3.3	11.23		0.30	0.68	0.70	118	101	4.0	326				
4.1	11.28	593.10	0.42	0.96	0.95	119	101	3.5	328				
4.2	11.31		0.44	1.00	1.00	120	102	4.3	340				
4.3	11.34		0.25	0.57	0.6	119	103	3.0	293	234	74		
										([illegible])			
													Estimates:
													MW= 65
													%H2O= 10%

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before	5	0.02
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.	100	280		80
2.	100			
3.	0			
4.	(sg)	94+34	97.5	86.5
5.				

(-2.[illegible]) cup

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT TPC	TEST DATE 9-02-92	ORIFICE CORRECTION (ΔH@)	HOT/COLD BOX NO.
TEST UNIT	TEST NO. PE3BE	METER CORRECTION (Y)	PROBE NO.
PROJECT NO.	NOZZLE (SIZE,#)	CALIBRATION DATE	FILTER NO. (7)
TEST CREW Rich / Thomas / [illegible]	STATIC PRESSURE	PITOT CORRECTION	STACK DIA.
BAROMETRIC PRESSURE	PORT DIRECTION	CONTROL BOX NO.	PORT SIZE

Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
5.1	11.38	597.75	0.50	1.14	1.15	121	103	4.2	343	228			3 min./point
5.2	11.41		0.36	0.82	0.80	121	103	4.4	350				3p/port
5.3	11.44		0.31	0.71	0.70	121	104	4.3	336	175			8 port
6.1	11.49	602.69	0.7	1.60	1.60	123	104	6.0	357				
6.2	11.52		0.32	0.73	0.75	121	104	5.0	360				
6.3	11.55		0.30	0.68	0.70	122	105	5.0	334				
7.1	12.00	602.64	0.7	1.60	1.60	123	105	6.5	362	302			
7.2	12.03		0.55	1.25	1.25	124	106	7.0	363				
7.3	12.06		0.27	0.62	0.60	123	106	5.0	336				
8.1	12.10	613.10	0.7	1.60	1.60	124	107	5.5	—				
8.2	12.13		0.36	0.82	0.8	124	108	5.0	354				
8.3	12.16	617.92	0.17	0.39	0.4	123	108	3.5	323				
													Estimates:
													MW=
													%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After	7.0	<0.02

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT	TPC	TEST DATE	04-02-92	ORIFICE CORRECTION (▲H@)	1.618
TEST UNIT	RPSC #2	TEST NO.	PE4BE	METER CORRECTION (Y)	0.9915
PROJECT NO.	LIFAC	NOZZLE (SIZE,Ø)	0.251	CALIBRATION DATE	05-05-92
TEST CREW	Tucmo / [illegible]	STATIC PRESSURE	-8.6	PITOT CORRECTION	0.84
BAROMETRIC PRESSURE	29.0	PORT DIRECTION	After Preheat	CONTROL BOX NO.	3

HOT/COLD BOX NO.	3
PROBE NO.	Short
FILTER NO.	8
STACK DIA.	
PORT SIZE	

Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ▲P (in. H2O)	Orifice ▲H Required (in. H2O)	Orifice ▲H Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
1.1	2.11	618.03	0.7	1.62	1.60	120	109	4.5	299	247	63	—	3 min./point
1.2	2.14		0.21	0.48	0.50	120	109	1.5	314				3 point/port
1.3	2.17		0.17	0.39	0.40	121	109	1.0	300				8 port
2.1	2.22	622.90	0.7	1.62	1.60	125	109	4.5	309				
2.2	2.25		0.39	0.86	0.85	123	110	4.0	316				
2.3	2.28		0.2	0.46	0.45	124	110	2.5	300				
3.1	2.33	629.0	0.42	0.97	0.95	125	111	3.5	319				
3.2	2.36		0.45	1.05	1.05	126	111	4.0	327				
3.3	2.39		0.28	0.65	0.65	126	112	3.0	306	205	72		
4.1	2.43	634.0	0.44	1.02	1.00	127	112	4.0	326				
4.2	2.46		0.47	1.09	1.10	128	113	4.5	336				
4.3	2.49		0.23	0.53	0.55	126	113	3.5	319				
													Estimates:
													MW=
													%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before	7	<0.03
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.	100 H2O	275		75
2.	100			
3.				
4.	(SG)	78 + 46	98.1	Δ = 2.8
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT	TEST DATE 09-02-92	ORIFICE CORRECTION (▲H@)	HOT/COLD BOX NO.
TEST UNIT	TEST NO. PEHBE	METER CORRECTION (Y)	PROBE NO.
PROJECT NO.	NOZZLE (SIZE,#)	CALIBRATION DATE	FILTER NO.
TEST CREW	STATIC PRESSURE	PITOT CORRECTION	STACK DIA.
BAROMETRIC PRESSURE	PORT DIRECTION	CONTROL BOX NO.	PORT SIZE

Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ▲P (in. H2O)	Orifice ▲H Required (in. H2O)	Orifice ▲H Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
5.1	2:54	638.22	0.20	0.48	0.45	124	113	2.5	341				min./point
5.2	2:57		0.40	0.95	0.95	127	113	4.0	347				
5.3	3:00		0.39	0.91	0.90	128	113	4.5	314				
6.1	3:05	642.64	0.47	1.09	1.00	128	113	4.5	355				
6.2	3:08		0.4	0.93	0.95	129	114	5.0	355				
6.3	3:11		0.23	0.53	0.55	127	114	4.0	329				
7.1	3:16	647.86	0.60	1.39	1.40	129	114	6.0	359	217	67		
7.2	3:19		0.45	1.04	1.05	129	114	6.0	357				
7.3	3:22		0.17	0.39	0.40	127	114	3.5	332				
8.1	3:27	653.27	0.70	1.62	1.60	129	114	5.0	354				
8.2	3:30		0.46	1.07	1.05	130	115	5.5	349				
8.3	3:33	658.84	0.20	0.46	0.45	127	115	3.5	339				

Estimates:
MW=
%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

APPENDIX C

ANALYTICAL RESULTS
AQUEOUS AND SOLID SAMPLES

LIFAC NA DEMONSTRATION PROJECT
RICHMOND POWER AND LIGHT
WHITEWATER VALLEY GENERATING UNIT #2

BASELINE ENVIRONMENTAL REPORT
SUMMARY OF SUPPLEMENTAL MONITORING

ICF KAISER ENGINEERS, INC.
PITTSBURGH, PA

Antech Ltd.

One Triangle Drive • Export, Pennsylvania 15632 • Phone: (412) 733-1161 • Fax: (412) 327-7793

September 21, 1992

Mr. John T. Kane
ICF Kaiser Engineers
Four Gateway Center
Pittsburgh, PA 15222-1207

Water Characterization
91001; LIFAC
Antech Ltd. Project No. 92-2554

Dear Mr. Kane:

Enclosed is the analytical result for the sample submitted by ICF Kaiser Engineers. The sample was received and logged in for analysis on September 3, 1992. A copy of this report was faxed to you.

Appropriate U.S. Environmental Protection Agency methods were used and are indicated accordingly on the data tables. Appropriate quality assurance/quality control analyses were performed in accordance with Antech Ltd.'s Statement of Qualifications. Results of these analyses can be furnished upon request. If you have any questions, please call me.

Sincerely,

Dominick Frollini, Jr.

Dominick Frollini, Jr.
Inorganic Chemistry Manager

DF:aeb

Enclosures

ANTECH LTD.
CASE NARRATIVE

I. **GENERAL:**

A: **PROJECT NUMBERS:**

ANTECH LTD.: 92-2554

CLIENT: 91001

B: **SAMPLE IDENTIFICATIONS:**

ANTECH LTD.: 9209-0231

CLIENT: #6 Pond Effluent at RP&L's outfall 001
(Not the Bottom Ash Aqueous Sample #6 in EMP)

C: **SHIPPING/RECEIVING COMMENTS:**

None

II. **PREPARATION/ANALYSIS COMMENTS:**

A: **GENERAL CHEMISTRY:**

None

III. **GENERAL COMMENTS:**

None

TABLE C-1

General Data Table
ICF Kaiser Engineers
Antech Ltd. Project No. 92-2554
Water Characterization; 91001; LIFAC
Collected September 2, 1992

Parameter	Analytical Method	Units	Sample Identification 9209-0231 #6 Pond Effluent
Alkalinity (Total)	310.1[1]	mg/l $CaCO_3$	111

[1] U.S. Environmental Protection Agency, 1983, Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

Antech Ltd.

One Triangle Drive • Export, Pennsylvania 15632 • Phone: (412) 733-1161 • Fax: (412) 327-7793

September 23, 1992

Mr. John T. Kane
ICF Kaiser Engineers
Four Gateway Center
Pittsburgh, PA 15222-1207

Waste Characterization
91001: LIFAC
Antech Ltd. Project No. 92-2555

Dear Mr. Kane:

Enclosed are analytical results for samples submitted by ICF Kaiser Engineers. Samples were received and logged in for analysis on September 3, 1992. A copy of this report was faxed to you.

Appropriate U.S. Environmental Protection Agency methods were used and are indicated accordingly on the data tables. Appropriate quality assurance/quality control analyses were performed in accordance with Antech Ltd.'s Statement of Qualifications. Results of these analyses can be furnished upon request. If you have any questions, please call me.

Sincerely,

Dominick Frollini, Jr.
Inorganic Chemistry Manager

DF:aeb

Enclosures

ANTECH LTD.
CASE NARRATIVE

I. GENERAL:

A: PROJECT NUMBERS:

ANTECH LTD.: 92-2555
CLIENT: 91001

B: SAMPLE IDENTIFICATIONS:

ANTECH LTD.: 9209-0232 and 9209-0233
CLIENT: #3 Economizer Hopper Ash and #5 ESP Hopper Ash

C: SHIPPING/RECEIVING COMMENTS:

None

II. PREPARATION/ANALYSIS COMMENTS:

A: PREPARATION:

None

B: ORGANICS:

1. VOLATILES:

The detection levels for the "total" analyses of both samples are elevated due to sample matrix.

2. SEMIVOLATILES:

None

C: METALS:

None

D: GENERAL CHEMISTRY:

None

III. GENERAL COMMENTS:

None

TABLE C-2

General Data Table
ICF Kaiser Engineers
Antech Ltd. Project No. 92-2555
Waste Characterization; 91001; LIFAC
Collected September 2, 1992

Parameter	Analytical Method	Units	Sample Identification 9209-0232 #3 Economizer Hopper A
Alkalinity (Total)	310.1(1)	mg/l $CaCO_3$	87.0
pH	9045(2)	pH units	11.90
Sulfate (ASTM)	9038(2)	mg/l	100
TCLP Metals:(3)			
Silver (TCLP)	6010(2)	mg/l	<0.10
Arsenic (TCLP)	6010(2)	mg/l	<0.10
Barium (TCLP)	6010(2)	mg/l	<10
Cadmium (TCLP)	6010(2)	mg/l	<0.10
Chromium (TCLP)	6010(2)	mg/l	<0.10
Mercury (TCLP)	7470(2)	mg/l	<0.01
Lead (TCLP)	6010(2)	mg/l	<0.10
Selenium (TCLP)	7740(2)	mg/l	<0.10
TCLP Extraction Fluid Data:			
Extraction Fluid	1311(2)	-	No. 1
pH with Deionized Water		pH units	11.05
pH After Addition of 1 Normal HCL		pH units	1.55
pH of TCLP Extract		pH units	5.15
Amount of Sample Extracted		g	100

See footnotes at end of table.

TABLE C-2
~~TABLE~~
(Continued)

Parameter	Analytical Method	Units	Sample Identification 9209-0233 #5 ESP Ash
Alkalinity (Total)	310.1[1]	mg/l $CaCO_3$	299
pH	9045[2]	pH units	11.60
Sulfate (ASTM)	9038[2]	mg/l	260
TCLP Metals:[3]			
Silver (TCLP)	6010[2]	mg/l	<0.10
Arsenic (TCLP)	6010[2]	mg/l	1.3
Barium (TCLP)	6010[2]	mg/l	<10
Cadmium (TCLP)	6010[2]	mg/l	<0.10
Chromium (TCLP)	6010[2]	mg/l	<0.10
Mercury (TCLP)	7470[2]	mg/l	<0.01
Lead (TCLP)	6010[2]	mg/l	<0.10
Selenium (TCLP)	7740[2]	mg/l	<0.10
TCLP Extraction Fluid Data:			
Extraction Fluid	1311[2]	-	No. 1
pH with Deionized Water		pH units	11.50
pH After Addition of 1 Normal HCL		pH units	1.90
pH of TCLP Extract		pH units	5.20
Amount of Sample Extracted		g	100

(1) U.S. Environmental Protection Agency, 1983, Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.
(2) U.S. Environmental Protection Agency, 1987, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.
(3) Toxicity Characteristic Leaching Procedure (TCLP) results have not been bias corrected.

TABLE C-3

TCLP(1) Organic Analyses
ICF Kaiser Engineers
Antech Ltd. Project No. 92-2555
Waste Characterization; 91001; LIFAC
Collected September 2, 1992

Parameter	CAS(2) Number	Units	Sample Identification 9209-0232 #3 Economizer Hopper A
TCLP Volatile Organic Analyses:(8260)(3)			
Benzene	71-43-2	µg/l	<50
2-Butanone	78-93-3	µg/l	<5000
Carbon tetrachloride	56-23-5	µg/l	<50
Chlorobenzene	108-90-7	µg/l	<1000
Chloroform	67-66-3	µg/l	<500
1,2-Dichloroethane	107-06-2	µg/l	<50
1,1-Dichloroethene	75-35-4	µg/l	<50
Tetrachloroethene	127-18-4	µg/l	<50
Trichloroethene	79-01-6	µg/l	<50
Vinyl chloride	75-01-4	µg/l	<50
TCLP Base/Neutral Extractables:(8270)(3)			
1,4-Dichlorobenzene	106-46-7	µg/l	<500
2,4-Dinitrotoluene	121-14-2	µg/l	<50
Hexachlorobutadiene	87-68-3	µg/l	<50
Hexachlorobenzene	118-74-1	µg/l	<100
Hexachloroethane	67-72-1	µg/l	<500
Nitrobenzene	98-95-3	µg/l	<100
Pyridine	110-86-1	µg/l	<500
TCLP Acid Extractables:(8270)(3)			
Total Cresol (TCLP)	(4)	µg/l	<5000
Pentachlorophenol	87-86-5	µg/l	<5000
2,4,5-Trichlorophenol	95-95-4	µg/l	<5000
2,4,6-Trichlorophenol	88-06-2	µg/l	<100

See footnotes at end of table.

TABLE C-3
~~TABLE~~
(Continued)

Parameter	CAS[2] Number	Units	Sample Identification 9209-0233 #5 ESP Hopper Ash
TCLP Volatile Organic Analyses:(8260)[3]			
Benzene	71-43-2	µg/l	<50
2-Butanone	78-93-3	µg/l	<5000
Carbon tetrachloride	56-23-5	µg/l	<50
Chlorobenzene	108-90-7	µg/l	<1000
Chloroform	67-66-3	µg/l	<500
1,2-Dichloroethane	107-06-2	µg/l	<50
1,1-Dichloroethene	75-35-4	µg/l	<50
Tetrachloroethene	127-18-4	µg/l	<50
Trichloroethene	79-01-6	µg/l	<50
Vinyl chloride	75-01-4	µg/l	<50
TCLP Base/Neutral Extractables:(8270)[3]			
1,4-Dichlorobenzene	106-46-7	µg/l	<500
2,4-Dinitrotoluene	121-14-2	µg/l	<50
Hexachlorobutadiene	87-68-3	µg/l	<50
Hexachlorobenzene	118-74-1	µg/l	<100
Hexachloroethane	67-72-1	µg/l	<500
Nitrobenzene	98-95-3	µg/l	<100
Pyridine	110-86-1	µg/l	<500
TCLP Acid Extractables:(8270)[3]			
Total Cresol (TCLP)	(4)	µg/l	<5000
Pentachlorophenol	87-86-5	µg/l	<5000
2,4,5-Trichlorophenol	95-95-4	µg/l	<5000
2,4,6-Trichlorophenol	88-06-2	µg/l	<100

(1) Toxicity Characteristic Leaching Procedure (TCLP) results have not been bias corrected.
(2) CAS - Chemical Abstracts Services.
(3) U.S. Environmental Protection Agency, 1987, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.
(4) m-Cresol 108-39-5, o-Cresol 95-48-7, and p-Cresol 106-44-5.

TABLE C-4

TCLP[1] Organic Analyses
ICF Kaiser Engineers
Antech Ltd. Project No. 92-2555
Waste Characterization; 91001; LIFAC

Parameter	CAS[2] Number	Units	Sample Identification Method Blank
TCLP Volatile Organic Analyses:(8260)[3]			
Benzene	71-43-2	µg/l	<50
Carbon Tetrachloride	56-23-5	µg/l	<50
Chlorobenzene	108-90-7	µg/l	<1,000
Chloroform	67-66-3	µg/l	<500
1,2-Dichloroethane	107-06-2	µg/l	<50
1,1-Dichloroethene	75-35-4	µg/l	<50
2-Butanone	78-93-3	µg/l	<5,000
Tetrachloroethene	127-18-4	µg/l	<50
Trichloroethene	79-01-6	µg/l	<50
Vinyl Chloride	75-01-4	µg/l	<50
TCLP Base/Neutral Extractables:(8270)[3]			
1,4-Dichlorobenzene	106-46-7	µg/l	<500
2,4-Dinitrotoluene	121-14-2	µg/l	<50
Hexachlorobenzene	118-74-1	µg/l	<100
Hexachlorobutadiene	87-68-3	µg/l	<50
Hexachloroethane	67-72-1	µg/l	<500
Nitrobenzene	98-95-3	µg/l	<100
Pyridine	110-86-1	µg/l	<500
TCLP Acid Extractables:(8270)[3]			
Total Cresols	(4)	µg/l	<5,000
Pentachlorophenol	87-86-5	µg/l	<5,000
2,4,5-Trichlorophenol	95-95-4	µg/l	<5,000
2,4,6-Trichlorophenol	88-06-2	µg/l	<100

(1) Toxicity Characteristic Leaching Procedure (TCLP) results have not been bias corrected.

(2) CAS - Chemical Abstracts Services.

(3) U.S. Environmental Protection Agency, 1987, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

(4) m-Cresol 108-39-4, o-Cresol 95-48-7, and p-Cresol 106-44-5.

TABLE C-5

Volatile Organic Analyses
EPA Method 8260(1)
ICF Kaiser Engineers
Antech Ltd. Project No. 92-2555
Waste Characterization; 91001; LIFAC
Collected September 2, 1992

Parameter	CAS(2) Number	Units	Sample Identification 9209-0232 #3Economizer Hopper Ash
Acetone	67-64-1	µg/kg	<500
Benzene	71-43-2	µg/kg	<25
Bromodichloromethane	75-27-4	µg/kg	<25
Bromoform	75-25-2	µg/kg	<25
Bromomethane	74-83-9	µg/kg	<50
2-Butanone (MEK)	78-93-3	µg/kg	<500
Carbon disulfide	75-15-0	µg/kg	<25
Carbon tetrachloride	56-23-5	µg/kg	<25
Chlorobenzene	108-90-7	µg/kg	<25
Chlorodibromomethane	124-48-1	µg/kg	<25
Chloroethane	75-00-3	µg/kg	<50
Chloromethane	74-87-3	µg/kg	<50
Chloroform	67-66-3	µg/kg	<25
1,1-Dichloroethane	75-34-3	µg/kg	<25
1,2-Dichloroethane	107-06-2	µg/kg	<25
1,1-Dichloroethene	75-35-4	µg/kg	<25
cis-1,2-Dichloroethene	156-59-2	µg/kg	<25
trans-1,2-Dichloroethene	156-60-5	µg/kg	<25
1,2-Dichloropropane	78-87-5	µg/kg	<25
cis-1,3-Dichloropropene	10061-01-5	µg/kg	<25
trans-1,3-Dichloropropene	10061-02-6	µg/kg	<25
Ethylbenzene	100-41-4	µg/kg	<25
2-Hexanone	591-78-6	µg/kg	<250
Methylene chloride	75-09-2	µg/kg	46
4-Methyl-2-pentanone (MIBK)	108-10-1	µg/kg	<250
Styrene	100-42-5	µg/kg	<25
1,1,2,2-Tetrachloroethane	79-34-5	µg/kg	<25
Tetrachloroethene	127-18-4	µg/kg	<25
Toluene	108-88-3	µg/kg	<25
1,1,1-Trichloroethane	71-55-6	µg/kg	<25
1,1,2-Trichloroethane	79-00-5	µg/kg	<25
Trichloroethene	79-01-6	µg/kg	<25
Vinyl chloride	75-01-4	µg/kg	<50
Xylenes (Total)	1330-20-7	µg/kg	<25

See footnotes at end of table.

TABLE C-5
~~TXXXXXX~~
(Continued)

Parameter	CAS(2) Number	Units	Sample Identification 9209-0233 ESP #5 Hopper Ash
Acetone	67-64-1	µg/kg	<13000
Benzene	71-43-2	µg/kg	<630
Bromodichloromethane	75-27-4	µg/kg	<630
Bromoform	75-25-2	µg/kg	<630
Bromomethane	74-83-9	µg/kg	<1300
2-Butanone (MEK)	78-93-3	µg/kg	<13000
Carbon disulfide	75-15-0	µg/kg	730
Carbon tetrachloride	56-23-5	µg/kg	<630
Chlorobenzene	108-90-7	µg/kg	<630
Chlorodibromomethane	124-48-1	µg/kg	<630
Chloroethane	75-00-3	µg/kg	<1300
Chloromethane	74-87-3	µg/kg	<1300
Chloroform	67-66-3	µg/kg	<630
1,1-Dichloroethane	75-34-3	µg/kg	<630
1,2-Dichloroethane	107-06-2	µg/kg	<630
1,1-Dichloroethene	75-35-4	µg/kg	<630
cis-1,2-Dichloroethene	156-59-2	µg/kg	<630
trans-1,2-Dichloroethene	156-60-5	µg/kg	<630
1,2-Dichloropropane	78-87-5	µg/kg	<630
cis-1,3-Dichloropropene	10061-01-5	µg/kg	<630
trans-1,3-Dichloropropene	10061-02-6	µg/kg	<630
Ethylbenzene	100-41-4	µg/kg	<630
2-Hexanone	591-78-6	µg/kg	<6300
Methylene chloride	75-09-2	µg/kg	<630
4-Methyl-2-pentanone (MIBK)	108-10-1	µg/kg	<6300
Styrene	100-42-5	µg/kg	<630
1,1,2,2-Tetrachloroethane	79-34-5	µg/kg	<630
Tetrachloroethene	127-18-4	µg/kg	<630
Toluene	108-88-3	µg/kg	2200
1,1,1-Trichloroethane	71-55-6	µg/kg	<630
1,1,2-Trichloroethane	79-00-5	µg/kg	<630
Trichloroethene	79-01-6	µg/kg	<630
Vinyl chloride	75-01-4	µg/kg	<1300
Xylenes (Total)	1330-20-7	µg/kg	<630

(1) U.S. Environmental Protection Agency, 1987, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.
(2) CAS = Chemical Abstracts Services.

TABLE C-6

Volatile Organic Analyses
EPA Method 8260[1]
ICF Kaiser Engineers
Antech Ltd. Project No. 92-2555
Waste Characterization; 91001; LIFAC

Parameter	CAS[2] Number	Units	Sample Identification Method Blank
Acetone	67-64-1	µg/l	<500
Benzene	71-43-2	µg/l	<2
Bromodichloromethane	75-27-4	µg/l	<25
Bromoform	75-25-2	µg/l	<25
Bromomethane	74-83-9	µg/l	<50
2-Butanone (MEK)	78-93-3	µg/l	<500
Carbon disulfide	75-15-0	µg/l	<25
Carbon tetrachloride	56-23-5	µg/l	<25
Chlorobenzene	108-90-7	µg/l	<25
Chlorodibromomethane	124-48-1	µg/l	<25
Chloroethane	75-00-3	µg/l	<50
Chloromethane	74-87-3	µg/l	<10
Chloroform	67-66-3	µg/l	<25
1,1-Dichloroethane	75-34-3	µg/l	<5.0
1,2-Dichloroethane	107-06-2	µg/l	<5.0
1,1-Dichloroethene	75-35-4	µg/l	<5.0
cis-1,2-Dichloroethene	156-59-2	µg/l	<5.0
trans-1,2-Dichloroethene	156-60-5	µg/l	<5.0
1,2-Dichloropropane	78-87-5	µg/l	<5.0
cis-1,3-Dichloropropene	10061-01-5	µg/l	<5.0
trans-1,3-Dichloropropene	10061-02-6	µg/l	<5.0
Ethylbenzene	100-41-4	µg/l	<5.0
2-Hexanone	591-78-6	µg/l	<50
Methylene chloride	75-09-2	µg/l	<5.0
4-Methyl-2-pentanone (MIBK)	108-10-1	µg/l	<50
Styrene	100-42-5	µg/l	<5.0
1,1,2,2-Tetrachloroethane	79-34-5	µg/l	<5.0
Tetrachloroethene	127-18-4	µg/l	<5.0
Toluene	108-88-3	µg/l	<5.0
1,1,1-Trichloroethane	71-55-6	µg/l	<5.0
1,1,2-Trichloroethane	79-00-5	µg/l	<5.0
Trichloroethene	79-01-6	µg/l	<5.0
Vinyl chloride	75-01-4	µg/l	<10
Total xylenes	1330-20-7	µg/l	<5.0

[1] U.S. Environmental Protection Agency, 1987, Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC.

[2] CAS = Chemical Abstracts Services.

APPENDIX D

PARTICULATE MATTER
DATA SHEETS AND CALCULATIONS
ESP OUTLET LOCATION

LIFAC NA DEMONSTRATION PROJECT
RICHMOND POWER AND LIGHT
WHITEWATER VALLEY GENERATING UNIT #2

BASELINE ENVIRONMENTAL REPORT
SUMMARY OF SUPPLEMENTAL MONITORING

ICF KAISER ENGINEERS, INC.
PITTSBURGH, PA

KEYSTONE ENVIRONMENTAL RESOURCES
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS, INC.
RICHMOND, IN
RICHMOND P & L UNIT #2 BREACH

DATE: 9-2-92
CHARGE #: ...150-399610
TEST #: ICF-BRE-C1

1. EMISSION RESULTS

PARAMETER	GR/SCFD	LB/HR
PARTICULATE	.01647	20.95156

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2. STACK CONDITIONS

FLOW (ACFM)	255766.
(SCFM)	164085.
MOISTURE CONTENT (%)	9.54
STACK TEMPERATURE (F)	341.6

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3. SAMPLING CONDITIONS

SAMPLE TIME (MIN.)	72.0
SCFD GAS SAMPLED	40.960
PERCENT ISOKINETIC	102.48

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS, INC.
RICHMOND, IN — RICHMOND P & L
ICF-BRE-C1 — 9-2-92

FIELD DATA AND VELOCITY CALCULATIONS

POINT	TIME	METER READING (DRY) CF	DELTA P IN.H2O	ORIFICE DELTA H REQ	ORIFICE DELTA H ACT	METER TEMP DEG F IN	METER TEMP DEG F OUT	VACUUM IN.HG.	STACK TEMP DEG F	CORRECTE VELOCITY FT/SEC
105.0A	845.0	258.801	.720	1.67	1.67	65.	64.	6.5	333.	58.5
63.0			.700	1.63	1.63	75.	65.	6.0	342.	58.0
21.0A	854.0		.310	.72	.72	80.	65.	3.0	325.	38.2
105.0B	855.0		.620	1.44	1.44	82.	67.	5.0	339.	54.5
63.0			.980	2.28	2.28	88.	69.	8.0	343.	68.7
21.0B	904.0		.350	.81	.81	87.	71.	3.0	344.	41.1
105.0C	905.0		.680	1.58	1.58	90.	71.	5.0	337.	57.0
63.0			.520	1.21	1.21	93.	73.	4.0	342.	50.0
21.0C	914.0		.360	.84	.84	97.	73.	3.0	345.	41.7
105.0D	915.0		.710	1.65	1.65	97.	75.	6.0	342.	58.4
63.0			.020	.05	.05	89.	79.	1.0	345.	9.8
21.0D	924.0		.510	1.20	1.20	98.	81.	4.5	349.	49.7
105.0E	925.0		.620	1.46	1.46	99.	82.	5.0	343.	54.6
63.0			.300	.71	.71	102.	82.	3.0	344.	38.0
21.0E	934.0		.660	1.56	1.56	105.	82.	5.5	341.	56.3
105.0F	935.0		.540	1.27	1.27	101.	82.	4.5	340.	50.9
63.0			.800	1.89	1.89	107.	82.	6.5	344.	62.1
21.0F	944.0		.700	1.65	1.65	109.	85.	5.5	349.	58.3
105.0G	945.0		.520	1.23	1.23	102.	85.	4.0	341.	50.0
63.0			.750	1.77	1.77	109.	85.	6.0	341.	60.0
21.0G	954.0		.680	1.60	1.60	110.	85.	5.5	341.	57.1
105.0H	955.0		.440	1.04	1.04	105.	87.	4.0	344.	46.0
63.0			.600	1.41	1.41	109.	87.	5.0	345.	53.8
21.0H	1004.0	304.048	.430	1.01	1.01	110.	89.	4.0	339.	45.4

O R S A T

CO2	15.0
O2	4.5
CO	.0
N	80.5

IMPINGER NO.	1	69.7
	2	10.7
	3	1.5
	4	.0
ABSORBED H2O		9.7

CONTROL BOX CALIBRATIONS

	FACTOR	DATE
ORIFICE	1.985	5-20-92
METER	0.9617	5-20-92
PITOT	0.84	4-24-92

LEAK CHECK

	RATE		IN.HG
INITIAL	0.006	CFM	5.0
FINAL	0.011	CFM	8.0

CONTROL BOX NO. 6 PROBE NO. 10-1 NOZZLE NO. 37

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS, INC.
RICHMOND, IN — RICHMOND P & L
ICF-BRE-C1 — 9-2-92

STACK SAMPLING CALCULATIONS

A.	BAROMETRIC PRESSURE IN. HG.....	29.06
B.	AVG. DELTA H (IN H2O).....	1.32
C.	METER PRESSURE (IN. HG.).....	29.16
D.	STATIC PRESSURE (IN. H2O).....	1.10
E.	STATIC PRESSURE (IN. HG.).....	.081
F.	STACK PRESSURE (IN. HG.) (A+E).....	29.14
G.	STACK DIMENSIONS 126.0 X 96.0 IN.	
H.	STACK AREA (SQ. FT.)..... (LENGTH X WIDTH)	84.00
	NOZZLE DIAMETER.....	.2400
I.	NOZZLE AREA (SQ. FT.).....	.000314
J.	AVG. STACK TEMP (DEG. R.).....	801.6
K.	AVG. METER TEMP (DEG. R.).....	547.0
L.	CONDENSATE VOL. (ML).....	81.9
M.	ABSORBED H2O (ML).....	9.7
N.	TOTAL H2O (ML).....	91.6
O.	METERED GAS (CF).....	45.247
P.	GAS METER CORRECTION.....	.9617
Q.	CORRECTED METERED GAS (CF).....	43.514
R.	H2O GAS VOLUME (CF) (0.00267N(K/C).....	4.588
S.	TOTAL SAMPLED VOLUME (CF) (Q+R).....	48.102
T.	PERCENT H2O (100R/S).....	9.54
	THEORETICAL MAXIMUM.....	100.00
	PERCENT WATER USED.....	9.54
U.	SCFD GAS SAMPLED (528*Q*C/(29.9*K)).....	40.960
V.	MOLECULAR WEIGHT OF STACK GAS	

COMPONENT	ORSAT-DRY VOL.PCT./100	X	MOISTURE CORRECTION (1-T/100)	X	MOLECULAR WEIGHT	=	WEIGHT PER MOLE
CO2	.150	X	.9046	X	44.0	=	5.97
CO	.000	X	.9046	X	28.0	=	.00
O2	.045	X	.9046	X	32.0	=	1.30
N2	.805	X	.9046	X	28.2	=	20.54
H2O		X	T/100= .0954	X	18.0	=	1.72
					MOLECULAR WEIGHT OF STACK GAS	=	29.53

W.	PITOT CORRECTION.....	.840
X.	AVERAGE CORRECTED VELOCITY (FPS)..... [85.49*W*SQRT{(J*DELTA P)/(V*F)}]	50.75
Y.	AVG. FLOW RATE (CFM) (X*H*60).....	255766.
Z.	STACK FLOW RATE (SCFM) (528*Y/J*F/29.92).....	164085.
	STACK FLOW RATE (DRY).....	148434.
AA.	SAMPLE TIME (SEC).....	4320.
BB.	PERCENT ISOKINETIC..... (J*100*U*29.92)/(528*X*AA*I*F*(1-T/100))	102.48

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS, INC.
RICHMOND, IN — RICHMOND P & L
ICF-BRE-C1 — 9-2-92

PARAMETER	CYCLONE WT. (G)	MATL.ON FILTER(G)	INSOL.MATL. IN PROBE(G)	SOL.MATL. IN PROBE(G)
PARTICULATE	.00000	.00630	.00000	.03750

PARAMETER	INSOL.MATL. IN IMP.(G)	SOLUBLE MATL. IN IMP.(G)
PARTICULATE	.00000	.00000

PARTICULATE	.04380
ALL MATLS.	.04380

PARAMETER	GR/SCFD	LB/HR
PARTICULATE	.01647	20.95156

Emission rates are based on EPA Method 5.

KEYSTONE ENVIRONMENTAL RESOURCES
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS, INC.
RICHMOND, IN
RICHMOND P & L UNIT #2 BREACH

DATE: 9-2-92
CHARGE #: ...150-399610
TEST #: ICF-BRE-C2

1. EMISSION RESULTS

PARAMETER	GR/SCFD	LB/HR
PARTICULATE	.01102	14.07459

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2. STACK CONDITIONS

FLOW (ACFM)	256916.
(SCFM)	165537.
MOISTURE CONTENT (%)	10.01
STACK TEMPERATURE (F)	338.1

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3. SAMPLING CONDITIONS

SAMPLE TIME (MIN.)	72.0
SCFD GAS SAMPLED	41.635
PERCENT ISOKINETIC	103.79

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS, INC.
RICHMOND, IN — RICHMOND P & L
ICF-BRE-C2 — 9-2-92

FIELD DATA AND VELOCITY CALCULATIONS

POINT	TIME	METER READING (DRY) CF	DELTA P IN.H2O	ORIFICE DELTA H REQ	ORIFICE DELTA H ACT	METER TEMP DEG F IN	METER TEMP DEG F OUT	VACUUM IN.HG.	STACK TEMP DEG F	CORRECTE VELOCITY FT/SEC
105.0H	1045.0	304.629	.410	.97	.97	84.	79.	3.0	329.	44.1
63.0			.600	1.42	1.42	95.	80.	4.5	336.	53.6
21.0H	1054.0		.480	1.14	1.14	99.	81.	4.0	331.	47.8
105.0G	1055.0		.550	1.30	1.30	99.	82.	4.5	336.	51.3
63.0			.800	1.89	1.89	104.	83.	6.0	335.	61.8
21.0G	1104.0		.710	1.68	1.68	108.	84.	5.5	346.	58.7
105.0F	1105.0		.450	1.07	1.07	104.	83.	3.5	340.	46.5
63.0			.760	1.80	1.80	109.	87.	6.0	341.	60.5
21.0F	1114.0		.730	1.73	1.73	111.	87.	5.5	340.	59.3
105.0E	1115.0		.680	1.61	1.61	106.	89.	5.0	336.	57.1
63.0			.300	.71	.71	105.	89.	3.0	340.	38.0
21.0E	1124.0		.690	1.63	1.63	110.	89.	5.0	341.	57.7
105.0D	1127.0		.780	1.85	1.85	102.	89.	6.0	345.	61.4
63.0			.100	.24	.24	101.	89.	1.0	342.	22.0
21.0D	1136.0		.510	1.21	1.21	105.	89.	4.0	341.	49.6
105.0C	1138.0		.630	1.49	1.49	105.	89.	4.5	342.	55.1
63.0			.540	1.28	1.28	110.	89.	4.0	335.	50.8
21.0C	1147.0		.420	.99	.99	110.	89.	3.0	338.	44.9
105.0B	1149.0		.710	1.68	1.68	106.	89.	5.5	333.	58.2
63.0			.560	1.33	1.33	111.	90.	4.0	335.	51.7
21.0B	1158.0		.330	.78	.78	109.	90.	3.0	340.	39.8
105.0A	1209.0		.800	1.89	1.89	92.	87.	6.0	335.	61.8
63.0			.630	1.49	1.49	102.	85.	4.5	338.	55.0
21.0A	1218.0	351.303	.280	.66	.66	103.	87.	2.5	340.	36.7

O R S A T

CO2	14.7
O2	4.4
CO	.0
N	80.9

IMPINGER NO.	1	68.7
	2	14.9
	3	1.6
	4	.0
ABSORBED H2O		13.0

CONTROL BOX CALIBRATIONS

	FACTOR	DATE
ORIFICE	1.985	5-20-92
METER	0.9617	5-20-92
PITOT	0.84	7-31-92

LEAK CHECK

	RATE		IN.HG
INITIAL	0.016	CFM	6.0
FINAL	0.007	CFM	8.0

CONTROL BOX NO. 6 PROBE NO. 10-2 NOZZLE NO. 37

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS, INC.
RICHMOND, IN RICHMOND P & L
ICF-BRE-C2 9-2-92

STACK SAMPLING CALCULATIONS

A.	BAROMETRIC PRESSURE IN. HG.....	29.06
B.	AVG. DELTA H (IN H2O).....	1.33
C.	METER PRESSURE (IN. HG.).....	29.16
D.	STATIC PRESSURE (IN. H2O).....	1.10
E.	STATIC PRESSURE (IN. HG.).....	.081
F.	STACK PRESSURE (IN. HG.) (A+E).....	29.14
G.	STACK DIMENSIONS 126.0 X 96.0 IN.	
H.	STACK AREA (SQ. FT.)..... (LENGTH X WIDTH)	84.00
	NOZZLE DIAMETER.....	.2400
I.	NOZZLE AREA (SQ. FT.).....	.000314
J.	AVG. STACK TEMP (DEG. R.).....	798.1
K.	AVG. METER TEMP (DEG. R.).....	555.1
L.	CONDENSATE VOL. (ML).....	85.2
M.	ABSORBED H2O (ML).....	13.0
N.	TOTAL H2O (ML).....	98.2
O.	METERED GAS (CF).....	46.674
P.	GAS METER CORRECTION.....	.9617
Q.	CORRECTED METERED GAS (CF).....	44.886
R.	H2O GAS VOLUME (CF) (0.00267N(K/C).....	4.992
S.	TOTAL SAMPLED VOLUME (CF) (Q+R).....	49.878
T.	PERCENT H2O (100R/S).....	10.01
	THEORETICAL MAXIMUM.....	100.00
	PERCENT WATER USED.....	10.01
U.	SCFD GAS SAMPLED (528*Q*C/(29.9*K)).....	41.635
V.	MOLECULAR WEIGHT OF STACK GAS	

COMPONENT	ORSAT-DRY VOL.PCT./100	X	MOISTURE CORRECTION (1-T/100)	X	MOLECULAR WEIGHT	=	WEIGHT PER MOLE
CO2	.147	X	.8999	X	44.0	=	5.82
CO	.000	X	.8999	X	28.0	=	.00
O2	.044	X	.8999	X	32.0	=	1.27
N2	.809	X	.8999	X	28.2	=	20.53
H2O		X	T/100= .1001	X	18.0	=	1.80
					MOLECULAR WEIGHT OF STACK GAS	=	29.42

W.	PITOT CORRECTION.....	.840
X.	AVERAGE CORRECTED VELOCITY (FPS)..... [85.49*W*SQRT((J*DELTA P)/(V*F))]	50.98
Y.	AVG. FLOW RATE (CFM) (X*H*60).....	256916.
Z.	STACK FLOW RATE (SCFM) (528*Y/J*F/29.92).....	165537.
	STACK FLOW RATE (DRY).....	148970.
AA.	SAMPLE TIME (SEC).....	4320.
BB.	PERCENT ISOKINETIC..... (J*100*U*29.92)/(528*X*AA*I*F*(1-T/100))	103.79

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS, INC.
RICHMOND, IN RICHMOND P & L
ICF-BRE-C2 9-2-92

PARAMETER	CYCLONE WT. (G)	MATL.ON FILTER(G)	INSOL.MATL. IN PROBE(G)	SOL.MATL. IN PROBE(G)
PARTICULATE	.00000	.01130	.00000	.01850

PARAMETER	INSOL.MATL. IN IMP.(G)	SOLUBLE MATL. IN IMP.(G)
PARTICULATE	.00000	.00000
PARTICULATE	.02980	
ALL MATLS.	.02980	

PARAMETER	GR/SCFD	LB/HR
PARTICULATE	.01102	14.07459

Emission rates are based on EPA Method 5.

KEYSTONE ENVIRONMENTAL RESOURCES
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS, INC.
RICHMOND, IN
RICHMOND P & L UNIT #2 BREACH

DATE: 9-2-92
CHARGE #: ...150-399610
TEST #: ICF-BRE-C3

1. EMISSION RESULTS

PARAMETER	GR/SCFD	LB/HR
PARTICULATE	.01304	16.80850

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2. STACK CONDITIONS

FLOW (ACFM)	258653.
(SCFM)	167224.
MOISTURE CONTENT (%)	10.09
STACK TEMPERATURE (F)	335.4

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3. SAMPLING CONDITIONS

SAMPLE TIME (MIN.)	72.0
SCFD GAS SAMPLED	41.324
PERCENT ISOKINETIC	102.07

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS, INC.
RICHMOND, IN — RICHMOND P & L
ICF-BRE-C3 — 9-2-92

FIELD DATA AND VELOCITY CALCULATIONS

POINT	TIME	METER READING (DRY) CF	DELTA P IN.H2O	ORIFICE DELTA H REQ	ORIFICE DELTA H ACT	METER TEMP DEG F IN	METER TEMP DEG F OUT	VACUUM IN.HG.	STACK TEMP DEG F	CORRECTE VELOCITY FT/SEC
105.0A	1412.0	352.453	.760	1.73	1.73	79.	75.	8.0	339.	60.4
63.0			.610	1.43	1.43	84.	75.	7.0	332.	53.9
21.0A	1421.0		.300	.71	.71	89.	75.	4.0	329.	37.7
105.0B	1422.0		.730	1.72	1.72	90.	77.	8.0	333.	59.0
63.0			.570	1.34	1.34	97.	79.	6.5	335.	52.2
21.0B	1431.0		.340	.80	.80	99.	80.	4.0	338.	40.4
105.0C	1432.0		.660	1.55	1.55	97.	80.	7.0	332.	56.1
63.0			.600	1.41	1.41	103.	82.	6.5	335.	53.6
21.0C	1441.0		.410	.96	.96	104.	82.	5.0	336.	44.3
105.0D	1442.0		.690	1.62	1.62	102.	84.	7.0	337.	57.5
63.0			.100	.24	.24	100.	85.	1.0	338.	21.9
21.0D	1451.0		.560	1.32	1.32	105.	85.	6.0	338.	51.9
105.0E	1452.0		.670	1.58	1.58	105.	87.	7.0	339.	56.8
63.0			.280	.66	.66	104.	89.	3.0	336.	36.6
21.0E	1501.0		.680	1.60	1.60	108.	89.	7.0	335.	57.0
105.0F	1502.0		.480	1.13	1.13	103.	89.	5.0	340.	48.1
63.0			.800	1.88	1.88	109.	89.	8.0	335.	61.9
21.0F	1511.0		.740	1.74	1.74	110.	89.	8.0	337.	59.6
105.0G	1512.0		.540	1.27	1.27	104.	89.	6.0	337.	50.9
63.0			.800	1.88	1.88	110.	90.	8.0	336.	61.9
21.0G	1521.0		.670	1.58	1.58	111.	90.	7.0	335.	56.6
105.0H	1522.0		.480	1.13	1.13	101.	91.	5.0	333.	47.9
63.0			.650	1.57	1.57	111.	92.	7.0	335.	55.8
21.0H	1531.0	398.614	.520	1.25	1.25	112.	91.	6.0	330.	49.7

O R S A T

CO2	14.7
O2	4.2
CO	.0
N	81.1

IMPINGER NO.	1	74.2
	2	11.5
	3	1.1
	4	.0
ABSORBED H2O		11.6

CONTROL BOX CALIBRATIONS

	FACTOR	DATE
ORIFICE	1.985	5-20-92
METER	0.9617	5-20-92
PITOT	0.84	7-31-92

LEAK CHECK

	RATE		IN.HG
INITIAL	0.014	CFM	5.0
FINAL	0.011	CFM	11.5

CONTROL BOX NO. 6 PROBE NO. 10-2 NOZZLE NO. 37

A. BARO
B. AVG.
C. METE
D. STAT
E. STAT
F. STAC
G. STAC
H. STAC

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS, INC.
RICHMOND, IN RICHMOND P & L
ICF-BRE-C3 9-2-92

PARAMETER	CYCLONE WT. (G)	MATL.ON FILTER(G)	INSOL.MATL. IN PROBE(G)	SOL.MATL. IN PROBE(G)
PARTICULATE	.00000	.01100	.00000	.02400

PARAMETER	INSOL.MATL. IN IMP.(G)	SOLUBLE MATL. IN IMP.(G)
PARTICULATE	.00000	.00000

PARTICULATE	.03500
ALL MATLS.	.03500

PARAMETER	GR/SCFD	LB/HR
PARTICULATE	.01304	16.80850

Emission rates are based on EPA Method 5.

ICF KAISER ENGINEERS

PROJECT LIFAC Richmond Power & Light PROJECT NO. 91001

Emission Rate Based on Method 19 (F Factor) PAGE ____ OF ____

MADE BY MEB DATE 11-11-92 CHECKED BY ____ DATE ____

(ME/HI)
Mass Emission / Heat Input = $C_d F_d (20.9 / (20.9 - \%O_{2d}))$

Mass Emission / Heat Input = lb/mmBtu

C_d = particulate concentration, lb/dscf

F_d = F Factor (dry basis) for bituminous coal
9780 dscf/mm

$\%O_{2d}$ = Percent oxygen (on dry basis)

Test Run	C_d (gr/dscf)	C_d (lb/dscf)	F_d (dscf/mm)	$\%O_{2d}$ (%)	ME/HI (lb/mmBtu)
1	0.0165	2.357×10^{-6}	9780	4.5	0.029
2	0.0110	1.571×10^{-6}	9780	4.4	0.019
3	0.0130	1.857×10^{-6}	9780	4.2	0.023

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ANALYTICAL REPORTING FORM

CLIENT: ICF KAISER
PLANT LOCATION: Richmond Power + Light Co - Unit #2
PROJECT NUMBER: 399610-02
UNIT TESTED: BREACHING AREA - UNIT #2

TEST DATE: 9/2/12
DATE RECEIVED: 9/3/12
DATE ANALYZED: 9/3/12
ANALYTICAL METHOD: EPA METHOD 5

Test Number	Component	Cyclone Weight Units ( )	Filter Weight Units (grams)	Insoluble Portion of Front Half Units ( )	0.22μ Filter Insoluble Portion of Back Half Units ( )	Soluble Portion of Back Half Units ( )	Soluble Portion of Front Half Units (grams)	Chloroform/ Ethyl Ether Extract Units ( )
ICF-BRE-C1	Particulate		0.0063				[illegible]	
							(0.0375)	
ICF-BRE-C2	Particulate		0.0113				[illegible]	
							(0.0185)	
ICF-BRE-C3	Particulate		0.0110				0.0240	
							(0.0240)	
ICF-BRE-Acet-Blk	Particulate						0.0000	

Extraction Method
Solvent

Analyst's Signature: [illegible]
Date: 9/4/12

Comments

AQE 3/92

STACK SAMPLING DATA SHEET

CLIENT Richmond Power & Light
TEST UNIT Richmond IN
PROJECT NO. ICF Kaiser
CONTROL BOX OPERATOR
BAROMETRIC PRESSURE 29.06

TEST DATE 9-2-92
TEST NO. ICF-DRE-C1
NOZZLE (SIZE,#) #37 0.240
STATIC PRESSURE +1.1
PORT DIRECTION A→B,→,C,D

ORIFICE CORRECTION ~~0~~ 1.985 (nd)
METER CORRECTION 0.9617
CALIBRATION DATE 5-20-92
PITOT CORRECTION 0.84
CONTROL BOX NO. 6

HOT BOX NO. 2
COLD BOX NO. 2
PROBE NO. 10-1 (4-24-92)
FILTER NO. 898
STACK DIA. 126x84

Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H20)	Orifice ΔH Req'd. (in. H20)	Orifice ΔH Act. (in. H20)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°C/°F)	Hot Box Temp. (°F)	Comments
A													
105	0845	258.801	.72	1.67	1.67	65	64	6.5	333	263	57	255	3 min's/PT
63			.70	1.63	1.63	75	65	6.0	342				
21	0854	264.752	.31	.72	.72	80	65	3.0	325	258	57	260	
B													
105	0855	264.752	.62	1.44	1.44	82	67	5.0	339	245	59	250	
63			.98	2.28	2.28	88	69	8.0	343				
21	0904	270.705	.35	.81	.81	87	71	3.0	344	262	58	260	
C													
105	0905	270.705	.68	1.58	1.58	90	71	5.0	337	259	58	243	
63			.52	1.21	1.21	93	73	4.0	342				
21	0914	276.061	.36	.84	.84	97	73	3.0	345	261	58	250	
D													
105	0915	276.061	.71	1.65	1.65	97	75	6.0	342	265	59	260	
63			.02	.05	.05	89	79	1.0	345				
21	0924	280.463	.51	1.20	1.20	98	81	4.5	349	266	59	261	Estimates:
													MW= 29.5
													%H2O= 8.0

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before	5.0	.006
After	8.0	.011

PITOT LEAK CHECK

	Positive	Negative
Before	OK 15sec	OK 15sec
After	OK 15sec	OK 15sec

	1	2
CO2	15.0	
O2	4.5	
CO		
N2		

CEM Results

Impinger No.	Impinger Contents	Final	Initial	Difference
1.	100ml H2O	564.2	494.5	69.7
2.	100ml H2O	574.6	563.9	10.7
3.	Dry	381.5	380.0	1.5
4.	Sil Gel	652.9	643.2	9.7
5.				

KEYSTONE

STACK SAMPLING DATA SHEET

CLIENT Richmond Power & Light	TEST DATE 9-2-92	ORIFICE CORRECTION 1.985	HOT BOX NO. 2
TEST UNIT Richmond IN.	TEST NO. ICF-BRE-C1	METER CORRECTION .9617	COLD BOX NO. 2
PROJECT NO. ICF KAISER	NOZZLE (SIZE,#)	CALIBRATION DATE 5-20-92	PROBE NO. 10-1
CONTROL BOX OPERATOR	STATIC PRESSURE +1.1	PITOT CORRECTION .84	FILTER NO. 878
BAROMETRIC PRESSURE	PORT DIRECTION E→F→G→H	CONTROL BOX NO. 6	STACK DIA. 126 x 84

Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Req'd. (in. H2O)	Orifice ΔH Act. (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°C/°F)	Hot Box Temp. (°F)	Comments
E													
105	0925	280.463	.62	1.46	1.46	99	89	5.0	343	266	58	265	
63			.30	.71	.71	102	89	3.0	344				
21	0934	286.128	.66	1.56	1.56	105	82	5.5	341	265	56	240	
F													
105	0935	286.128	.54	1.27	1.27	101	82	4.5	340	265	57	242	
63			.80	1.89	1.89	107	82	6.5	344				
21	0944	292.450	.70	1.65	1.65	109	85	5.5	349	262	57	250	
G													
105	0945	292.450	.52	1.23	1.23	102	85	4.0	341	265	56	245	
63			.75	1.77	1.77	109	85	6.0	341				
21	0954	298.538	.68	1.60	1.60	110	85	5.5	341	266	56	243	
H													
105	0955	298.538	.44	1.04	1.04	105	87	4.0	344	266	57	247	
63			.60	1.41	1.41	109	87	5.0	345				Estimates:
21	1004	304.048	.43	1.01	1.01	110	89	4.0	339	267	57	254	MW=
													%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE

STACK SAMPLING DATA SHEET

CLIENT Richmond Power & Light
TEST DATE 9-2-92
ORIFICE CORRECTION 1.985
HOT BOX NO. 6
TEST UNIT Richmond IN.
TEST NO. ICF-BRE-C2
METER CORRECTION 0.9617
COLD BOX NO. Canned
PROJECT NO. ICF Kaiser
NOZZLE (SIZE,#) #37 0.240
CALIBRATION DATE 5-20-92
PROBE NO. ~~891~~ 10-2
CONTROL BOX OPERATOR
STATIC PRESSURE +1.1
PITOT CORRECTION 0.84
FILTER NO. 891 (7-31-92)
BAROMETRIC PRESSURE 29.06
PORT DIRECTION H, → G → F → E
CONTROL BOX NO. 6
STACK DIA. 126 x 84

Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Req'd. (in. H2O)	Orifice ΔH Act. (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°C/°F)	Hot Box Temp. (°F)	Comments
H													
105	1045	304.629	.41	.97	.97	84	79	3.0	329	240	64	245	3 min/pt
63			.60	1.42	1.42	95	80	4.5	336				
21	1054	310.122	.48	1.14	1.14	99	81	4.0	331	242	64	255	
G													
105	1055	310.122	.55	1.30	1.30	99	82	4.5	336	240	65	260	
63			.80	1.89	1.89	104	83	6.0	335	245	65	260	
21	1104	316.625	.71	1.68	1.68	108	84	5.5	346	250	65	255	
F													
105	1105	316.625	.45	1.07	1.07	104	83	3.5	340	248	63	245	
63			.76	1.80	1.80	109	87	6.0	341	245	63	250	
21	1114	322.829	.73	1.73	1.73	111	87	5.5	340	245	63	255	
E													
105	1115	322.829	.68	1.61	1.61	106	89	5.0	336	255	64	260	
63			.30	.71	.71	105	89	3.0	340	255	63	255	Estimates:
21	1124	328.702	.69	1.63	1.63	110	89	5.0	341	256	62	260	MW= 29.5
													%H2O= 8.0

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before	6.0	.016
After	8.0	.007

PITOT LEAK CHECK

	Positive	Negative
Before	OK 15sec	OK 15sec
After	OK 15sec	OK 15sec

CEM Results

	1	2
CO2	14.7	
O2	4.4	
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.	100ml H2O	609.8	541.1	68.7
2.	100ml H2O	564.2	549.3	14.9
3.	Dry	471.0	469.4	1.6
4.	Si/GC	677.1	664.1	13.0
5.				

STACK SAMPLING DATA SHEET

CLIENT Richmond Power & Light	TEST DATE 9-2-92	ORIFICE CORRECTION 1.985	HOT BOX NO. 6
TEST UNIT Richmond IND.	TEST NO. ICF-BRE-C2	METER CORRECTION .9617	COLD BOX NO. 6
PROJECT NO. ICF Kaiser	NOZZLE (SIZE,#)	CALIBRATION DATE 5-20-92	PROBE NO. 10-2
CONTROL BOX OPERATOR	STATIC PRESSURE +1.1	PITOT CORRECTION .84	FILTER NO. 871
BAROMETRIC PRESSURE 29.06	PORT DIRECTION D→C→B→A	CONTROL BOX NO. 6	STACK DIA. 126x84

Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Req'd. (in. H2O)	Orifice ΔH Act. (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°C/°F)	Hot Box Temp. (°F)	Comments
D	~~HZ~~												
105	1127	328.702	.78	1.85	1.85	102	89	6.0	345	252	62	250	3m/pt
63			.10	.24	.24	101	89	1.0	342	255	63	255	
21	1136	333.715	.51	1.21	1.21	105	89	4.0	341	248	65	260	
C													
105	1138	333.715	.63	1.49	1.49	105	89	4.5	342	240	62	260	
63			.54	1.28	1.28	110	89	4.0	335	245	59	260	
21	1147	339.707	.42	0.99	.99	110	89	3.0	338	243	60	260	
B													
105	1149	339.707	.71	1.68	1.68	106	89	5.5	333	247	61	260	
63			.56	1.33	1.33	111	90	4.0	335	248	61	250	
21	1158	345.357	.33	.78	.78	109	90	3.0	340	245	61	245	
A													
105	1209	345.357	.80	1.89	1.89	92	87	6.0	335	248	62	250	
63			.63	1.49	1.49	102	85	4.5	338	252	63	260	Estimates:
21	1218	351.303	.28	.66	.66	103	87	2.5	340	252	64	255	MW=
													%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE

STACK SAMPLING DATA SHEET

CLIENT Richmond Power & Light	TEST DATE 9-2-92	ORIFICE CORRECTION 1.985	HOT BOX NO. 7
TEST UNIT Richmond IN.	TEST NO. ICF-BRE-C3	METER CORRECTION 0.9617	COLD BOX NO. 7
PROJECT NO. ICF KAISER	NOZZLE (SIZE,#) #37 .240	CALIBRATION DATE 5-20-92	PROBE NO. 10-2 (7-31-92)
CONTROL BOX OPERATOR	STATIC PRESSURE +1.1	PITOT CORRECTION 0.84	FILTER NO. 892
BAROMETRIC PRESSURE 29.06	PORT DIRECTION A→B→C→D	CONTROL BOX NO. 6	STACK DIA. 126x84

Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Req'd. (in. H2O)	Orifice ΔH Act. (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°C/°F)	Hot Box Temp. (°F)	Comments
A			.76										3min/PT
105	1412	352.453	.86	1.99	1.79	79	75	8.0	339	254	60	239	
63			.61	1.43	1.43	84	75	7.0	332	263	58	245	
21	1421	358.256	.30	.71	.71	89	75	4.0	329	256	58	253	
B													
105	1422	358.256	.73	1.72	1.72	90	77	8.0	333	255	59	255	
63			.57	1.34	1.34	97	79	6.5	335	252	60	255	
21	1431	364.208	.34	.80	.80	99	80	4.0	338	255	61	256	
C													
105	1432	364.208	.66	1.55	1.55	97	80	7.0	332	251	60	255	
63			.60	1.41	1.41	103	82	6.5	335	254	61	253	
21	1441	370.141	.41	.96	.96	104	82	5.0	336	250	63	256	
D													
105	1442	370.141	.69	1.62	1.62	102	84	7.0	337	248	63	256	
63			.10	.24	.24	100	85	1.0	338	246	63	250	Estimates:
21	1451	375.515	.56	1.32	1.32	105	85	6.0	338				MW= 29.5
													%H2O= 8.0

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before	6.0	.014
After	11.5	.011

PITOT LEAK CHECK

	Positive	Negative
Before	OK 15sec	OK 15sec
After	OK 15sec	OK 15sec

CEM Results

	1	2
CO2	14.7	
O2	4.2	
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.	100ml H2O	594.0	519.8	74.2
2.	100ml H2O	577.8	566.3	11.5
3.	Dry	443.3	442.2	1.1
4.	Silicel	660.6	649.0	11.6
5.				

KEYSTONE ENVIRONMENTAL RESOURCES INC

STACK SAMPLING DATA SHEET

CLIENT Richmond Power & Light	TEST DATE 9-2-92	ORIFICE CORRECTION 1.885	HOT BOX NO. 7
TEST UNIT Richmond IN	TEST NO. ICF-BR5-C3	METER CORRECTION 96.7	COLD BOX NO. 7
PROJECT NO. ICF Kaiser	NOZZLE (SIZE,#)	CALIBRATION DATE 5-20-92	PROBE NO. 10-2
CONTROL BOX OPERATOR	STATIC PRESSURE	PITOT CORRECTION 84	FILTER NO. 892
BAROMETRIC PRESSURE	PORT DIRECTION E→F→G→H	CONTROL BOX NO. 6	STACK DIA. 126x84

Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Req'd. (in. H2O)	Orifice ΔH Act. (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°C/°F)	Hot Box Temp. (°F)	Comments
E													
105	1452	375.515	.67	1.58	1.58	105	87	7.0	339	251	63	250	3m/PT
63			.28	.66	.66	104	89	3.0	336	253	63	252	
21	1501	381.124	.68	1.60	1.60	108	89	7.0	335	246	61	250	
F													
105	1507	381.124	.48	1.13	1.13	103	89	5.0	340	248	59	246	
63			.80	1.88	1.88	109	89	8.0	335	248	57	246	
21	1511	387.104	.74	1.74	1.74	110	89	8.0	337	251	57	241	
G													
105	1517	387.104	.54	1.27	1.27	104	89	6.0	337	246	57	248	
63			.80	1.88	1.88	110	90	8.0	336	248	57	250	
21	1521	393.149	.67	1.58	1.58	111	90	7.0	335	251	60	248	
to H													
105	1527	393.149	.48	1.13	1.13	101	91	5.0	333	250	61	251	
63			.65	1.57	1.57	111	92	7.0	335	248	61	246	Estimates:
21	1531	398.614	.52	1.25	1.25	112	91	6.0	330	251	61	246	MW=
													%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE ENVIRONMENTAL RESOURCES INC

APPENDIX E

PRODUCTION INFORMATION

LIFAC NA DEMONSTRATION PROJECT
RICHMOND POWER AND LIGHT
WHITEWATER VALLEY GENERATING UNIT #2

BASELINE ENVIRONMENTAL REPORT
SUMMARY OF SUPPLEMENTAL MONITORING

ICF KAISER ENGINEERS, INC.
PITTSBURGH, PA

TIME	GENERATOR No. 1 Temp T	Temp P	Amps 1	Amps 2	Amps 3	MW	MVAR (-) In	KV	Field Amps	MWH Meter Reads	MWH Meter MWH	GENERATOR No. 2 Temp T	Temp P	Amps 1	Amps 2	Amps 3	MW	MVAR (-) In	KV	Field Amps	MWH Meter Reads	MWH Meter MWH	IMP GEN	INDIANA & MICH MW (-) Out	Reads X.1	MW
12:00 M										361750											98425.1				1778.2	
1:00	58	2	600	550	600	15	0	14.7	235	361899	14.9	57	9	2250	2200	2250	56	0	14.7	525	984832	58.1		4	17833	5
2:00	58	2	590	550	600	15	0	14.7	240	362049	15.0	57	9	2020	1990	2030	51	0	14.7	500	985352	52.0		7	17897	6
3:00	57	2	590	550	600	15	0	14.7	240	362198	14.9	57	9	2000	1900	2000	50	0	14.7	495	985858	50.6		7	17968	7
4:00	57	2	590	550	600	15	0	14.7	240	362349	15.1	57	9	2000	1900	2000	50	0	14.7	495	986351	49.3		7	18040	7
5:00	57	2	600	560	600	15	1.0	14.7	250	362498	14.9	57	9	2000	1910	2000	50	0	14.7	500	986851	50.0		8	18131	9
6:00	58	2	780	750	780	19	1.0	14.7	260	362668	17.0	57	9	2010	1970	2010	56	2.0	14.7	505	987361	51.0		6	18225	9
7:00	60	2	950	900	950	24	1.5	14.7	280	362883	21.5	60	9	2360	2290	2350	60	3.0	14.7	560	987941	58.0		10	18315	9
8:00	69	2	1130	1100	1130	27	2.0	14.7	300	363154	27.1	60	9	2590	2500	2590	65	4.0	14.7	600	988575	63.4		8	18404	8
9:00	66	2	1240	1200	1240	30	2.5	14.7	320	363453	29.9	61	9	2600	2500	2600	65	4.0	14.7	600	989274	65.9		8	18494	9
10:00	68	2	1270	1250	1270	31	1.5	14.7	320	363771	31.8	62	9	2600	2510	2600	65	3.0	14.7	600	989885	65.1		12	18613	11
11:00	68	2	1270	1250	1270	31	1.5	14.7	320	364090	31.9	62	9	2600	2510	2600	65	4.0	14.7	600	990529	65.4		14	18756	14
12:00N	68	2	1270	1250	1270	31	1.0	14.7	320	364408	31.8	62	9	2600	2510	2600	65	3.0	14.7	600	991190	65.1		10	18882	12
1:00	69	2	1270	1240	1260	31	2.0	14.7	320	364723	31.5	62	9	2580	2500	2550	65	4.0	14.7	600	991836	64.6		14	19037	15
2:00	69	2	1240	1210	1240	30	1.5	14.7	320	365035	31.2	63	9	[illegible]	[illegible]	2560	65	4.0	[illegible]	[illegible]	992475	65.9		11	19176	14
3:00	69	2	1260	1240	1260	31	1.5	14.7	330	365349	31.4	63	9	2590	2510	2600	65	2.5	14.7	585	993140	65.0		13	19315	13
4:00	70	2	1230	1250	1260	31	1.0	14.7	315	365660	31.1	63	9	2590	2510	2590	65	1.0	14.7	585	993789	64.9		9	19427	1
5:00	70	2	1250	1210	1250	30	.5	14.7	310	365971	31.1	63	9	2540	2490	2550	65	1.0	14.7	580	994446	65.1		10	19524	
6:00	68	2	1200	1160	1210	30	.5	14.7	305	366280	30.9	63	9	2580	2500	2570	65	1.0	14.7	585	995087	64.7		9	19612	8
7:00	67	2	1220	1190	1230	30	1.0	14.7	310	366582	30.2	62	9	2550	2510	2580	65	1.5	14.7	585	995740	65.3		6	19690	7
8:00	67	2	1220	1190	1230	30	.5	14.7	310	366883	30.6	62	9	2570	2500	2580	65	2.0	14.7	585	996389	64.9		7	19770	8
9:00	66	2	1060	1040	1080	26	1.0	14.7	275	367161	27.3	63	9	2580	2500	2520	65	2.0	14.7	590	997039	65.0		9	19861	9
10:00	64	2	920	890	940	22	1.5	14.7	270	367414	25.3	62	9	2520	2440	2540	63	1.5	14.7	580	997680	64.1		7	19941	8
11:00	60	2	700	650	700	17	-.8	14.7	245	367594	18.0	60	9	2430	2350	2450	61	0	14.7	560	998300	62.0		6	10026	8
12:00	59	2	690	650	700	17	-.4	14.7	252	367768	17.4	58	9	2180	2100	2180	55	1.5	14.7	530	998877	57.7		7	10097	7
TOTAL										6018	601.8										14626	14626			231.5	23

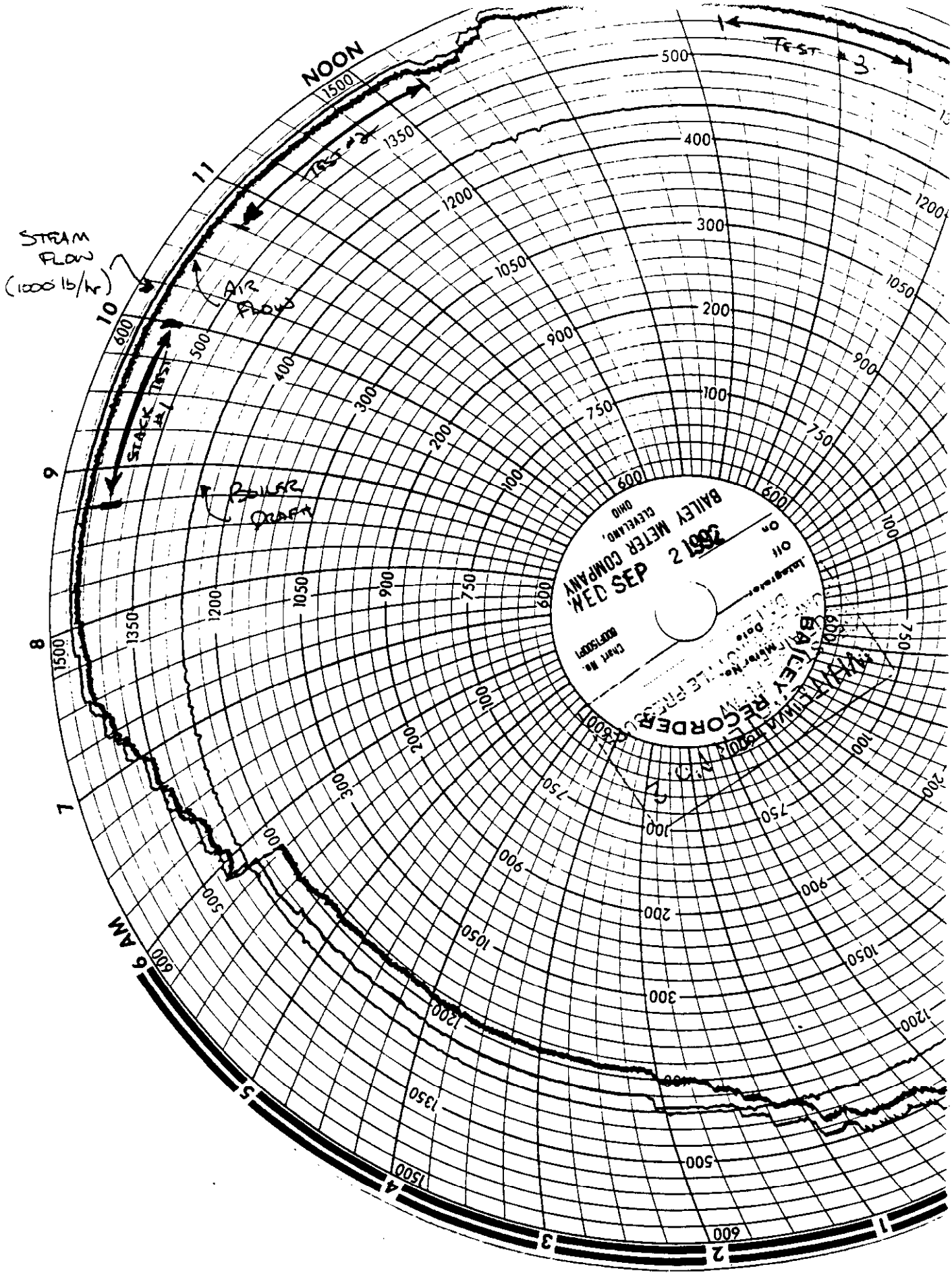
Operator	Engineer	Dn	OM		Maximum Instantaneous MW	Time	Maximum Instantaneous MW	Time	Maximum MWH	MDOT	24 Hour Gross MWH Delivered	System Maximum Net MWH	Time	Time Weather Report
[illegible]	[illegible]	[illegible]	[illegible]	INPA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
				IMP	[illegible]	0016	93.0	0815	7.0	1100	2247.4	86.0	1100	
				T&M	1.9	0016	17.0	1008	1.5	1500	231.5	15.5	1500	
				SYSTEM	69.0	0245	113.2	1008	111.6	1100	2295.9	104.25	1300	

LOG ALL UNUSUAL CONDITIONS IN SPACE BELOW — "DON'T SAY IT — WRITE IT"

24 Hr Firm Sch. - 192.0

~~Short Term~~ - 28.0

Reserve


NOON
6 AM
STEAM FLOW (1000 lb/hr)
AIR FLOW
BOILER DRAFT
STACK TEST #1
TEST #2
TEST #3
BAILEY RECORDER
BAILEY METER COMPANY
CLEVELAND, OHIO
WED SEP 2 1992

ICF K[redacted]
FOUR [redacted]
PITTS[redacted]222-1207
(412) [redacted]-2000 (as of 2/25/91)
TELEX: [redacted]
FAX: 412[redacted]
FAX: 41[redacted] (as of 2/25/91)

FAX NO: 497-2312

DATE: 9/17/92

KE REF: 91001

PAGE 1 OF 1

COMPANY/LOCATION: ICF KE

ATTENTION: JOHN KANE

FROM: [redacted] EASLER

DEPT:

** [redacted]TIFY RECEPTIONIST IF TRANSMISSION IS INCOMPLETE/ILLEGIBLE. **

MESSAGE

SUBJ: [redacted]ED DATA -

TIME	COAL FEED (lb/min)	UNIT OUTPUT (MW)
8-9 [redacted]	1059	65
9-10 [redacted]	1000	65
10-[redacted]	1017	65
11-[redacted]	1010	65
12-[redacted]	1014	65
1-[redacted]	1045	65
2-[redacted]	1010	65
3-[redacted]	1026	65

MONTH Sept '92' NO. L-40

COAL ANALYSIS

WHITEWATER VALLEY STATION

COMPANY [redacted]

SPECIAL COMMENTS: [redacted]

Btu's Received: 11,352 Btu's/lb.

Btu's Dry: 13,104 Btu's/lb.

Moisture: 13.37 % (As Received)

Ash: 8.38 % (As Received)

Sulfur: 2.19 %(As Rec'd) 2.52 % Dry)

SOURCE OF SAMPLE: Feeder's

DATE SAMPLE TAKEN: 9-2-1992

DATE RUN: 9-23-1992

BY: B.L.RV

TONS BURNED _____

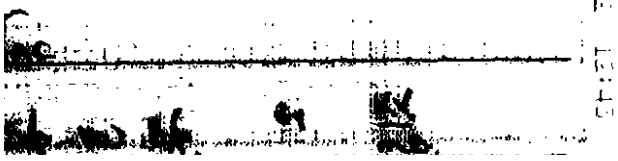
MMBtu's _____

By _____

MONTH Sept 92 NO. L-41

DAL ANALYSIS

FER VALLEY STATION



10 OCT 1992 13:45

Branch Code 44

Lab. No. 40446

Date Rec'd 09/28/92

Date Sampled --------

Sampled By YOURSELVES

STANDARD LABORATORIES, INC.

TAMPELLA POWER CORPORATION
P.O. BOX 356
RICHMOND, IN. 47374
ATT: RICH [illegible]

SAMPLE IDENTIFICATION

BA-CF-65-[illegible]

	% Moisture	% Ash	% Volatile	% Fixed Carbon	B.T.U./LB	% Sulfur
As Rec'd.	13.[illegible]	[illegible].90	XXXX	XXXX	11343	2.38
Dry Basis	-----	[illegible].24	XXXX	XXXX	13049	2.73
M-A-Free					14537	

NOTE: XXXX INDICATES ANALYSIS WAS NOT PERFORMED

FOR YOUR PROTECTION THIS DOCUMENT HAS SEEN PRINTED ON CONTRACTED PAPER STOCK. NOT VALID IF ALTERED.

Respectfully Submitted,

MARK M. SMITH

STANDARD LABORATORIES, INC.

Branch Code 44

Lab. No 40445

Date Rec'd 09/28/92

Date Sampled --------

Sampled By YOURSELVES

TAMPELLA POWER CORPORATION
P.O. BOX 366
RICHMOND, IN 47374
ATT: RICH EAGLER

SAMPLE IDENTIFICATION

BA-CP-65-09220

	% Moisture	% Ash	% Volatile	% Fixed Carbon	B.T.U./LB.	% Sulfur
As Rec'd.	13.35	9.09	XXXX	XXXX	11366	2.53
Dry Basis	-----	10.49	XXXX	XXXX	13118	2.92
M-A-Free					14656	

NOTE: XXXX INDICATES ANALYSIS WAS NOT PERFORMED

FOR YOUR PROTECTION THIS DOCUMENT HAS BEEN PRINTED ON CONTROLLED PAPER STOCK. NOT VALID IF ALTERED.

Respe[illegible]itted. Mark M. Smith

MARK M. SMITH

ICF KAISER ENGINEERS

PROJECT [illegible] PROJECT NO. [illegible]

COAL FEED & HEAT INPUT PAGE 1 OF 1

MADE BY JK/EEB DATE 9/24/11-9-92 CHECKED BY _____ DATE _____

RUN #1

AVERAGE FEED $\underbrace{\frac{(1059 + 1000)}{2}}_{\text{COAL FEED HOURLY AVE. DURING TEST}}$ lb/min × 60 min/hr = 61,770 lb/hr

= 30.9 TON/hr

HEAT RELEASE 61,770 lb/hr × 11,289 BTU/lb × $\frac{1}{10^6}$ = 697.3 MMBTU/hr

RUN #2

$\frac{(1017 + 1013)}{2}$ lb/min × 60 min/hr = 60,910 lb/hr

60,910 lb/hr × 11,289 BTU/lb × $\frac{1}{10^6}$ = 686.5 MMBTU/hr

RUN #3

$\frac{(1013 + 1026)}{2}$ lb/min × 60 min/hr = 61,090 lb/hr

61,090 lb/hr × 11,289 BTU/lb × $\frac{1}{10^6}$ = 689.5 MMBTU/hr

Average coal heating value = $\frac{11352 + 11271 + 11245}{3}$ = 11289 BTU/lb

APPENDIX F

PARTICULATE MATTER SAMPLING EQUIPMENT CALIBRATIONS

LIFAC NA DEMONSTRATION PROJECT
RICHMOND POWER AND LIGHT
WHITEWATER VALLEY GENERATING UNIT #2

BASELINE ENVIRONMENTAL REPORT
SUMMARY OF SUPPLEMENTAL MONITORING

ICF KAISER ENGINEERS, INC.
PITTSBURGH, PA

CONTROL BOX CALIBRATION

THREE POINT CALIBRATION

BOX # 6 BP 29.2 in. Hg
DATE 05-20-92 OPERATOR RPC

	WET TEST METER				DRY TEST METER					METER COEFFICIENT Y	ORIFICE COEFFICIENT ΔH@
	TIME (min)	TEMP TW	VOLUME VM	PRESSURE PW	TEMP IN TI	TEMP OUT TO	TEMP AVG TA	ORIFICE PD	VOLUME VD		
START			0.000	29.20				0.50	777.500		
HALF		72.0			94.0	83.0	88.5				
STOP	13.40		5.000						782.822		
CALCULATION	13.40	532.0	5.013	29.20			548.5	29.24	5.322	0.9698	2.002
START			0.000	29.20				1.00	783.500		
HALF		72.0			96.0	85.0	90.5				
STOP	9.46		5.000						788.954		
CALCULATION	9.46	532.0	5.013	29.20			550.5	29.27	5.454	0.9486	1.988
START			0.000	29.20				2.00	789.800		
HALF		72.0			109.0	89.0	99.0				
STOP	6.70		5.000						795.222		
CALCULATION	6.70	532.0	5.013	29.20			559.0	29.35	5.422	0.9665	1.964
AVERAGE										0.9617	1.985

POST TEST

BOX # 6 BP 28.95 in. Hg
DATE 9-3-92 OPERATOR RPC

	WET TEST METER				DRY TEST METER					METER COEFFICIENT	ORIFICE COEFFICIENT
	TIME (min)	TEMP TW	VOLUME VM	PRESSURE PW	TEMP IN TI	TEMP OUT TO	TEMP AVG TA	ORIFICE PD	VOLUME VD	Y	ΔH@
START			0.000	28.95				1.30	418.400		
HALF		75.0			104.0	86.0	95.0				
STOP	8.23		5.000						423.796		
CALCULATION	8.23	535.0	5.013	28.95			555.0	29.05	5.396	0.9605	1.979
START			0.000	28.95				1.30	424.175		
HALF		75.0			108.0	87.0	97.5				
STOP	8.16		5.000						429.517		
CALCULATION	8.16	535.0	5.013	28.95			557.5	29.05	5.342	0.9746	1.937
START			0.000	28.95				1.30	429.650		
HALF		75.0			110.0	90.0	100.0				
STOP	8.15		5.000						434.988		
CALCULATION	8.15	535.0	5.013	28.95			560.0	29.05	5.338	0.9797	1.923
AVERAGE										0.9716	1.946
DIFFERENCE										-1.02%	1.96%

PRE-TEST MAGNEHELIC CALIBRATION

BOX# 6
DATE 05-20-92
OPERATOR RPC

0 to 10" H2O RANGE

MAGNEHELIC Δ P	MANOMETER
0.50	0.50
1.00	1.00
2.00	2.00
4.00	4.00
6.00	6.00
8.00	8.00

0 to 0.50" H2O RANGE

MAGNEHELIC Δ P	MANOMETER
0.50	0.50
0.40	0.40
0.30	0.30
0.20	0.20
0.10	0.10

0 to 5" H2O RANGE

MAGNEHELIC Δ H	MANOMETER
4.00	4.00
3.00	3.00
2.00	2.00
1.00	1.00
0.50	0.50

PRE-TEST LEAK CHECK

DATE 05-20-92
OPERATOR RPC

	START CF	STOP CF	VOLUME CF	TIME (min)	LEAK RATE
DRY	776.425	776.572	0.147	10.000	-0.002
WET	0.000	0.131	0.131		

PYROMETER CALIBRATION

DATE 04-28-88
OPERATOR AGL

VOLTAGE INPUT (mV)	TARGET TEMP (°F)	TEMP READING (°F)
0.18	40	40.0
0.40	50	50.0
0.84	70	70.0
1.29	90	90.0
1.74	110	110.0
2.66	150	150.0
3.82	200	200.0
6.09	300	301.0
8.31	400	400.0
10.57	500	500.0

PRE-TEST PYROMETER CHECK

DATE 05-20-92
OPERATOR RPC

VOLTAGE INPUT (mV)	TARGET TEMP (°F)	TEMP READING (°F)
0.18	40	41.0
0.40	50	51.0
0.84	70	70.0
1.29	90	90.0
1.74	110	110.0
2.66	150	150.0
3.82	200	200.0
6.09	300	300.0
8.31	400	399.0
10.57	500	500.0

POST-TEST MAGNEHELIC CALIBRATION

BOX# 6
DATE 9-3-92
OPERATOR RPC

0 to 10" H2O RANGE

MAGNEHELIC Δ P	MANOMETER
0.50	0.50
1.00	1.00
2.00	2.00
4.00	4.00
6.00	6.00
8.00	8.00

0 to 0.50" H2O RANGE

MAGNEHELIC Δ P	MANOMETER
0.50	0.50
0.40	0.40
0.30	0.30
0.20	0.20
0.10	0.10

0 to 5" H2O RANGE

MAGNEHELIC Δ H	MANOMETER
4.00	4.00
3.00	3.00
2.00	2.00
1.00	1.00
0.50	0.50

POST-TEST LEAK CHECK

DATE 9-3-92
OPERATOR RPC

	START CF	STOP CF	VOLUME CF	TIME (min)	LEAK RATE
DRY	417.600	417.930	0.330	10.000	-0.002
WET	0.000	0.310	0.310		

PYROMETER CALIBRATION

DATE 04-28-88
OPERATOR AGL

VOLTAGE INPUT (mV)	TARGET TEMP (°F)	TEMP READING (°F)
0.18	40	40.0
0.40	50	50.0
0.84	70	70.0
1.29	90	90.0
1.74	110	110.0
2.66	150	150.0
3.82	200	200.0
6.09	300	301.0
8.31	400	400.0
10.57	500	500.0

POST-TEST PYROMETER CHECK

DATE 9-3-92
OPERATOR RPC

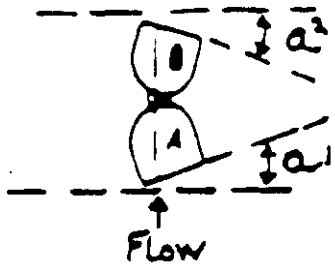
VOLTAGE INPUT (mV)	TARGET TEMP (°F)	TEMP READING (°F)
0.18	40	40.0
0.40	50	50.0
0.84	70	70.0
1.29	90	90.0
1.74	110	110.0
2.66	150	150.0
3.82	200	202.0
6.09	300	302.0
8.31	400	402.0
10.57	500	502.0

GEOMETRIC PITOT CALIBRATION

Caliper # YLF-59
Precheck ✓
Post Check

Probe #: 10-2
Date: 7-31-92
Initials: [illegible]

①

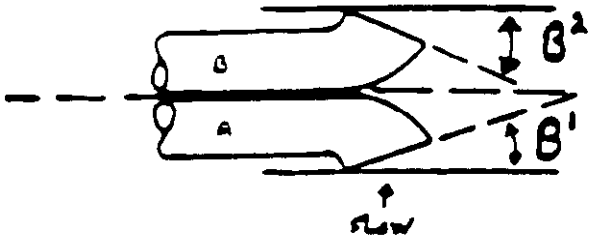


a^1 = 4.5°
a^2 = 0°
a^1, a^2 = <10°

B^1 = 0.5°
B^2 = 0.5°
B^1, B^2 = <5°

F = 0.909"

②



μ = 0 — μ = ≤ 0.1250" (μ = F TAN γ)

V = 0 — V = ≤0.03125" (V = F TAN θ)

W = 0.221 — W ≥ 0"

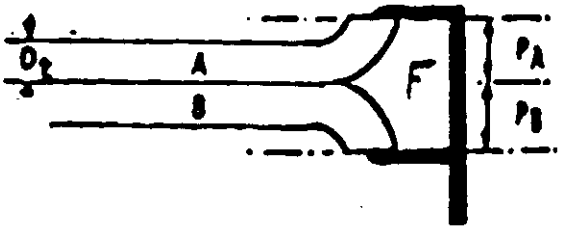
X = 0.954 — X ≥ 0.750" (3/4" using 1/2" nozzle)

Y = 5.761 — Y ≥ 3.0"

Z = 2.771 — Z > 2.0"

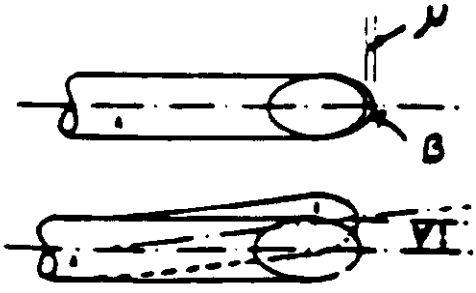
D_t = 0.375 — D_t > .1875" to .375" (3/16" to 3/8")

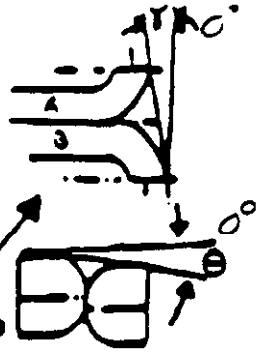
③



1.05 D_t < A < 1.50 D_t
P_A = P_B
2.10 D_t < A < 3.00 D_t

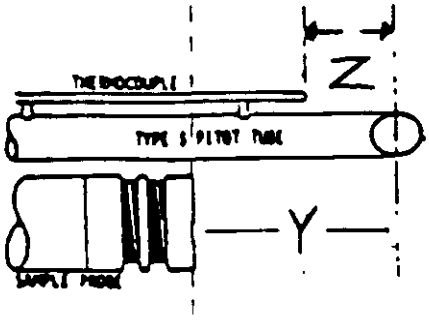
④





(γ, θ EXPRESSED IN DEGREES)

⑥



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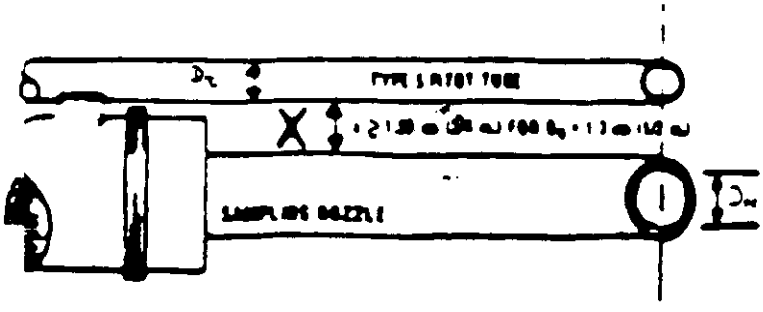

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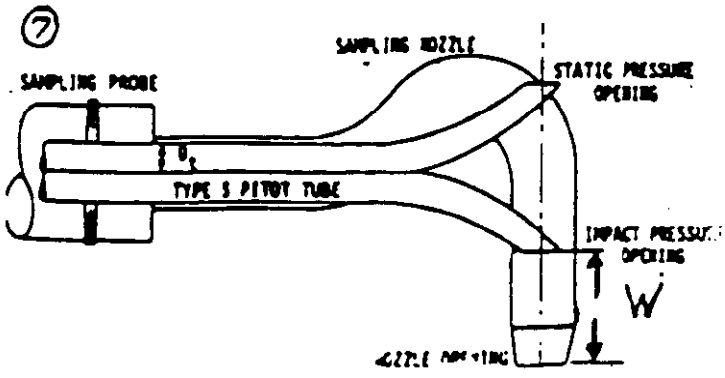
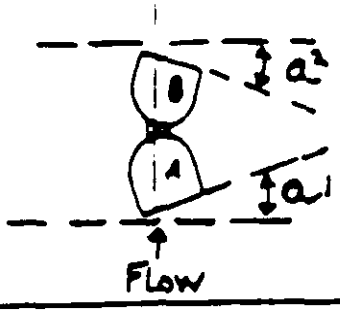


GEOMETRIC PITOT CALIBRATION

Caliper # XEF-59
Precheck
Post Check X

Probe #: 10-2
Date: 9-10-92
Initials: [illegible]

①



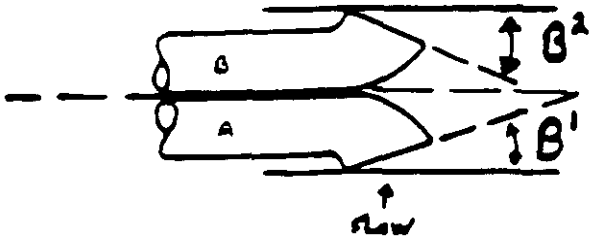
a¹ = 40°
a² = 1.0°
B¹ = 0°
B² = 0°

a¹, a² = <10°

B¹, B², = <5°

F = 0.909"

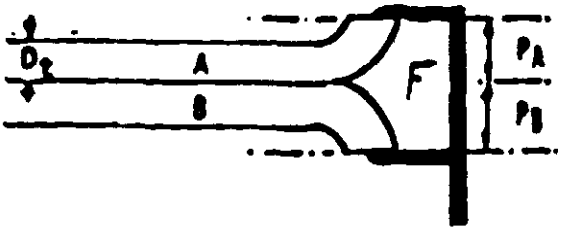
②



β = 0.0159" β = ≤ 0.1250" (β = F TAN γ
V = Ø V = ≤0.03125" (V = F TAN
W = 0.328 W ≥ 0"

X = 1.048 X ≥ 0.750" (3/4" using 1/2" nozzle)

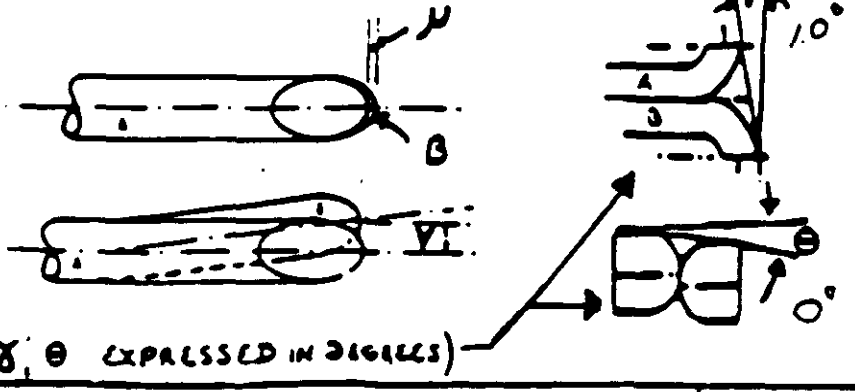
③



1.05 D_t < l < 1.50 D_t
P_A = P_B
2.10 D_t < l < 3.00 D_t

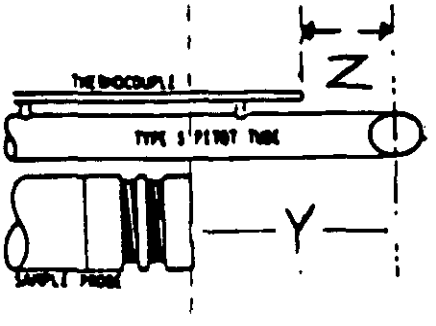
Y = 5.608 Y ≥ 3.0"
Z = 2.270 Z > 2.0"
D_t = 0.375 D_t > .1875" to .375" (3/16" to 3/8")

④



(γ, θ EXPRESSED IN DEGREES)

⑥



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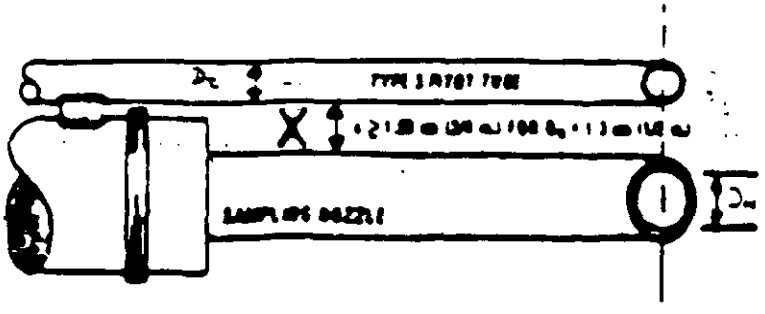

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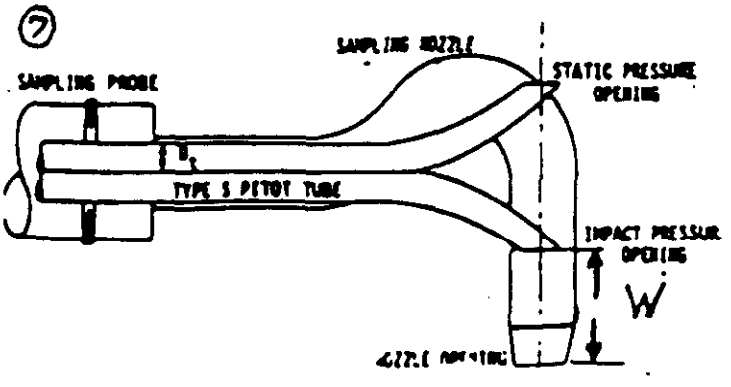
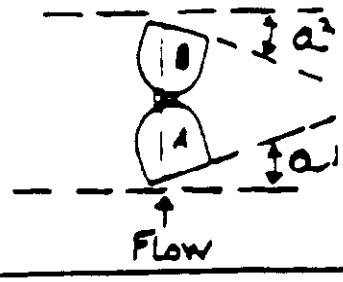


GEOMETRIC PITOT CALIBRATION

Caliper # XCF-59
Precheck ✓
Post Check

Probe #: 10-1
Date: 4-24-92
Initials: TJM

①

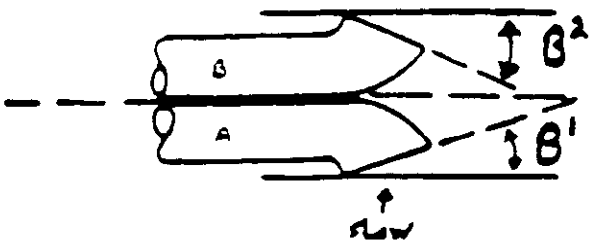


a¹ = 1.0°
a² = 0.5°
a¹, a² = <10°

B¹ = 2.0°
B² = 3.0°
B¹, B², = <5°

F = 0.942"

②



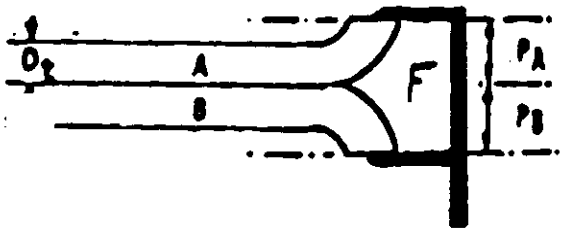
μ = 0.0494 — μ = ≤ 0.1250" (μ = F TAN γ)

V = 0.0167 — V = ≤0.03125" (V = F TAN θ)

W = 0.105 — W ≥ 0"

X = 0.776 — X ≥ 0.750" (3/4" using 1/2" nozzle)

③



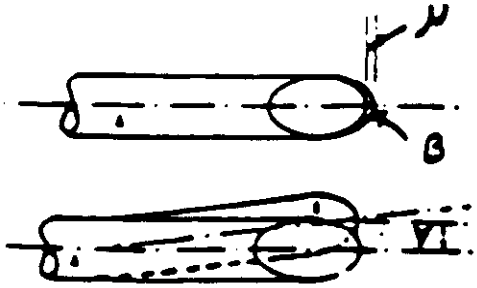
1.05 D_t < d < 1.50 D_t
P_A = P_B
2.10 D_t < A < 3.00 D_t

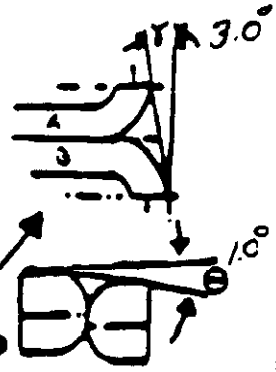
Y = 5.996 — Y ≥ 3.0"

Z = 2.438 — Z > 2.0"

D_t = 0.375 — D_t > .1875" to .375" (3/16" to 3/8").

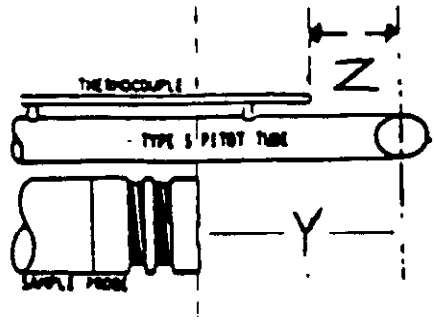
④



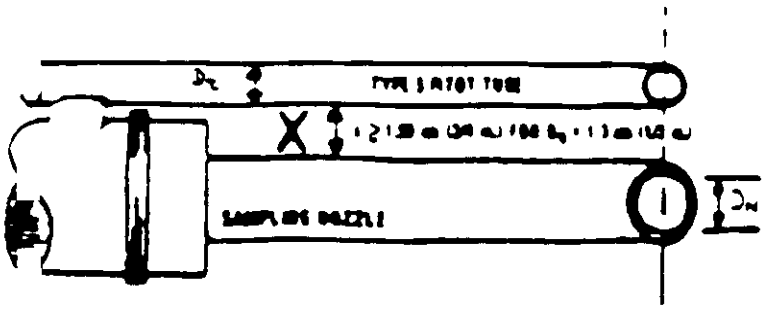


(γ, θ EXPRESSED IN DEGREES)

⑥



⑤



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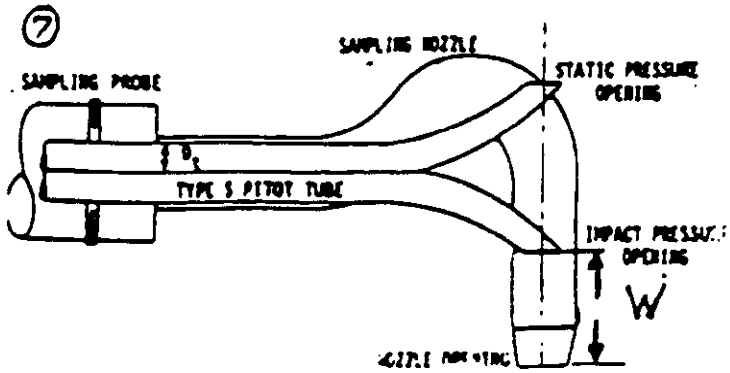
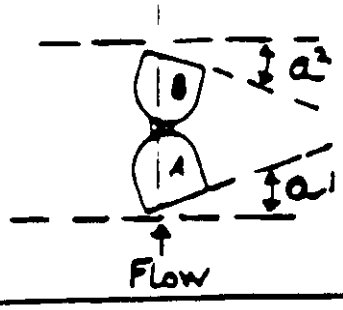


GEOMETRIC PITOT CALIBRATION

Caliper # XCF-59
Precheck
Post Check K

Probe #: 10-1
Date: 9-10-92
Initials: [illegible]

①

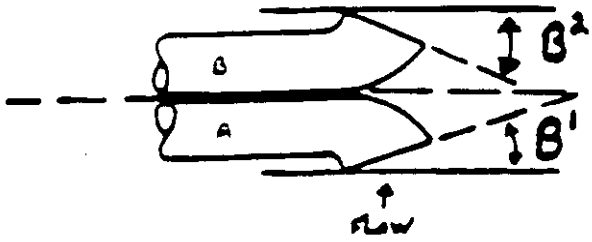


a^1 = 1.0°
a^2 = 0.5°
a^1, a^2 = <10°

B^1 = 4.0°
B^2 = 3.0°
B^1, B^2, = <5°

F = 0.970"

②



μ = 0.0169" μ = ≤ 0.1250" (μ = F TAN γ)

V = 0.0169" V = ≤0.03125" (V = F TAN θ)

W = 0.408 W ≥ 0"

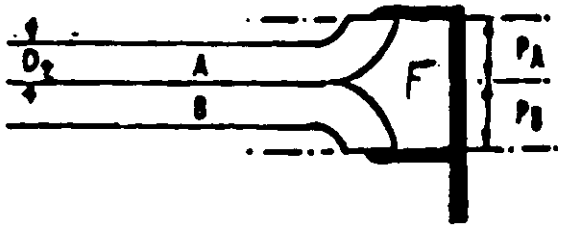
X = 0.783 X ≥ 0.750" (3/4" using 1/2" nozzle)

Y = 6.138 Y ≥ 3.0"

Z = 2.980 Z > 2.0"

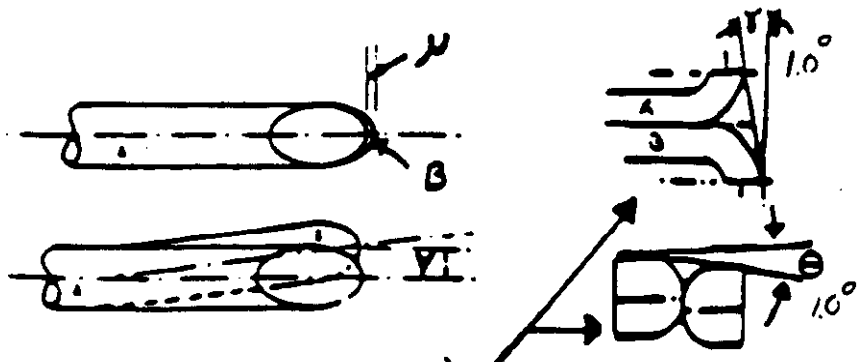
D_t = 0.375 D_t > .1875" to .375" (3/16" to 3/8")

③



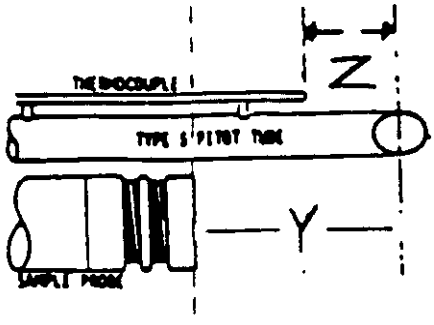
$1.05\ D_t < \phi < 1.50\ D_t$
$P_A = P_B$
$2.10\ D_t < A < 3.00\ D_t$

④

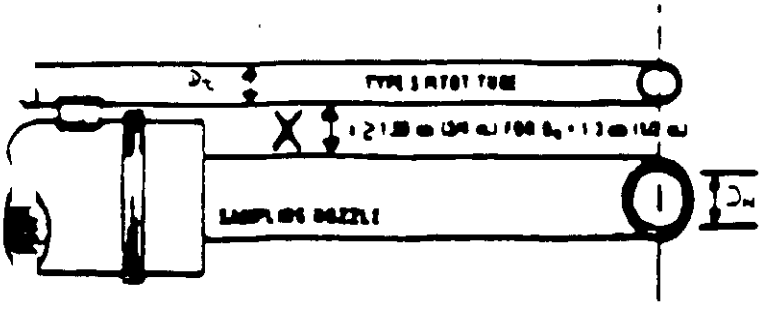


(γ, θ EXPRESSED IN DEGREES)

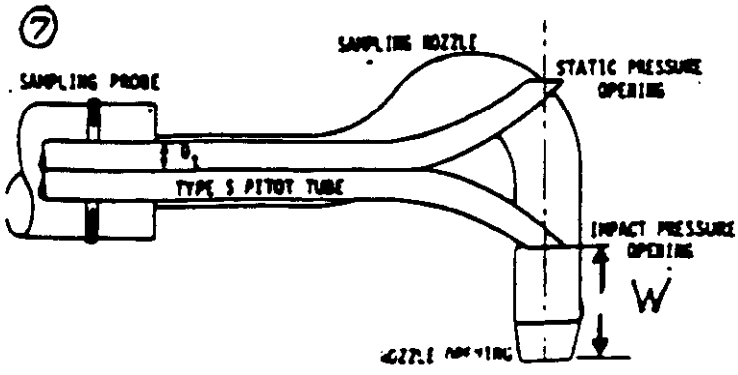
⑥



⑤



⑦



APPENDIX G

PARTICULATE MATTER DATA SHEETS AND CALIBRATIONS
ANALYTICAL RESULTS AND EMISSIONS CALCULATIONS
ESP OUTLET LOCATION

LIFAC NA DEMONSTRATION PROJECT
RICHMOND POWER AND LIGHT
WHITEWATER VALLEY GENERATING UNIT #2

BASELINE ENVIRONMENTAL REPORT
SUMMARY OF SUPPLEMENTAL MONITORING

ICF KAISER ENGINEERS, INC.
PITTSBURGH, PA

ICF KAISER ENGINEERS, INC.
PITTSBURGH, PA

PARTICULATE MATTER AND SULFURIC ACID EMISSION RESULTS TESTING CONDUCTED AT RICHMOND POWER AND LIGHT

FIELD DATA SHEETS AND CALIBRATION RESULTS

CHESTER
ENVIRONMENTAL

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT ICF Kaiser Engineers	TEST DATE 12-18-92	ORIFICE CORRECTION (ΔH@) 1.724	HOT/COLD BOX NO. 5
TEST UNIT Richmond P&L	TEST NO. ICF-BRC-1	METER CORRECTION (Y) 1.0094	PROBE NO. 15-1
PROJECT NO. 399610-004	NOZZLE (SIZE,#) 0.240 #37	CALIBRATION DATE 11-12-92	FILTER NO. 958
TEST CREW TM, RC, JS	STATIC PRESSURE −0.40"	PITOT CORRECTION 0.84	STACK DIA. 8' x 10.5'
BAROMETRIC PRESSURE 29.22	PORT DIRECTION D, C	CONTROL BOX NO. 3	PORT SIZE [96" x 126"]

	Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
	115.5	0650	898.235	0.30	0.58	0.58	65	65	3.5	234	250	<68°F	250°	2.5 min./point
	94.5			0.45	0.86	0.86	67	63	5.3	236				
D	73.5			0.50	0.96	0.96	68	61	6.5	232				#1 unit down
	52.5			0.75	1.44	1.44	69	59	10.5	229				
	31.5			0.80	1.53	1.53	67	58	12.0	231				
	10.5	0705	907.502	0.40	0.77	0.77	66	56	6.0	228				
	115.5	0709	907.502	0.35	0.77	0.77	60	53	5.0	209				
	94.5			0.55	1.22	1.22	63	52	8.7	207				
C	73.5			0.20	0.44	0.44	62	51	3.1	206				
	52.5			0.90	1.99	1.99	64	51	16.0	210				
	31.5			0.90	1.99	1.99	59	49	16.0	216				
	10.5	0724	917.900	0.75	1.66	1.66	58	49	13.3	221				
														Estimates:
														MW= 29.4
														%H2O= 10%

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before	5.0	0.029
After	16.0	[redacted]

JB

0.050

PITOT LEAK CHECK

	Positive	Negative
Before	OK 15sec	OK 15sec
After	OK 15sec	OK 15sec

GAS	1	2
CO2	14.0	
O2	6.0	
CO	0.0	
N2	80.0	

Impinger No.	Impinger Contents	Final	Initial	Difference
1.	100mL Isopropyl Alcohol	449.0	472.7	−23.7
2.	100mL H_2O_2	604.8	562.4	42.4
3.	100mL H_2O_2	597.3	572.9	24.4
4.	Silica Gel	660.1	634.0	26.1
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT ICF Kaiser Engineers	TEST DATE 12-18-92	ORIFICE CORRECTION (ΔH@) 1.724	HOT/COLD BOX NO. 5
TEST UNIT Richmond PFL	TEST NO. ICF-BRE-1	METER CORRECTION (Y) 1.0094	PROBE NO. 15-1
PROJECT NO. 399610-084	NOZZLE (SIZE,#) 0.240 #37	CALIBRATION DATE 11-12-92	FILTER NO. 958
TEST CREW TM, RC, JS	STATIC PRESSURE -0.40"	PITOT CORRECTION 0.84	STACK DIA. 8' x 10.5'
BAROMETRIC PRESSURE 29.22	PORT DIRECTION B, A	CONTROL BOX NO. 3	PORT SIZE [96" x 126"]

	Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
	115.5	0727	917.900	0.43	0.95	0.95	57	47	7.0	210	250	<68F	250	2.5 min./point
	94.5			0.60	1.33	1.33	60	47	11.0	215				
B	73.5			0.60	1.31	1.31	61	47	11.0	214				#1 unit down
	52.5			0.01	0.02	0.02	56	46	1.0	209				
	31.5			0.70	1.53	1.53	61	46	13.0	207				
	10.5	0742	926.455	0.45	0.98	0.98	61	46	8.0	203				
	115.5	0744	926.455	0.40	0.87	0.87	58	45	6.2	193				
	94.5			0.40	0.87	0.87	60	45	6.2	201				
	73.5			0.80	1.74	1.74	62	45	16.0	207				
A	52.5			0.65	1.42	1.42	60	46	12.0	207				
	31.5			0.40	0.87	0.87	60	46	6.5	205				
	10.5	~~0747~~	935.823	0.22	0.48	0.48	60	46	3.8	204				
		0759	↑											Estimates:
		JB/												MW= 29.4
			corrected value = 934.023											%H2O= 10%

SYSTEM LEAK CHECK for excess leak rate

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT ICF Kaiser Engineers	TEST DATE 12-18-92	ORIFICE CORRECTION (ΔH@) 1.724	HOT/COLD BOX NO. 2
TEST UNIT Richmond RFL	TEST NO. ICF-BRE-2	METER CORRECTION (Y) 1.0094	PROBE NO. 15-1
PROJECT NO. 399610-024	NOZZLE (SIZE,#) 0.240 # 37	CALIBRATION DATE 11-12-92	FILTER NO. 955
TEST CREW TM, RC, JB	STATIC PRESSURE -0.40"	PITOT CORRECTION 0.84	STACK DIA. 8' x 10.5'
BAROMETRIC PRESSURE 29.22	PORT DIRECTION D, C	CONTROL BOX NO. 3	PORT SIZE [96" x 126"]

	Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
	115.5	1445	937.087	0.40	0.76	0.76	44	35	3.0	336	250°	48°	250°	2.5 min./point
	94.5			0.35	0.66	0.66	46	36	2.5	340				
D	73.5			0.55	0.99	0.99	51	37	4.0	342				
	52.5			0.85	1.55	1.55	56	39	6.1	342				
	31.5			0.70	1.27	1.27	58	40	5.2	342				
	10.5	1500	946.117	0.60	1.09	1.09	59	41	5.0	324				
	115.5	1502	946.117	0.65	1.18	1.18	58	42	5.0	337				
	94.5			0.70	1.29	1.29	62	44	5.0	343				
	73.5			0.80	1.47	1.47	65	45	5.8	342				
C	52.5			0.95	1.76	1.76	67	46	7.0	344				
	31.5			0.90	1.67	1.67	67	47	6.9	344				
	10.5	1517	956.811	0.85	1.58	1.58	68	48	6.5	343				
														Estimates:
														MW=29.4 49
														%H2O= 10% 5%

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before	5.0	0.016
After	7.0	0.016

PITOT LEAK CHECK

	Positive	Negative
Before	OK 15sec	OK 15sec
After	OK 15sec	OK 15sec

GAS	1	2
CO2	14.0	
O2	6.0	
CO	0.0	
N2	80.0	

Impinger No.	Impinger Contents	Final	Initial	Difference
1.	100mL Impinger/Alcohol	539.1	551.1	-12.0
2.	100mL H_2O_2	602.8	563.8	39.0
3.	100mL H_2O_2	512.8	486.7	26.1
4.	Silica Gel	687.7	658.4	29.3
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT ICF Kaiser Engineers	TEST DATE 12-18-92	ORIFICE CORRECTION (ΔH@) 1.724	HOT/COLD BOX NO. 2
TEST UNIT Richmond FHL	TEST NO. ICF-BRE-2	METER CORRECTION (Y) 1.0094	PROBE NO. 15-1
PROJECT NO. 399610-004	NOZZLE (SIZE,#) 0.240 #37	CALIBRATION DATE 11-12-92	FILTER NO. 955
TEST CREW TM, RC, JS	STATIC PRESSURE -0.40"	PITOT CORRECTION 0.84	STACK DIA. 8' x 10.5'
BAROMETRIC PRESSURE 29.22	PORT DIRECTION B, A	CONTROL BOX NO. 3	PORT SIZE [96" x 126"]

	Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
	115.5	1518	956.811	0.85	1.58	1.58	65	48	6.2	341	250°	<68°	250°	2.5 min./point
	94.5			0.80	1.49	1.49	70	49	6.0	344				
B	73.5			0.55	1.02	1.02	66	49	4.0	342				
	52.5			0.40	0.75	0.75	65	50	3.0	343				
	31.5			0.70	1.31	1.31	66	50	5.2	344				
	10.5	1533	966.412	0.55	1.03	1.03	66	50	4.0	343				
	115.5	1534	966.412	0.70	1.31	1.31	64	49	5.2	342				
	94.5			0.80	1.50	1.50	66	50	6.0	343				
A	73.5			0.90	1.69	1.69	67	49	7.0	342				
	52.5			0.65	1.22	1.22	66	49	5.0	343				
	31.5			0.50	0.94	0.94	65	49	4.0	343				
	10.5	1549	976.378	0.35	0.66	0.66	63	49	2.8	341				
														Estimates:
														MW= 29.4
														%H2O= 10%

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT ICF Kaiser Engineers	TEST DATE 12-18-92	ORIFICE CORRECTION (ΔH@) 1.724	HOT/COLD BOX NO. 8
TEST UNIT Richmond PTL	TEST NO. ICF-BRE-3	METER CORRECTION (Y) 1.0094	PROBE NO. 15-1
PROJECT NO. 399610-02 4	NOZZLE (SIZE,#) 0.240 #37	CALIBRATION DATE 11-12-92	FILTER NO. 960
TEST CREW TM, RC, JS	STATIC PRESSURE -0.60"	PITOT CORRECTION 0.84	STACK DIA. 8'×10.5'
BAROMETRIC PRESSURE 29.22	PORT DIRECTION D, C	CONTROL BOX NO. 3	PORT SIZE [96"×126"]

	Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
	115.5	1700	976.868	0.60	1.08	1.08	46	39	11.0	348	250°	<68°	250°	2.5 min./point
	94.5			0.75	1.35	1.35	50	41	14.2	348				
D *	73.5			1.10	1.98	1.40	50	42	18.0	349				
*	52.5			0.90	1.62	1.32	48	42	18.0	348				
	31.5			0.55	0.99	0.99	50	42	10.2	325				
	10.5	1715	986.968	0.55	0.99	0.99	53	42	10.2	322				
	115.5	1716	986.960	0.65	1.18	1.18	54	42	12.8	347				
	94.5			0.60	1.09	1.09	55	42	12.2	349				
	73.5			0.75	1.36	1.36	56	43	17.0	349				
C *	52.5			0.80	1.46	1.35	53	43	18.0	348				
*	31.5			0.90	1.64	1.28	50	43	18.0	348				
	10.5	1731	997.232	0.70	1.27	1.27	49	43	18.0	348				
														Estimates:
														MW=29.4 4%
														%H2O= 10% 15%

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before	5.0	0.018
After	18.0	0.050

PITOT LEAK CHECK

	Positive	Negative
Before	OK 15sec	OK 15sec
After	OK 15sec	OK 15sec

GAS	1	2
CO2	5.0	
O2	14.5	
CO	0.0	
N2	80.5	

Impinger No.	Impinger Contents	Final	Initial	Difference
1.	100mL Isopropyl Alcohol	469.4	490.0	-20.6
2.	100mL H2O	510.3	471.3	39.0
3.	100mL H2O	606.7	585.2	21.5
4.	Silica Gel	732.1	696.7	35.4
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT	JCF Kaiser Engineers	TEST DATE	12-18-92	ORIFICE CORRECTION (▲H@)	1.724	HOT/COLD BOX NO.	8
TEST UNIT	Richmond PTC	TEST NO.	JCF-BE-3	METER CORRECTION (Y)	1.0094	PROBE NO.	15-1
PROJECT NO.	399610-02	NOZZLE (SIZE,#)	0.240 #37	CALIBRATION DATE	11-12-92	FILTER NO.	960
TEST CREW	TM, RC, JS	STATIC PRESSURE	-0.60"	PITOT CORRECTION	0.84	STACK DIA.	8' x 10.5'
BAROMETRIC PRESSURE	29.22	PORT DIRECTION	B, A	CONTROL BOX NO.	3	PORT SIZE	[8" x 126"]

	Traverse Point (inches)	Time	Dry Gas Meter Reading (dcf)	Pitot ▲P (in. H2O)	Orifice ▲H Required (in. H2O)	Orifice ▲H Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
	115.5	1732	997.232	0.70	1.27	1.27	52	42	15.0	346	250	<68°F	250	2.5 min./point
B	94.5			0.80	1.45	1.45	53	42	18.0	348				
	73.5			0.20	0.36	0.36	51	43	3.3	348				
	52.5			0.25	0.45	0.45	53	42	4.0	348				
	31.5			0.60	1.09	1.09	57	43	11.0	347				
	10.5	1747	1005.917	0.40	0.72	0.72	57	43	6.8	347				
	115.5	1748	1005.917	0.60	1.09	1.09	57	43	10.8	346				
	94.5			0.80	1.45	1.45	59	43	16.0	348				
A	73.5			0.80	1.45	1.45	56	44	17.1	348				
	52.5			0.55	0.99	0.99	54	44	10.0	348				
	31.5			0.35	0.63	0.63	56	44	5.7	346				
	10.5	1803	1014.865	0.20	0.36	0.36	56	44	3.0	323				
			↑											Estimates:
														MW= 28.4
			corrected value = 1013.065											%H2O= 10%

SYSTEM LEAK CHECK for excess leak rate

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT ICF Kaiser Engineers	TEST DATE 12-17-92	ORIFICE CORRECTION (ΔH@) —	HOT/COLD BOX NO. —
TEST UNIT Richmond P&L	TEST NO. CYCLONIC FLOW TEST	METER CORRECTION (Y) —	PROBE NO. 15-1
PROJECT NO. 399610-02	NOZZLE (SIZE,#) —	CALIBRATION DATE —	FILTER NO. —
TEST CREW RC, JN, JS	STATIC PRESSURE —	PITOT CORRECTION 0.84	STACK DIA. 8' X 10.5'
BAROMETRIC PRESSURE 29.06	PORT DIRECTION ▷	CONTROL BOX NO. —	PORT SIZE [96" X 126"]

Traverse Point (inches)	Time	~~Dry Gas Meter Reading (dcf)~~	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
120.75	1530	1°	0.56						325				min./point
110.25		1°	0.44										EPA Method 1
99.75		1°	0.56										Section 2.4
89.25		3°	0.50										
78.75		3°	[redacted]	0.56									no units down
68.25		4°	[redacted]	0.72									
57.75		2°	0.84										
47.25		1°	1.10										
36.75		6°	0.94										
26.25		4°	0.78										
15.75		13°	0.46										
5.25		2°	0.48										
		↑											
		yaw angle (degrees)											
													Estimates:
													MW=
		Σ = 41°											%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before	OK 15sec	OK 15sec
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT ICF Kaiser Engineers	TEST DATE 12-17-92	ORIFICE CORRECTION (ΔH@) —	HOT/COLD BOX NO. —
TEST UNIT Richmond P4C	TEST NO. CYCLONE FLOW TEST	METER CORRECTION (Y) —	PROBE NO. 15-1
PROJECT NO. 399610-02	NOZZLE (SIZE,#) —	CALIBRATION DATE —	FILTER NO. —
TEST CREW RC, TM, JS	STATIC PRESSURE —	PITOT CORRECTION 0.84	STACK DIA. 8' x 10.5'
BAROMETRIC PRESSURE 29.06	PORT DIRECTION C	CONTROL BOX NO. —	PORT SIZE [96" x 126"]

Traverse Point (inches)	Time	~~Dry Gas Meter Reading (dcf)~~	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
120.75		1°	0.58						325				min./point
110.25		3°	0.64										EPA Method 1
99.75		6°	0.60										Section 2.4
89.25		2°	0.54										
78.75		2°	0.56										no units down
68.25		1°	0.84										
57.75		6°	0.98										
47.25		9°	0.62										
36.75		2°	0.90										
26.25		7°	0.86										
15.75		7°	0.78										
5.25		7°	0.78										
		↑											
		Yaw angle (degrees)											
													Estimates:
													MW=
		Σ = 53°											%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT	ICF Kaiser Engineers	TEST DATE	12-17-92	ORIFICE CORRECTION (ΔH@)	—	HOT/COLD BOX NO.	—
TEST UNIT	Richmond H-L	TEST NO.	CYCLONIC FLOW TEST	METER CORRECTION (Y)	—	PROBE NO.	15-1
PROJECT NO.	399610-02	NOZZLE (SIZE,#)	—	CALIBRATION DATE	—	FILTER NO.	—
TEST CREW	RC, TM, JS	STATIC PRESSURE	—	PITOT CORRECTION	0.84	STACK DIA.	8' x 10.5'
BAROMETRIC PRESSURE	29.06	PORT DIRECTION	B	CONTROL BOX NO.	—	PORT SIZE	96" x 126"

Traverse Point (inches)	Time	~~Dry Gas Meter Reading (deg)~~	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H20)	Orifice ΔH Actual (in. H20)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
120.75		8°	0.48						325				min./point
110.25		4°	0.80										EPA Method 1
99.75		4°	0.74										Section 2.4
89.25		8°	0.68										
78.75		10°	0.62										no units down
68.25		3°	0.05										
57.75		1°	0.30										
47.25		15°	0.46										
36.75		10°	0.68										
26.25		4°	0.60										
15.75		4°	0.50										
5.25		4°	0.48										
		↑											
		Yaw angle (degrees)											
													Estimates:
													MW=
		Σ = 75°											%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT ICF Kaiser Engineers	TEST DATE 12-17-92	ORIFICE CORRECTION (ΔH@) —	HOT/COLD BOX NO. —
TEST UNIT Richmond PFL	TEST NO. CYCLONE FLOW TEST	METER CORRECTION (Y) —	PROBE NO. 15-1
PROJECT NO. 399610-02	NOZZLE (SIZE,#) —	CALIBRATION DATE —	FILTER NO. —
TEST CREW RL, TM, JS	STATIC PRESSURE —	PITOT CORRECTION 0.84	STACK DIA. 8' x 10.5'
BAROMETRIC PRESSURE 29.06	PORT DIRECTION A	CONTROL BOX NO. —	PORT SIZE [96" x 126"]

Traverse Point (inches)	Time	~~Dry-Gas Meter Reading (deg)~~	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
120.75		9°	0.60						~~325~~ 280 JS				min./point
110.25		2°	0.66						284				EPA Method 1
99.75		4°	0.80						300				Section 2.4
89.25		3°	0.74						300				
78.75		1°	0.90						298				no units down
68.25		8°	0.80						297				
57.75		5°	0.70						299				
47.25		4°	0.66						298				
36.75		2°	0.86						298				
26.25		9°	0.48						309				
15.75		4°	0.32						321				
5.25		5°	0.06						321				
		↑							↑				
		yaw angle (degrees)							determined 12-18-92				
											0900		Estimates:
													MW=
		Σ = 56°									JTS		%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

overall average $= \frac{41° + 53° + 75° + 56°}{4\ (12)} =$ 47°

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT ICF Kaiser Engineers	TEST DATE 12-19-92	ORIFICE CORRECTION (ΔH@) —	HOT/COLD BOX NO. —
TEST UNIT Richmond Pkg	TEST NO. CYCLONE FLOW TEST	METER CORRECTION (Y) —	PROBE NO. 15-1
PROJECT NO. 399610-02	NOZZLE (SIZE,#) —	CALIBRATION DATE —	FILTER NO. —
TEST CREW	STATIC PRESSURE	PITOT CORRECTION 0.84	STACK DIA. 8'x10.5'
BAROMETRIC PRESSURE 29.22	PORT DIRECTION D	CONTROL BOX NO. —	PORT SIZE [96" x 126"]

Traverse Point (inches)	Time	~~Dry Gas Meter Reading (dcf)~~	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
120.75	1600	5°	0.44										min./point
110.25		6°	0.36										EPA Method 1
99.75		4°	0.48										Section 2.4
89.25		4°	0.48										
78.75		6°	0.48										
68.25		8°	0.72										
57.75		5°	0.85										
47.25		5°	1.92										
36.75		2°	0.90										
26.25		6°	0.80										
15.75		2°	0.46										
5.25		5°	0.38										
		↑											
		yaw angle (degrees)											
		Σ = 58°											Estimates: MW= %H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT	ICF Kaiser Engineers	TEST DATE	12-18-92	ORIFICE CORRECTION (ΔH@)	—	HOT/COLD BOX NO.	—
TEST UNIT	Richmond PFL	TEST NO.	CYCLONIC FLOW TEST	METER CORRECTION (Y)	—	PROBE NO.	15-7
PROJECT NO.	39960-02	NOZZLE (SIZE,#)	—	CALIBRATION DATE	—	FILTER NO.	—
TEST CREW		STATIC PRESSURE	—	PITOT CORRECTION	0.84	STACK DIA.	8'×10.5'
BAROMETRIC PRESSURE	29.22	PORT DIRECTION	C	CONTROL BOX NO.	—	PORT SIZE	[96"×126"]

Traverse Point (inches)	Time	~~Dry Gas Meter Reading (deg)~~	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
120.75		8°	0.6										min./point
110.25		8½°	0.64										EPA Method 1
99.75		7°	0.63										Section 2.4
89.25		10°	0.62										
79.75		5°	0.50										
68.25		2°	0.72										
57.75		9°	0.88										
47.25		3°	0.40										
36.75		6°	0.84										
26.25		5°	0.76										
15.75		4°	0.75										
5.25		4°	0.62										
		↑											
		yaw angle (degrees)											
													Estimates:
													MW=
		Z = 71°											%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT ICF Kaiser Engineers	TEST DATE 12-18-92	ORIFICE CORRECTION (ΔH@) —	HOT/COLD BOX NO. —
TEST UNIT Richmond P&L	TEST NO. CYCLONE FLOW TEST	METER CORRECTION (Y) —	PROBE NO. 15-7
PROJECT NO. 399610-02	NOZZLE (SIZE,#) —	CALIBRATION DATE —	FILTER NO. —
TEST CREW	STATIC PRESSURE —	PITOT CORRECTION 0.84	STACK DIA. 8' x 10.5'
BAROMETRIC PRESSURE 29.22	PORT DIRECTION B	CONTROL BOX NO. —	PORT SIZE (96" x 126")

Traverse Point (inches)	Time	~~Dry Gas Meter Reading (cuft)~~	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H2O)	Orifice ΔH Actual (in. H2O)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
120.75		6	0.50										min./point
110.25		5°	0.70										EPA Method 1
99.75		3°	0.69										Section 2.4
89.25		5°	0.66										
78.75		5°	0.60										
68.25		0	0.05	Dropped									
57.75		6°	0.45										
47.25		7°	0.60										
36.75		3°	0.66										
26.25		3°	0.54										
15.75		2°	0.49										
5.25		5°	0.35										
		↑											
		Yaw angle (degrees)											
													Estimates:
													MW=
		$\bar{Y}$ = 50°											%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

KEYSTONE ENVIRONMENTAL RESOURCES / AIR QUALITY ENGINEERING
STACK SAMPLING DATA SHEET

CLIENT TCF Kaiser Engineers	TEST DATE 12-18-92	ORIFICE CORRECTION (ΔH@) —	HOT/COLD BOX NO. —
TEST UNIT Richmond P&L	TEST NO. SCREENING FLOW TEST	METER CORRECTION (Y) —	PROBE NO. 15-1
PROJECT NO. 399610-02	NOZZLE (SIZE,#) —	CALIBRATION DATE —	FILTER NO. —
TEST CREW	STATIC PRESSURE —	PITOT CORRECTION 0.84	STACK DIA. 8' x 10.5'
BAROMETRIC PRESSURE 29.22	PORT DIRECTION A	CONTROL BOX NO. —	PORT SIZE [8" x 12"]

Traverse Point (inches)	Time	~~Dry-Gas Meter Reading (deg)~~	Pitot ΔP (in. H2O)	Orifice ΔH Required (in. H20)	Orifice ΔH Actual (in. H20)	Meter Temperature In (°F)	Meter Temperature Out (°F)	Vacuum (in. Hg)	Stack Temp. (°F)	Probe Temp. (°F)	Impinger Temp. (°F)	Hot Box Temp. (°F)	Comments
120.75		5°	0.54										min./point
110.25		7°	0.55										CFR Method 1
99.75		9°	0.74										Section 2.4
89.25		3°	0.74										
78.75		8°	0.75										
68.25		7°	0.68										
57.75		5°	0.59										
47.25		2°	0.54										
36.75		3°	0.46										
26.25		10°	0.37										
15.75		10°	0.25										
5.25		0°	0.25										
		↑											
		Yaw angle (degrees)											
													Estimates:
													MW=
		Σ = 69°											%H2O=

SYSTEM LEAK CHECK

	Vacuum (in. Hg)	DGM Rate (cfm)
Before		
After		

PITOT LEAK CHECK

	Positive	Negative
Before		
After		

GAS	1	2
CO2		
O2		
CO		
N2		

Impinger No.	Impinger Contents	Final	Initial	Difference
1.				
2.				
3.				
4.				
5.				

overall average $= \frac{58° + 71° + 50° + 69°}{4\ (12)} =$

5.2°

CONTROL BOX CALIBRATION

THREE POINT CALIBRATION

BOX # 3 BP 28.35 in. Hg
DATE 11-12-92 OPERATOR RPC

	WET TEST METER				DRY TEST METER					METER COEFFICIENT	ORIFICE COEFFICIENT
	TIME (min)	TEMP TW	VOLUME VM	PRESSURE PW	TEMP IN TI	TEMP OUT TO	TEMP AVG TA	ORIFICE PD	VOLUME VD	Y	ΔH@
START			0.000	28.35				0.50	36.400		
HALF		72.0			102.0	88.0	95.0				
STOP	12.58		5.000						41.600		
CALCULATION	12.58	532.0	5.013	28.35			555.0	28.39	5.200	1.0043	1.796
START			0.000	28.35				1.00	42.200		
HALF		72.0			105.0	89.0	97.0				
STOP	8.68		5.000						47.379		
CALCULATION	8.68	532.0	5.013	28.35			557.0	28.42	5.179	1.0107	1.704
START			0.000	28.35				2.00	48.100		
HALF		72.0			111.0	90.0	100.5				
STOP	6.20		5.000						53.286		
CALCULATION	6.20	532.0	5.013	28.35			560.5	28.50	5.186	1.0131	1.728
AVERAGE										1.0094	1.742

POST TEST

BOX # 3 BP 28.90 in. Hg
DATE 01-05-93 OPERATOR RPC

	WET TEST METER				DRY TEST METER					METER COEFFICIENT	ORIFICE COEFFICIENT
	TIME (min)	TEMP TW	VOLUME VM	PRESSURE PW	TEMP IN TI	TEMP OUT TO	TEMP AVG TA	ORIFICE PD	VOLUME VD	Y	ΔH@
START			0.000	28.90				1.25	126.900		
HALF		70.0			101.0	89.0	95.0				
STOP	7.70		5.000						131.974		
CALCULATION	7.70	530.0	5.013	28.90			555.0	28.99	5.074	1.0312	1.638
START			0.000	28.90				1.25	132.300		
HALF		70.0			104.0	90.0	97.0				
STOP	7.70		5.000						137.421		
CALCULATION	7.70	530.0	5.013	28.90			557.0	28.99	5.121	1.0254	1.632
START			0.000	28.90				1.25	137.800		
HALF		70.0			105.0	90.0	97.5				
STOP	7.78		5.000						142.930		
CALCULATION	7.78	530.0	5.013	28.90			557.5	28.99	5.130	1.0245	1.664
AVERAGE										1.0270	1.645
DIFFERENCE										-1.7%	6.0%

PRE-TEST MAGNEHELIC CALIBRATION

BOX# 3
DATE 11-12-92
OPERATOR RPC

0 to 10" H2O RANGE

MAGNEHELIC Δ P	MANOMETER
0.50	0.50
1.00	1.00
2.00	2.00
4.00	4.00
6.00	6.00
8.00	8.00

0 to 0.50" H2O RANGE

MAGNEHELIC Δ P	MANOMETER
0.50	0.48
0.40	0.40
0.30	0.30
0.20	0.20
0.10	0.10

0 to 5" H2O RANGE

MAGNEHELIC Δ H	MANOMETER
4.00	4.00
3.00	3.00
2.00	2.00
1.00	1.00
0.50	0.50

PRE-TEST LEAK CHECK

DATE 11-12-92
OPERATOR RPC

	START CF	STOP CF	VOLUME CF	TIME (min)	LEAK RATE
DRY	17.430	17.612	0.182	10.000	-0.000
WET	0.000	0.180	0.180		

PYROMETER CALIBRATION

DATE 04-28-88
OPERATOR AGL

VOLTAGE INPUT (mV)	TARGET TEMP (°F)	TEMP READING (°F)
0.18	40	40.0
0.40	50	50.0
0.84	70	70.0
1.29	90	90.0
1.74	110	110.0
2.66	150	150.0
3.82	200	200.0
6.09	300	301.0
8.31	400	400.0
10.57	500	500.0

PRE-TEST PYROMETER CHECK

DATE 11-12-92
OPERATOR RPC

VOLTAGE INPUT (mV)	TARGET TEMP (°F)	TEMP READING (°F)
0.18	40	41.0
0.40	50	51.0
0.84	70	71.0
1.29	90	90.0
1.74	110	110.0
2.66	150	150.0
3.82	200	202.0
6.09	300	302.0
8.31	400	404.0
10.57	500	504.0

POST-TEST MAGNEHELIC CALIBRATION

BOX# 3
DATE 01-05-93
OPERATOR RPC

0 to 10" H2O RANGE

MAGNEHELIC Δ P	MANOMETER
0.50	0.50
1.00	1.00
2.00	2.00
4.00	4.00
6.00	6.00
8.00	8.00

0 to 0.50" H2O RANGE

MAGNEHELIC Δ P	MANOMETER
0.50	0.50
0.40	0.40
0.30	0.30
0.20	0.20
0.10	0.10

0 to 5" H2O RANGE

MAGNEHELIC Δ H	MANOMETER
4.00	4.00
3.00	3.00
2.00	2.00
1.00	1.00
0.50	0.50

POST-TEST LEAK CHECK

DATE 01-05-93
OPERATOR RPC

	START CF	STOP CF	VOLUME CF	TIME (min)	LEAK RATE
DRY	125.610	125.856	0.246	10.000	-0.0004
WET	0.000	0.242	0.242		

PYROMETER CALIBRATION

DATE 04-28-88
OPERATOR AGL

VOLTAGE INPUT (mV)	TARGET TEMP (°F)	TEMP READING (°F)
0.18	40	40.0
0.40	50	50.0
0.84	70	70.0
1.29	90	90.0
1.74	110	110.0
2.66	150	150.0
3.82	200	200.0
6.09	300	301.0
8.31	400	400.0
10.57	500	500.0

POST-TEST PYROMETER CHECK

DATE 01-07-93
OPERATOR RPC

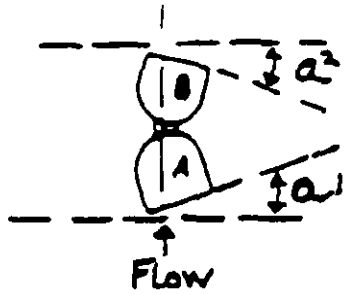
VOLTAGE INPUT (mV)	TARGET TEMP (°F)	TEMP READING (°F)
0.18	40	39.0
0.40	50	49.0
0.84	70	70.0
1.29	90	90.0
1.74	110	110.0
2.66	150	150.0
3.82	200	200.0
6.09	300	300.0
8.31	400	400.0
10.57	500	500.0

GEOMETRIC PITOT CALIBRATION

Caliper # XES-168
Precheck ✓
Post Check

Probe #: 15-1
Date: 12-11-92
Initials: TM

①



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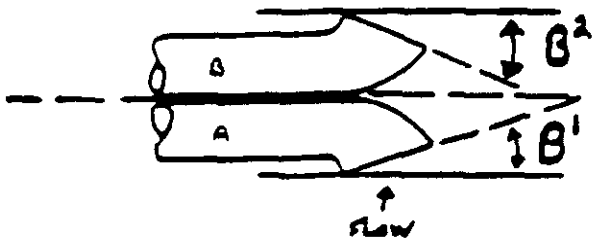

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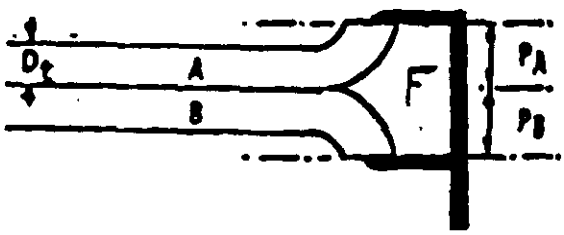


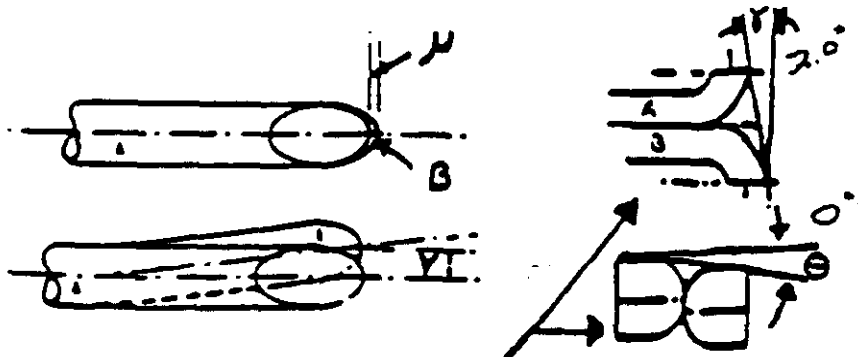
$1.05\ D_t < d < 1.50\ D_t$

$P_A = P_B$

$2.10\ D_t < A < 3.00\ D_t$

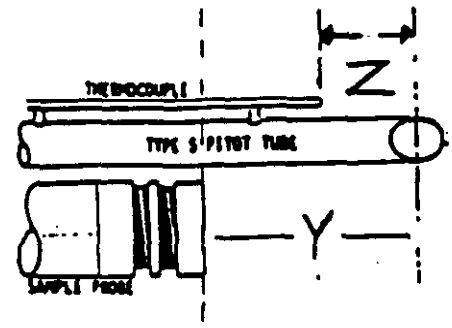
a^1 = 4.0°		$a^1, a^2 = <10°$
a^2 = 4.0°		
B^1 = 0.5°		$B^1, B^2, = <5°$
B^2 = 0.5°		
F = 0.904"		
μ = 0.0916		$\mu = \leq 0.1250"$ ($\mu = F \tan \gamma$)
V = 0		$V = \leq 0.03125"$ ($V = F \tan \theta$)
W = 0.325		$W \geq 0"$
X = 0.768		$X \geq 0.750"$ (3/4" using 1/2" nozzle)
Y = 6.154		$Y \geq 3.0"$
Z = 2.304		$Z > 2.0"$
D_t = 0.374		$D_t > .1875"$ to $.375"$ (3/16" to 3/8")

④



γ, θ EXPRESSED IN DEGREES

⑥



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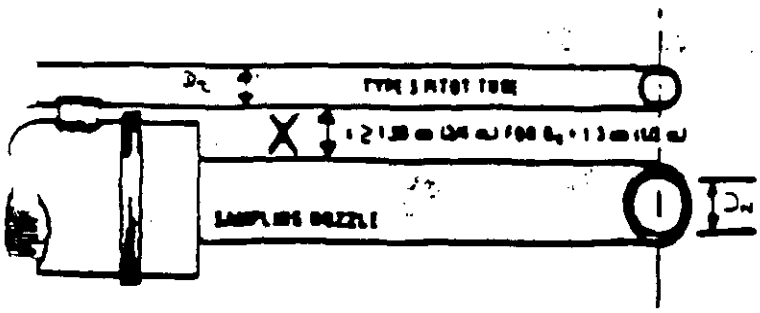

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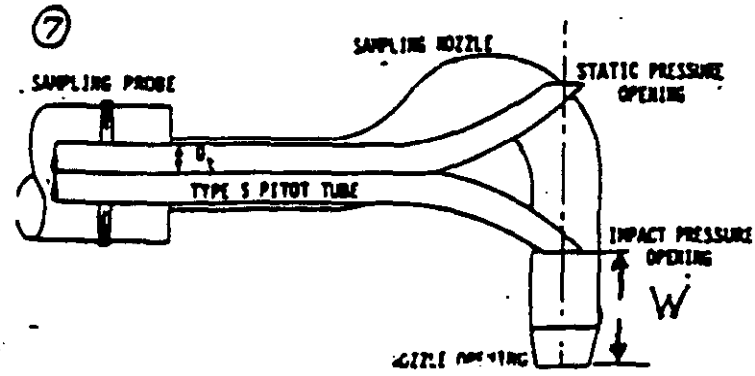
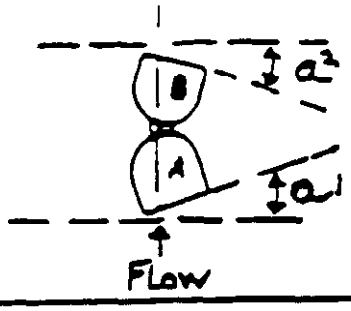


GEOMETRIC PITOT CALIBRATION

Caliper # XFS-68
Precheck
Post Check ✓

Probe #: 15-1
Date: 01-07-93
Initials: RPS

①

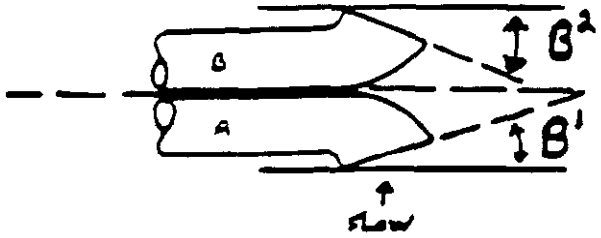


a^1 = 4
a^2 = 4
$a^1, a^2 = <10°$

B^1 = 0
B^2 = 0
$B^1, B^2, = <5°$

F = .904"

②



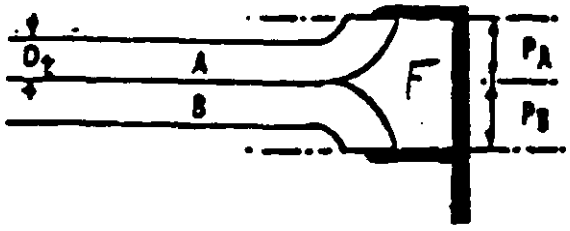
μ = .0316 — $\mu = \leq 0.1250"$ ($\mu = F \tan \gamma$)

V = 0 — $V = \leq 0.03125"$ ($V = F \tan \theta$)

W = 0 — $W \geq 0"$

X = .765 — $X \geq 0.750"$ (3/4" using 1/2" nozzle)

③



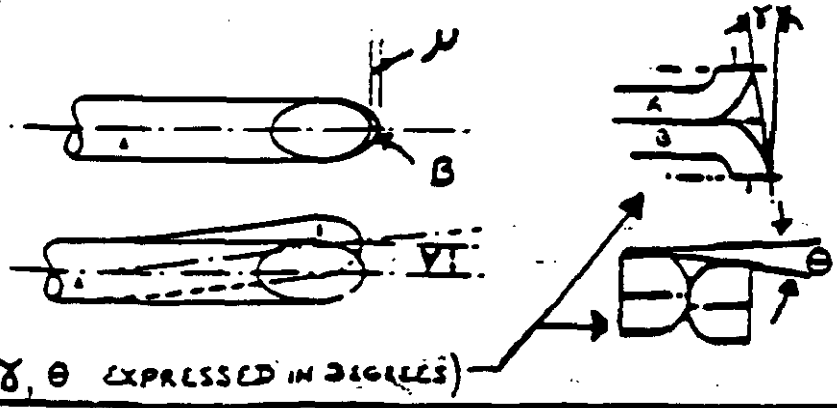
$1.05\ D_t < d < 1.50\ D_t$
$P_A = P_B$
$2.10\ D_t < A < 3.00\ D_t$

Y = 6.15 — $Y \geq 3.0"$

Z = 2.3 — $Z > 2.0"$

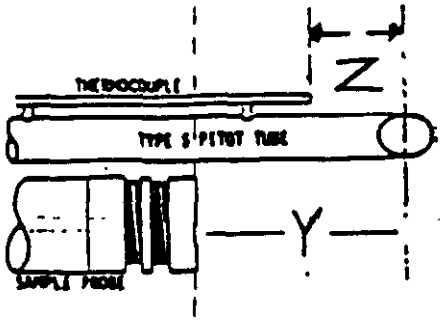
D_t = .374 — $D_t > .1875"$ to $.375"$ (3/16" to 3/8")

④



(γ, θ EXPRESSED IN DEGREES)

⑥



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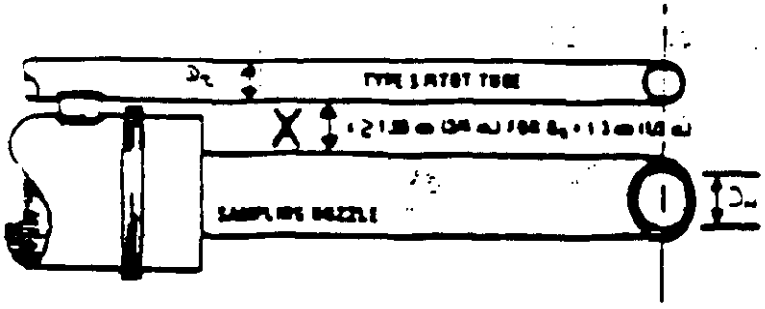

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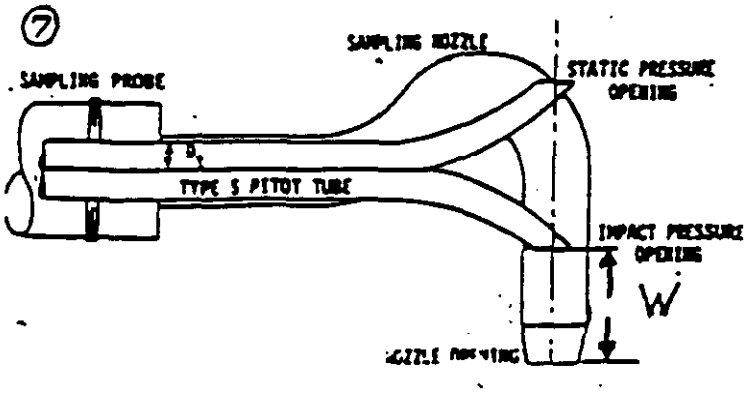

ICF KAISER ENGINEERS, INC.
PITTSBURGH, PA

PARTICULATE MATTER AND SULFURIC ACID EMISSION RESULTS TESTING CONDUCTED AT RICHMOND POWER AND LIGHT

ANALYTICAL RESULTS AND EMISSION CALCULATIONS

CHESTER
ENVIRONMENTAL

KEYSTONE ENVIRONMENTAL RESOURCES
AIR QUALITY ENGINEERING

ANALYTICAL REPORTING FORM

CLIENT: ICF KAISER
PLANT LOCATION:
PROJECT NUMBER: 399610-04
UNIT TESTED: BRE

TEST DATE: 12/18/92
DATE RECEIVED: 12/21/92
DATE ANALYZED: 12/29/92
ANALYTICAL METHOD:

Test Number	Filter ID Number	Component	Cyclone Weight Units ( )	Filter Weight Units (grams)	Soluble Portion of Front Half H2O Rinse Units ( )	Soluble Portion of Front Half Acetone Rinse Units (grams)	Soluble Portion of Back Half H2O Rinse Units ( )	Soluble Portion of Back Half Acetone Rinse Units ( )	0.22μm Filter Insoluble Portion of Back Half H2O Rinse Units ( )
ICF-BRE-1	958	Particulate		0.0379		0.2291			
ICF-BRE-2	955	Particulate		0.0597		0.0838			
ICF-BRE-3	960	Particulate		0.0855		0.1678			
ICF-BRE-BLANK	965	Particulate		0.0001		0.0000			

Analyst's Signature: Patricia J. Stratton
Date: 1/4/93

Comments: Both the Filters and the Front-half Acetone Rinse Residues were Dried at 100°C for 1hr. prior to Final weighing.

AQE 10/92

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

CHAIN OF CUSTODY RECORD

PROJECT NUMBER	399610-04
PROJECT NAME	ICF KAISER
ANALYTICAL LAB	Chester Labnet - Monroeville
DELIVER TO	A. Lee
COMMENTS	

SAMPLE IDENTIFICATION NUMBER	SAMPLE COLLECTION DATE	SAMPLE COLLECTION TIME	COMP	GRAB	NO. OF CONTAINERS	ANALYSES TO BE CONDUCTED: SO_3 by EPA Method 8								REMARKS OR OBSERVATIONS
ICF-BRE-1	12/21/92		✓		1	✓								Total Vol. 250 ml
ICF-BRE-2	12/21/92		✓		1	✓								Total Vol. 250 ml
ICF-BRE-3	12/21/92		✓		1	✓								Total Vol. 250 ml
ICF-BRE-Blank	12/21/92		✓		1	✓								Total Vol. 250 ml

Relinquished by (Signature)	Date	Time	Received by (Signature)	Date	Time
Patrick J. Stockton	12/23/92				

COMP = Composite Sample
GRAB = Grab Sample

AQE 7/92

R PORT TO:
K_ystone Environmental Resources
3000 Tech Center Drive
M nroeville PA 15146
R : IFC Kaiser

ATTENTION: John Shimshock

E..OJECT ID: 399610-04
P.O. NUMBER:

WORK ORDER: M92-12-169
DATE RECEIVED: 23-DEC-1992
DATE REPORTED: 6-JAN-1993

PREPARED BY:
Keystone Lab - Monroeville
3000 Tech Center Drive
Monroeville, PA 15146
(412) 825-9600

CERTIFIED BY : Kenneth J Kuzio

Please call the above number if you have any questions regarding this Work Order. NOTE: All samples will be retained for 60 days. Unused soil and waste samples will be returned to you at no charge. Alternately, Keystone can make disposal arrangement for a fee.

Samples included in this report:

Keystone Sample ID	Client's Sample Name	Date Collected	Sample Matrix
M92-12-169-003	ICF-BRE-1	21-DEC-1992	WATER
M92-12-169-004	ICF-BRE-1 DUP		WATER
M92-12-169-005	ICF-BRE-2	21-DEC-1992	WATER
M92-12-169-006	ICF-BRE-2 DUP		WATER
M92-12-169-007	ICF-BRE-3	21-DEC-1992	WATER
M92-12-169-008	ICF-BRE-3 DUP		WATER
M92-12-169-009	ICF-BRE-BLANK	21-DEC-1992	WATER

Analyses and Descriptions referred to in this report.

Analysis ID	Parameter Description
SO2	Sulfur Dioxide

KEYSTONE LAB - MONROEVILLE

Summary of Analytical Results

Date received: 23-DEC-1992 Customer: Keystone Environmental Resources Job name: M92-12-169

		Samples						
Keystone ID		169-003	169-004	169-005	169-006	169-007	169-008	169-009
Date Sampled		21-DEC-1992		21-DEC-1992		21-DEC-1992		21-DEC-1992
Customer ID		ICF-BRE-1	ICF-BRE-1 DUP	ICF-BRE-2	ICF-BRE-2 DUP	ICF-BRE-3	ICF-BRE-3 DUP	ICF-BRE-BLANK
Parameters	Units							
SO2	*	.007	.007	.005	.005	.007	.007	<0.001

* Sulfur Dioxide as grams of sulfuric acid.

KEYSTONE ENVIRONMENTAL RESOURCES
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN
BOILER NO.2 OUTLET BREECHING

DATE: 12-18-92
CHARGE #: ...150-399610
TEST #: ICF-BRE-1

1. EMISSION RESULTS

PARAMETER	GR/SCFD	LB/HR	PPM
PARTICULATE	.11358	139.60420	
SULFURIC ACID	.00298	3.66003	1.67433

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2. STACK CONDITIONS

FLOW (ACFM)	243154.
(SCFM)	156325.
MOISTURE CONTENT (%)	8.27
STACK TEMPERATURE (F)	341.3

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3. SAMPLING CONDITIONS

SAMPLE TIME (MIN.)	60.0
SCFD GAS SAMPLED	36.203
PERCENT ISOKINETIC	112.50

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN — BOILER NO.2 OUTLET
ICF-BRE-1 — 12-18-92

FIELD DATA AND VELOCITY CALCULATIONS

POINT	TIME	METER READING (DRY)CF	DELTA P IN.H2O	ORIFICE DELTA H REQ	ORIFICE DELTA H ACT	METER TEMP DEG F IN	METER TEMP DEG F OUT	VACUUM IN.HG.	STACK TEMP DEG F	CORRECTE VELOCITY FT/SEC
115.5D	650.0	898.235	.300	.58	.58	65.	65.	3.5	336.	37.8
94.5			.450	.86	.86	67.	63.	5.3	340.	46.4
73.5			.500	.96	.96	68.	61.	6.5	342.	48.9
52.5			.750	1.44	1.44	69.	59.	10.5	342.	59.9
31.5			.800	1.53	1.53	67.	58.	12.0	342.	61.9
10.5D	705.0	907.502	.400	.77	.77	66.	56.	6.0	324.	43.3
115.5C	709.0	907.502	.350	.77	.77	60.	53.	5.0	337.	40.8
94.5			.550	1.22	1.22	63.	52.	8.7	343.	51.3
73.5			.200	.44	.44	62.	51.	3.1	342.	30.9
52.5			.900	1.99	1.99	64.	51.	16.0	344.	65.7
31.5			.900	1.99	1.99	59.	49.	16.0	344.	65.7
10.5C	724.0	917.900	.750	1.66	1.66	58.	49.	13.3	343.	60.0
115.5B	727.0	917.900	.430	.95	.95	57.	47.	7.0	341.	45.3
94.5			.600	1.33	1.33	60.	47.	11.0	344.	53.7
73.5			.600	1.31	1.31	61.	47.	11.0	342.	53.6
52.5			.010	.02	.02	56.	46.	1.0	343.	6.9
31.5			.700	1.53	1.53	61.	46.	13.0	344.	58.0
10.5B	742.0	926.435	.450	.98	.98	61.	46.	8.0	343.	46.4
115.5A	744.0	926.435	.400	.87	.87	58.	45.	6.2	342.	43.8
94.5			.400	.87	.87	60.	45.	6.2	343.	43.8
73.5			.800	1.74	1.74	62.	45.	16.0	342.	61.9
52.5			.650	1.42	1.42	60.	46.	12.0	343.	55.8
31.5			.400	.87	.87	60.	46.	6.5	343.	43.8
10.5A	759.0	934.023	.220	.48	.48	60.	46.	3.8	341.	32.4

O R S A T

CO2	14.0
O2	6.0
CO	.0
N	80.0

IMPINGER NO. 1	-23.7
2	42.4
3	24.4
4	.0
ABSORBED H2O	26.1

CONTROL BOX CALIBRATIONS

	FACTOR	DATE
ORIFICE	1.724	11-12-92
METER	1.0094	11-12-92
PITOT	0.84	12-11-92

LEAK CHECK

	RATE	IN.HG
INITIAL	LT 0.02CFM	5.0
FINAL	0.050CFM	16.0

CONTROL BOX NO. 3 — PROBE NO. 15-1 — NOZZLE NO. 37

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN — BOILER NO.2 OUTLET
ICF-BRE-1 — 12-18-92

STACK SAMPLING CALCULATIONS

A.	BAROMETRIC PRESSURE IN. HG.....	29.22
B.	AVG. DELTA H (IN H2O).....	1.11
C.	METER PRESSURE (IN. HG.).....	29.30
D.	STATIC PRESSURE (IN. H2O).....	-.40
E.	STATIC PRESSURE (IN. HG.).....	-.029
F.	STACK PRESSURE (IN. HG.) (A+E).....	29.19
G.	STACK DIMENSIONS 96.0 X 126.0 IN.	
H.	STACK AREA (SQ. FT.)..... (LENGTH X WIDTH)	84.00
	NOZZLE DIAMETER.....	.2400
I.	NOZZLE AREA (SQ. FT.).....	.000314
J.	AVG. STACK TEMP (DEG. R.).....	801.3
K.	AVG. METER TEMP (DEG. R.).....	516.3
L.	CONDENSATE VOL. (ML).....	43.1
M.	ABSORBED H2O (ML).....	26.1
N.	TOTAL H2O (ML).....	69.2
O.	METERED GAS (CF).....	35.788
P.	GAS METER CORRECTION.....	1.0094
Q.	CORRECTED METERED GAS (CF).....	36.124
R.	H2O GAS VOLUME (CF) (0.00267N(K/C).....	3.256
S.	TOTAL SAMPLED VOLUME (CF) (Q+R).....	39.380
T.	PERCENT H2O (100R/S).....	8.27
	THEORETICAL MAXIMUM.....	100.00
	PERCENT WATER USED.....	8.27
U.	SCFD GAS SAMPLED (528*Q*C/(29.9*K)).....	36.203
V.	MOLECULAR WEIGHT OF STACK GAS	

COMPONENT	ORSAT-DRY VOL.PCT./100	X	MOISTURE CORRECTION (1-T/100)	X	MOLECULAR WEIGHT	=	WEIGHT PER MOLE
CO2	.140	X	.9173	X	44.0	=	5.65
CO	.000	X	.9173	X	28.0	=	.00
O2	.060	X	.9173	X	32.0	=	1.76
SULFURIC ACID	.000	X	.9173	X	98.0	=	.00
N2	.800	X	.9173	X	28.2	=	20.69
H2O		X	T/100= .0827	X	18.0	=	1.49
					MOLECULAR WEIGHT OF STACK GAS	=	29.60

W.	PITOT CORRECTION.....	.840
X.	AVERAGE CORRECTED VELOCITY (FPS)..... [85.49*W*SQRT{(J*DELTA P)/(V*F)}]	48.24
Y.	AVG. FLOW RATE (CFM) (X*H*60).....	243154.
Z.	STACK FLOW RATE (SCFM) (528*Y/J*F/29.92).....	156325.
	STACK FLOW RATE (DRY).....	143401.
AA.	SAMPLE TIME (SEC).....	3600.
BB.	PERCENT ISOKINETIC..... (J*100*U*29.92)/(528*X*AA*I*F*(1-T/100))	112.50

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN BOILER NO.2 OUTLET
ICF-BRE-1 12-18-92

PARAMETER	CYCLONE WT. (G)	MATL.ON FILTER(G)	INSOL.MATL. IN PROBE(G)	SOL.MATL. IN PROBE(G)
PARTICULATE	.00000	.03790	.00000	.22910
SULFURIC ACID	.00000	.00000	.00000	.00000

PARAMETER	INSOL.MATL. IN IMP.(G)	SOLUBLE MATL. IN IMP.(G)
PARTICULATE	.00000	.00000
SULFURIC ACID	.00000	.00700

PARTICULATE	.26700
SULFURIC ACID	.00700
ALL MATLS.	.27400

PARAMETER	MW	PPM	GR/SCFD	LB/H R
PARTICULATE			.11358	139.60420
SULFURIC ACID	98.0	1.67	.00298	3.66003

Emission rates are based on the PP method.
The results include total sample train catch

KEYSTONE ENVIRONMENTAL RESOURCES
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN
BOILER NO.2 OUTLET BREECHING

DATE: 12-18-92
CHARGE #: ...150-399610
TEST #: ICF-BRE-2

1. EMISSION RESULTS

PARAMETER	GR/SCFD	LB/HR	PPM
PARTICULATE	.05531	78.50984	
SULFURIC ACID	.00193	2.73553	1.08371

---

2. STACK CONDITIONS

FLOW (ACFM)	282613.
(SCFM)	181694.
MOISTURE CONTENT (%)	8.86
STACK TEMPERATURE (F)	341.3

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3. SAMPLING CONDITIONS

SAMPLE TIME (MIN.)	60.0
SCFD GAS SAMPLED	39.952
PERCENT ISOKINETIC	107.52

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN — BOILER NO.2 OUTLET
ICF-BRE-2 — 12-18-92

FIELD DATA AND VELOCITY CALCULATIONS

POINT	TIME	METER READING (DRY)CF	DELTA P IN.H2O	ORIFICE DELTA H REQ	ORIFICE DELTA H ACT	METER TEMP DEG F IN	METER TEMP DEG F OUT	VACUUM IN.HG.	STACK TEMP DEG F	CORRECTE VELOCITY FT/SEC
115.5D	1445.0	937.087	.400	.76	.76	44.	35.	3.0	336.	43.6
94.5			.350	.66	.66	46.	36.	2.5	340.	40.9
73.5			.550	.99	.99	51.	37.	4.0	342.	51.4
52.5			.850	1.55	1.55	56.	39.	6.1	342.	63.9
31.5			.700	1.27	1.27	58.	40.	5.2	342.	58.0
10.5D	1500.0	946.117	.600	1.09	1.09	59.	41.	5.0	324.	53.1
115.5C	1502.0	946.117	.650	1.18	1.18	58.	42.	5.0	337.	55.7
94.5			.700	1.29	1.29	62.	44.	5.0	343.	58.0
73.5			.800	.47	.47	65.	45.	5.8	342.	62.0
52.5			.950	1.76	1.76	67.	46.	7.0	344.	67.6
31.5			.900	1.67	1.67	67.	47.	6.9	344.	65.8
10.5C	1517.0	956.811	.850	1.58	1.58	68.	48.	6.5	343.	63.9
115.5B	1518.0	956.811	.850	1.58	1.58	65.	48.	6.2	341.	63.8
94.5			.800	1.49	1.49	70.	49.	6.0	344.	62.0
73.5			.550	1.02	1.02	66.	49.	4.0	342.	51.4
52.5			.400	.75	.75	65.	50.	3.0	343.	43.8
31.5			.700	1.31	1.31	66.	50.	5.2	344.	58.0
10.5B	1533.0	966.412	.550	1.03	1.03	66.	50.	4.0	343.	51.4
115.5A	1534.0	966.412	.700	1.31	1.31	64.	49.	5.2	342.	58.0
94.5			.800	1.50	1.50	66.	50.	6.0	343.	62.0
73.5			.900	1.69	1.69	67.	49.	7.0	342.	65.7
52.5			.650	1.22	1.22	66.	49.	5.0	343.	55.9
31.5			.500	.94	.94	65.	49.	4.0	343.	49.0
10.5A	1549.0	976.378	.350	.66	.66	63.	49.	2.8	341.	41.0

O R S A T

CO2	14.0
O2	6.0
CO	.0
N	80.0

IMPINGER NO.	1	-12.0
	2	39.0
	3	26.1
	4	.0
ABSORBED H2O		29.3

CONTROL BOX CALIBRATIONS

	FACTOR	DATE
ORIFICE	1.724	11-12-92
METER	1.0094	11-12-92
PITOT	0.84	12-11-92

LEAK CHECK

	RATE	IN.HG
INITIAL LT	0.02CFM	5.0
FINAL LT	0.02CFM	7.0

CONTROL BOX NO. 3 — PROBE NO. 15-1 — NOZZLE NO. 37

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN BOILER NO.2 OUTLET
ICF-BRE-2 12-18-92

STACK SAMPLING CALCULATIONS

A.	BAROMETRIC PRESSURE IN. HG.....	29.22
B.	AVG. DELTA H (IN H2O).....	1.20
C.	METER PRESSURE (IN. HG.).....	29.31
D.	STATIC PRESSURE (IN. H2O).....	-.40
E.	STATIC PRESSURE (IN. HG.).....	-.029
F.	STACK PRESSURE (IN. HG.) (A+E).....	29.19
G.	STACK DIMENSIONS 96.0 X 126.0 IN.	
H.	STACK AREA (SQ. FT.)..... (LENGTH X WIDTH)	84.00
	NOZZLE DIAMETER.....	.2400
I.	NOZZLE AREA (SQ. FT.).....	.000314
J.	AVG. STACK TEMP (DEG. R.).....	801.3
K.	AVG. METER TEMP (DEG. R.).....	513.8
L.	CONDENSATE VOL. (ML).....	53.1
M.	ABSORBED H2O (ML).....	29.3
N.	TOTAL H2O (ML).....	82.4
O.	METERED GAS (CF).....	39.291
P.	GAS METER CORRECTION.....	1.0094
Q.	CORRECTED METERED GAS (CF).....	39.660
R.	H2O GAS VOLUME (CF) (0.00267N(K/C).....	3.857
S.	TOTAL SAMPLED VOLUME (CF) (Q+R).....	43.517
T.	PERCENT H2O (100R/S).....	8.86
	THEORETICAL MAXIMUM.....	100.00
	PERCENT WATER USED.....	8.86
U.	SCFD GAS SAMPLED (528*Q*C/(29.9*K)).....	39.952
V.	MOLECULAR WEIGHT OF STACK GAS	

COMPONENT	ORSAT-DRY VOL.PCT./100	X	MOISTURE CORRECTION (1-T/100)	X	MOLECULAR WEIGHT	=	WEIGHT PER MOLE
CO2	.140	X	.9114	X	44.0	=	5.61
CO	.000	X	.9114	X	28.0	=	.00
O2	.060	X	.9114	X	32.0	=	1.75
SULFURIC ACID	.000	X	.9114	X	98.0	=	.00
N2	.800	X	.9114	X	28.2	=	20.56
H2O		X	T/100= .0886	X	18.0	=	1.60
					MOLECULAR WEIGHT OF STACK GAS	=	29.52

W.	PITOT CORRECTION.....	.840
X.	AVERAGE CORRECTED VELOCITY (FPS)..... [85.49*W*SQRT{(J*DELTA P)/(V*F)}]	56.07
Y.	AVG. FLOW RATE (CFM) (X*H*60).....	282613.
Z.	STACK FLOW RATE (SCFM) (528*Y/J*F/29.92).....	181694.
	STACK FLOW RATE (DRY).....	165591.
AA.	SAMPLE TIME (SEC).....	3600.
BB.	PERCENT ISOKINETIC..... (J*100*U*29.92)/(528*X*AA*I*F*(1-T/100))	107.52

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN BOILER NO.2 OUTLET
ICF-BRE-2 12-18-92

PARAMETER	CYCLONE WT. (G)	MATL.ON FILTER(G)	INSOL.MATL. IN PROBE(G)	SOL.MATL. IN PROBE(G)
PARTICULATE	.00000	.05970	.00000	.08380
SULFURIC ACID	.00000	.00000	.00000	.00000

PARAMETER	INSOL.MATL. IN IMP.(G)	SOLUBLE MATL. IN IMP.(G)
PARTICULATE	.00000	.00000
SULFURIC ACID	.00000	.00500

PARTICULATE	.14350
SULFURIC ACID	.00500
ALL MATLS.	.14850

PARAMETER	MW	PPM	GR/SCFD	LB/H R
PARTICULATE			.05531	78.50984
SULFURIC ACID	98.0	1.08	.00193	2.73553

Emission rates are based on the PP method.
The results include total sample train catch

KEYSTONE ENVIRONMENTAL RESOURCES
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN
BOILER NO.2 OUTLET BREECHING

DATE: 12-18-92
CHARGE #: ...150-399610
TEST #: ICF-BRE-3

1. EMISSION RESULTS

PARAMETER	GR/SCFD	LB/HR	PPM
PARTICULATE	.10479	142.73610	
SULFURIC ACID	.00290	3.94454	1.62833

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2. STACK CONDITIONS

FLOW (ACFM)	272048.
(SCFM)	174071.
MOISTURE CONTENT (%)	8.71
STACK TEMPERATURE (F)	344.7

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3. SAMPLING CONDITIONS

SAMPLE TIME (MIN.)	60.0
SCFD GAS SAMPLED	37.225
PERCENT ISOKINETIC	104.39

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN — BOILER NO.2 OUTLET
ICF-BRE-3 — 12-18-92

FIELD DATA AND VELOCITY CALCULATIONS

POINT	TIME	METER READING (DRY)CF	DELTA P IN.H2O	ORIFICE DELTA H REQ	ORIFICE DELTA H ACT	METER TEMP DEG F IN	METER TEMP DEG F OUT	VACUUM IN.HG.	STACK TEMP DEG F	CORRECTE VELOCITY FFT/SEC
115.5D	1700.0	976.868	.600	1.08	1.08	46.	39.	11.0	348.	53.8
94.5			.750	1.35	1.35	50.	41.	14.2	348.	60.2
73.5			1.100	1.98	1.40	50.	42.	18.0	349.	72.9
52.5			.900	1.62	1.32	48.	42.	18.0	348.	65.9
31.5			.550	.99	.99	50.	42.	10.2	325.	50.8
10.5D	1715.0	986.968	.550	.99	.99	53.	42.	10.2	322.	50.7
115.5C	1716.0	986.968	.650	1.18	1.18	54.	42.	12.8	347.	56.0
94.5			.600	1.09	1.09	55.	42.	12.2	349.	53.9
73.5			.750	1.36	1.36	56.	43.	17.0	349.	60.2
52.5			.800	1.46	1.35	53.	43.	18.0	348.	62.1
31.5			.900	1.64	1.28	50.	43.	18.0	348.	65.9
10.5C	1731.0	997.232	.700	1.27	1.27	49.	43.	18.0	348.	58.1
115.5B	1732.0	997.232	.700	1.27	1.27	52.	42.	15.0	346.	58.1
94.5			.800	1.45	1.45	53.	42.	18.0	348.	62.1
73.5			.200	.36	.36	51.	43.	3.3	348.	31.1
52.5			.250	.45	.45	53.	42.	4.0	348.	34.7
31.5			.600	1.09	1.09	57.	43.	11.0	347.	53.8
10.5B	1747.0	1005.917	.400	.72	.72	57.	43.	6.8	347.	43.9
115.5A	1748.0	1005.917	.600	1.09	1.09	57.	43.	10.8	346.	53.8
94.5			.800	1.45	1.45	59.	43.	16.0	348.	62.1
73.5			.800	1.45	1.45	56.	44.	17.1	348.	62.1
52.5			.550	.99	.99	54.	44.	10.0	348.	51.5
31.5			.350	.63	.63	56.	44.	5.7	346.	41.1
10.5A	1803.0	1013.065	.200	.36	.36	56.	44.	3.0	323.	30.6

O R S A T

CO2	14.5
O2	5.0
CO	.0
N	80.5

IMPINGER NO.	1	-20.6
	2	39.0
	3	21.5
	4	.0
ABSORBED H2O		35.4

CONTROL BOX CALIBRATIONS

	FACTOR	DATE
ORIFICE	1.724	11-12-92
METER	1.0094	11-12-92
PITOT	0.84	12-11-92

LEAK CHECK

	RATE	IN.HG
INITIAL	LT 0.02CFM	5.0
FINAL	0.050CFM	18.0

CONTROL BOX NO. 3 — PROBE NO. 15-1 — NOZZLE NO. 37

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN BOILER NO.2 OUTLET
ICF-BRE-3 12-18-92

STACK SAMPLING CALCULATIONS

A.	BAROMETRIC PRESSURE IN. HG.....	29.22
B.	AVG. DELTA H (IN H2O).....	1.08
C.	METER PRESSURE (IN. HG.).....	29.30
D.	STATIC PRESSURE (IN. H2O).....	-.60
E.	STATIC PRESSURE (IN. HG.).....	-.044
F.	STACK PRESSURE (IN. HG.) (A+E).....	29.18
G.	STACK DIMENSIONS 96.0 X 126.0 IN.	
H.	STACK AREA (SQ. FT.).....	84.00
	(LENGTH X WIDTH)	
	NOZZLE DIAMETER.....	.2400
I.	NOZZLE AREA (SQ. FT.).....	.000314
J.	AVG. STACK TEMP (DEG. R.).....	804.7
K.	AVG. METER TEMP (DEG. R.).....	507.8
L.	CONDENSATE VOL. (ML).....	39.9
M.	ABSORBED H2O (ML).....	35.4
N.	TOTAL H2O (ML).....	75.3
O.	METERED GAS (CF).....	36.197
P.	GAS METER CORRECTION.....	1.0094
Q.	CORRECTED METERED GAS (CF).....	36.537
R.	H2O GAS VOLUME (CF) (0.00267N(K/C).....	3.485
S.	TOTAL SAMPLED VOLUME (CF) (Q+R).....	40.022
T.	PERCENT H2O (100R/S).....	8.71
	THEORETICAL MAXIMUM.....	100.00
	PERCENT WATER USED.....	8.71
U.	SCFD GAS SAMPLED (528*Q*C/(29.9*K)).....	37.225
V.	MOLECULAR WEIGHT OF STACK GAS	

COMPONENT	ORSAT-DRY VOL.PCT./100	X	MOISTURE CORRECTION (1-T/100)	X	MOLECULAR WEIGHT	=	WEIGHT PER MOLE
CO2	.145	X	.9129	X	44.0	=	5.82
CO	.000	X	.9129	X	28.0	=	.00
O2	.050	X	.9129	X	32.0	=	1.46
SULFURIC ACID	.000	X	.9129	X	98.0	=	.00
N2	.805	X	.9129	X	28.2	=	20.72
H2O		X	T/100= .0871	X	18.0	=	1.57
					MOLECULAR WEIGHT OF STACK GAS	=	29.58

W.	PITOT CORRECTION.....	.840
X.	AVERAGE CORRECTED VELOCITY (FPS).....	53.98
	[85.49*W*SQRT{(J*DELTA P)/(V*F)}]	
Y.	AVG. FLOW RATE (CFM) (X*H*60).....	272048.
Z.	STACK FLOW RATE (SCFM) (528*Y/J*F/29.92).....	174071.
	STACK FLOW RATE (DRY).....	158915.
AA.	SAMPLE TIME (SEC).....	3600.
BB.	PERCENT ISOKINETIC.....	104.39
	(J*100*U*29.92)/(528*X*AA*I*F*(1-T/100))	

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
AIR QUALITY ENGINEERING

ICF KAISER ENGINEERS
RICHMOND, IN BOILER NO.2 OUTLET
ICF-BRE-3 12-18-92

PARAMETER	CYCLONE WT. (G)	MATL.ON FILTER(G)	INSOL.MATL. IN PROBE(G)	SOL.MATL. IN PROBE(G)
PARTICULATE	.00000	.08550	.00000	.16780
SULFURIC ACID	.00000	.00000	.00000	.00000

PARAMETER	INSOL.MATL. IN IMP.(G)	SOLUBLE MATL. IN IMP.(G)
PARTICULATE	.00000	.00000
SULFURIC ACID	.00000	.00700

PARTICULATE	.25330
SULFURIC ACID	.00700
ALL MATLS.	.26030

PARAMETER	MW	PPM	GR/SCFD	LB/H R
PARTICULATE			.10479	142.73610
SULFURIC ACID	98.0	1.63	.00290	3.94454

Emission rates are based on the PP method.
The results include total sample train catch