APPENDIX NO. 20

Hazardous Air Pollution Monitoring Report

HAZARDOUS AIR POLLUTION MONITORING: DEMONSTRATION OF COAL REBURNING FOR CYCLONE BOILER NO_x CONTROL

Test Report

June 1993

Acurex Environmental Project No. 6676

Prepared For

Babcock & Wilcox
Research & Development Division
1562 Beeson Street
Alliance, Ohio 44601

By

Acurex Environmental Corporation
555 Clyde Avenue
P.O. Box 7044
Mountain View, California 94039

Acurex Environmental
CORPORATION
A Geraghty & Miller Company

HAZARDOUS AIR POLLUTION MONITORING: DEMONSTRATION OF COAL REBURNING FOR CYCLONE BOILER NO_x CONTROL

Test Report

June 1993

Acurex Environmental Project No. 6676

Prepared For

Babcock & Wilcox
Research & Development Division
1562 Beeson Street
Alliance, Ohio 44601

By

Acurex Environmental Corporation
555 Clyde Avenue
P.O. Box 7044
Mountain View, California 94039

TABLE OF CONTENTS

SECTION 1 INTRODUCTION AND SUMMARY 1-1

SECTION 2 FACILITY DESCRIPTION 2-1

SECTION 3 TEST PLAN 3-1

3.1 TEST MATRIX 3-1

3.2 SAMPLING PROCEDURES 3-6

3.2.1 Continuous Emission Monitoring 3-6
3.2.2 Particulate Loading Upstream of ESP: Method 17 3-6
3.2.3 Downstream ESP: Semivolatile Organics 3-9
3.2.4 Downstream ESP: Volatile Organics 3-9
3.2.5 Upstream ESP: Multiple Metals Method 3-12
3.2.6 Downstream ESP: Multiple Metals Train 3-12
3.2.7 Downstream ESP: Method 5 and Method 421 Acid Gases 3-12
3.2.8 Downstream ESP Aldehydes 3-15
3.2.9 Solids Sampling 3-15
3.2.10 Quality Assurance 3-17

SECTION 4 TEST RESULTS 4-1

4.1 CONTINUOUS EMISSIONS MONITORING 4-2
4.2 PARTICULATE MEASUREMENTS 4-2
4.3 TRACE METALS 4-5
4.4 VOLATILE ORGANICS 4-31
4.5 SEMI-VOLATILE ORGANICS 4-13
4.6 ALDEHYDES 4-16
4.8 CHLORIDES AND FLUORIDES 4-16
4.9 QUALITY ASSSURANCE 4-17

LIST OF ILLUSTRATIONS

Figure 2-1. Test facility 2-2

Figure 3-1. Sampling location 3-2

Figure 3-2. Orientation of sampling ports 3-5

Figure 3-3. Continuous emission monitoring system 3-7

Figure 3-4. Method 17 particulate train 3-8

Figure 3-5. Modified Method 5 organics train 3-10

Figure 3-6. Volatile organics sampling train 3-11

Figure 3-7. Metals sampling train 3-13

Figure 3-8. Method 5-421 acid gas sampling train 3-14

Figure 3-9. Method 430 sampling train for formaldehyde and acetaldehyde 3-16

LIST OF TABLES

Table 3-1. Test matrix for air toxics testing 3-4

Table 4-1. Test Run Summary 4-1

Table 4-2. Coal analyses 4-3

Table 4-3. Particulate Results at ESP Inlet and Outlet 4-4

Table 4-4. Trace metal emissions results at ESP outlet 4-6

Table 4-5. Metals partitioning results, Baseline A 4-7

Table 4-6. Volatile organics results as ESP outlet 4-14

Table 4-7. Organics results at ESP outlet 4-15

Table 4-8. Aldehyde Results at ESP Outlet 4-16

Table 4-9. Chloride/fluoride emission results — ESP outlet 4-17

Table 4-10. Flue gas emissions summary at ESP outlet 4-18

Table 4-11. QA objectives for MDLs 4-19

Table 4-12. CEM Performance Checks 4-21

Table 4-13. Metals train/acid gas audit sample 4-21

Table 4-14. Coal, ash, and slag samples audit sample 4-22

Table 4-15. Average surrogate recoveries 4-23

Table 4-16. Percent recovery of aldehyde trip spikes 4-23

SECTION 1

INTRODUCTION AND SUMMARY

Unit 2 at the Nelson Dewey Station of Wisconsin Power and Light was selected for detailed emission characterization of hazardous air pollutants (HAP). Unit 2 is a 100 MW coal-fired cyclone unit retrofit in 1991 with coal reburn for NO_x reduction. This unit was selected for testing for the following reasons:

- Hazardous air pollutant emission measurements for utility power boilers are needed to decide if and how to implement HAP control measures mandated by the 1990 Clean Air Act Amendments (CAAA).
- Cyclone-fired boilers are a significant part of the utility population and cyclone firing may strongly affect the composition and concentration of HAP emissions.
- The current data base for cyclone units is sparser than for other boiler firing types.
- Coal reburn is a promising technology for adoption by other cyclone units; this is the first full-scale field evaluation.

Title III of the 1990 CAAA listed 189 HAP compounds or substances of possible concern in air toxics control. These substances span the range of trace metals, other inorganics, organics, pesticides, and radionuclides. In utility boilers, only a fraction of the listed substances would be emitted in significant concentrations. The question of which substances are of most concern in utility boilers depends on the fuel composition, the boiler operation, and on the efficiency of emission controls. In boilers, most of the inorganic compounds formed are directly related to the mineral matter in the fuel. Organics formation is strongly affected by combustion conditions. Once formed, the partitioning of both inorganic and organic compounds around the possible gaseous and solid

boiler effluent streams depends on the downstream boiler air pollution control equipment. Studies by the Electric Power Research Institute (EPRI), the Department of Energy (DOE), and the EPA have identified the following classes of substances as high priority based on expected probability of occurrence and risk:

- Trace metal emissions and particularly, the partitioning of metals into the flue gas and solid streams.
- Flue gas emissions of semi-volatile organics, primarily polynuclear aromatics (PNA).
- Flue gas emissions of volatile organics, primarily benzene and toluene.
- Flue gas emissions of aldehydes.
- Flue gas emissions of total acid gases (chlorides and fluorides).

Additionally, to obtain perspective on the quality and quantity of HAP emissions, other boiler parameters are of interest:

- Criteria emissions: particulate, O_2, NO_x, SO_2, CO, CO_2, and the associated efficiency of the particulate and NO_x and/or SO_x controls.
- Partitioning of non-HAP inorganics in coal.

The purpose of this test was to obtain triplicate HAP emissions data for the WP&L coal-fired cyclone boiler operated in both the baseline, uncontrolled mode and in the coal-reburn low NO_x mode. Testing was specifically scheduled during firing of the midwestern medium sulfur coal which was the test coal for the reburning project. The Unit 2 boiler was tested on November 2 through November 6, 1992. The field sampling and post test analyses included the following:

- Continuous emissions monitoring of O_2, NO_x, CO, CO_2, and SO_2;
- Particulate loading upstream and downstream of the ESP;
- Trace metals emissions upstream and downstream of the ESP;
- Volatile and semi-volatile organics, aldehydes, and chlorides/fluorides emissions downstream of the ESP;
- Inlet concentrations in the coal feed stream of trace metals and chlorides/fluorides;

- Trace metals concentrations in the ESP hopper and cyclone slag discharge streams.

All runs were conducted at full load with near-optimum excess air levels. The reburn hardware was operated at the preferred operational settings determined during the earlier parametric and optimization testing. Soot blowing was curtailed during testing to promote uniformity. During testing, the unit fired the remaining supply of Indiana Lamar coal prior to converting over to low-sulfur western coal. The scheduling and duration of testing was chosen to obtain the maximum of useable data for the limited coal supply.

Observations and conclusions based on the emissions data and operational data are as follows:

- HAP emissions were generally well within expected levels. No unexpectedly high emissions, attributable either to cyclone firing or to reburn, were observed.
- HAP emissions with reburn were comparable to baseline non-reburn operation. Particle loading at the ESP outlet appeared to be reduced somewhat with reburning, even though reburn causes a higher ash loading to the upper furnace than pure cyclone firing. This effect could result from the larger particle sizing at the ESP inlet with reburn. Apart from this effect, no significant HAP effect attributable to reburn was noticed.
- The unit exhibited considerable variability in HAP emissions with replicate runs. This is consistent with the observations during earlier non-HAP testing. The variability is due in part to significant variations in coal composition which caused variations of a factor of two or more in some trace species over a run or between runs. Test runs at the ESP outlet which required up to 6 hours may reflect some of this variability.
- Heavy metals did not exhibit any strong partitioning tendency. These species partitioned roughly equally between the slag and flue gas stream in the furnace and between hopper ash and outlet around the ESP. Mass balances around the furnace and around the ESP were generally in the range of 0.5 to 2.0 for the heavy metals.

- Mass balances with the volatile metals, arsenic, selenium, and mercury, were poor. The mass balance calculation is aggravated by non-detectable concentrations for most of the solid stream samples. The flue gas samples at the ESP inlet and outlet were more quantifiable because of the long run times used specifically to obtain detectable limits.
- Mercury and selenium exhibited tendencies to enrich to smaller particle sizes which escape the ESP.
- None of the 16 targeted polynuclear aromatic semi-volatile organics was present in detectable concentrations, at a detection limit of 1.2 parts per billion level, for either baseline or reburn.
- Of the 28 targeted volatile organics analyzed, the only compounds present at detectable levels were benzene and toluene. Toluene was present at levels of 0.07 - 0.77 ppb, with an average of 0.41 ppb, and benzene was present at levels of 0.2 to 4 ppb with an average of 0.55. No discernable effect of reburn was evident.
- Aldehydes were non detectable at the 2.8 ppb level for formaldehyde and 1.9 ppb level for acetaldehyde; only one of the 6 runs gave detectable levels, and these were marginally above the detectable limit.

SECTION 2

FACILITY DESCRIPTION

The specifications of the WP&L host site test facility are as follows:

Utility: Wisconsin Power & Light, Nelson Dewey Unit No. 2.

Location: County Trunk VV, Cassville, Grant County Wisconsin 53806.

Boiler Type: Babcock & Wilcox, cyclone fired reheat

Boiler Model: B&W R8-369

Burner Configuration: Three single-wall cyclones

Preheat: Tubular primary and secondary preheat

Draft type: Forced draft with a duct pressure of 20 in. H_2O at the ESP

Boiler Capacity: 100 MW_e

Installed: October, 1962

Fuel: Indiana Lamar bituminous

Reburn burners: Pulverized coal single-wall-fired

Particulate control: Dual Research Cottrell electrostatic precipitator

Figure 2-1 shows the overall unit 2 configuration with the reburn retrofit. The low-NO_x reburn retrofit consisted of installation of the pulverizer, reburn burners in the upper furnace, overfire air ports, and modifications to the control system. The unit could be operated in either the baseline mode without the reburn burners or in the low-NO_x mode with approximately 20 percent of the heat input from the reburn burners. Under low NO_x reburn operation, the existing cyclone burners are fired with 70 to 80 percent of the total coal feed as crushed coal. The cyclones are operated at around 110 percent excess air in the main combustion zone. The reburn burners

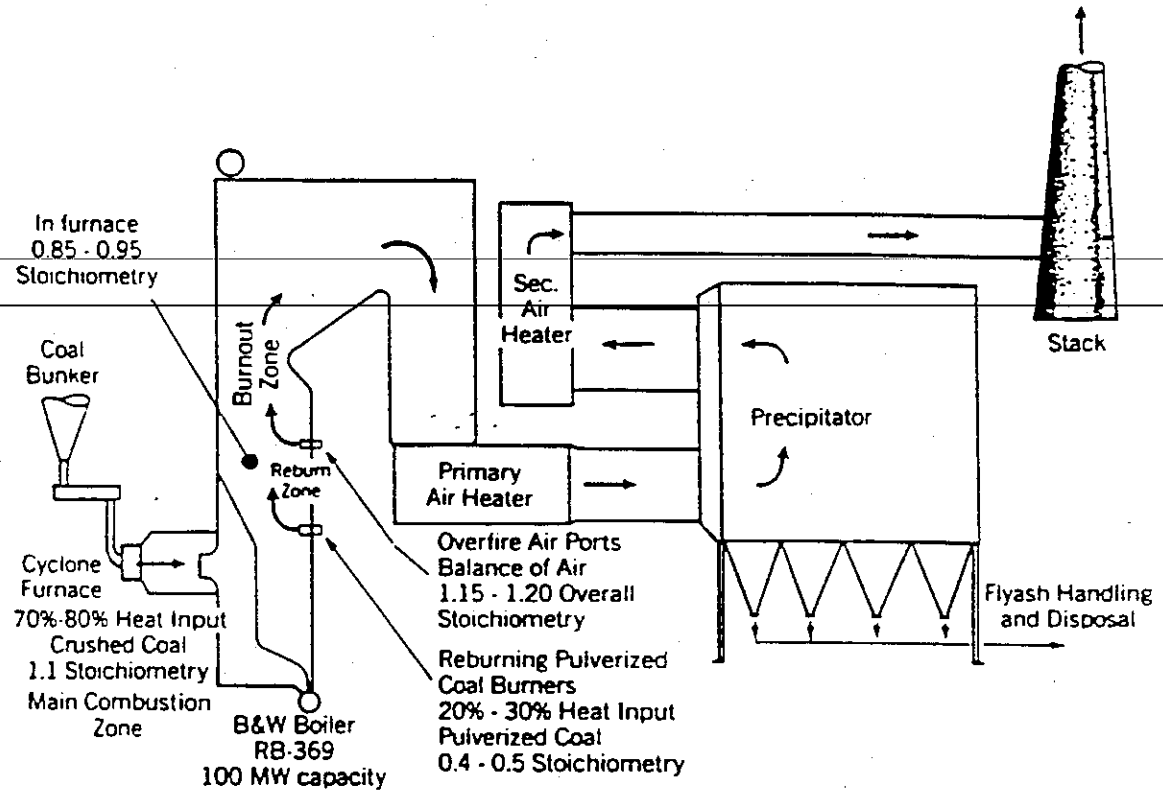


Figure 2-1. Test facility

are fired with the remaining 20 to 30 percent of the coal feed as pulverized coal. These reburn burners are operated fuel rich at a reducing stoichiometry of 0.85 to 0.95. This reducing condition converts the nitrogen oxides formed in the cyclone burners to molecular nitrogen, thereby reducing NO_x. The balance of air required to complete combustion is added in the burnout zone above the reburn zone through the use of overfire air ports.

The standard baseline coal which was used throughout the development of the reburn system was a bituminous Indiana Lamar coal with a heating value of about 11,500 Btu/lb, a sulfur level of about 1.6 percent, and ash content of about 9 percent. Analyses of the coal are given in Section 4. The plant was converting to subbituminous western coal as the standard fuel after the test. As a result, the remaining supply of Lamar coal was very limited and the plant totally consumed the

residual Lamar supply during the HAP testing. Some decisions on test priorities, sequencing, and duration of runs were structured around the need to stretch out the coal supply. To conserve coal, the unit was normally operated at low load between tests. During testing, and 2 hours before, the unit was operated at full load. At other times, however, the unit was fired at the lowest practical load to conserve remaining coal and maximize the flexibility for test run times.

Unit 2 is equipped with a Research Cottrell electrostatic precipitator for particulate control. The average particulate collection efficiency is around 98 percent. The plant is equipped with a Black and Veatch process data acquisition system. This was used during the test to obtain steam, air, and fuel flows and steam pressures and temperatures during all run periods.

SECTION 3

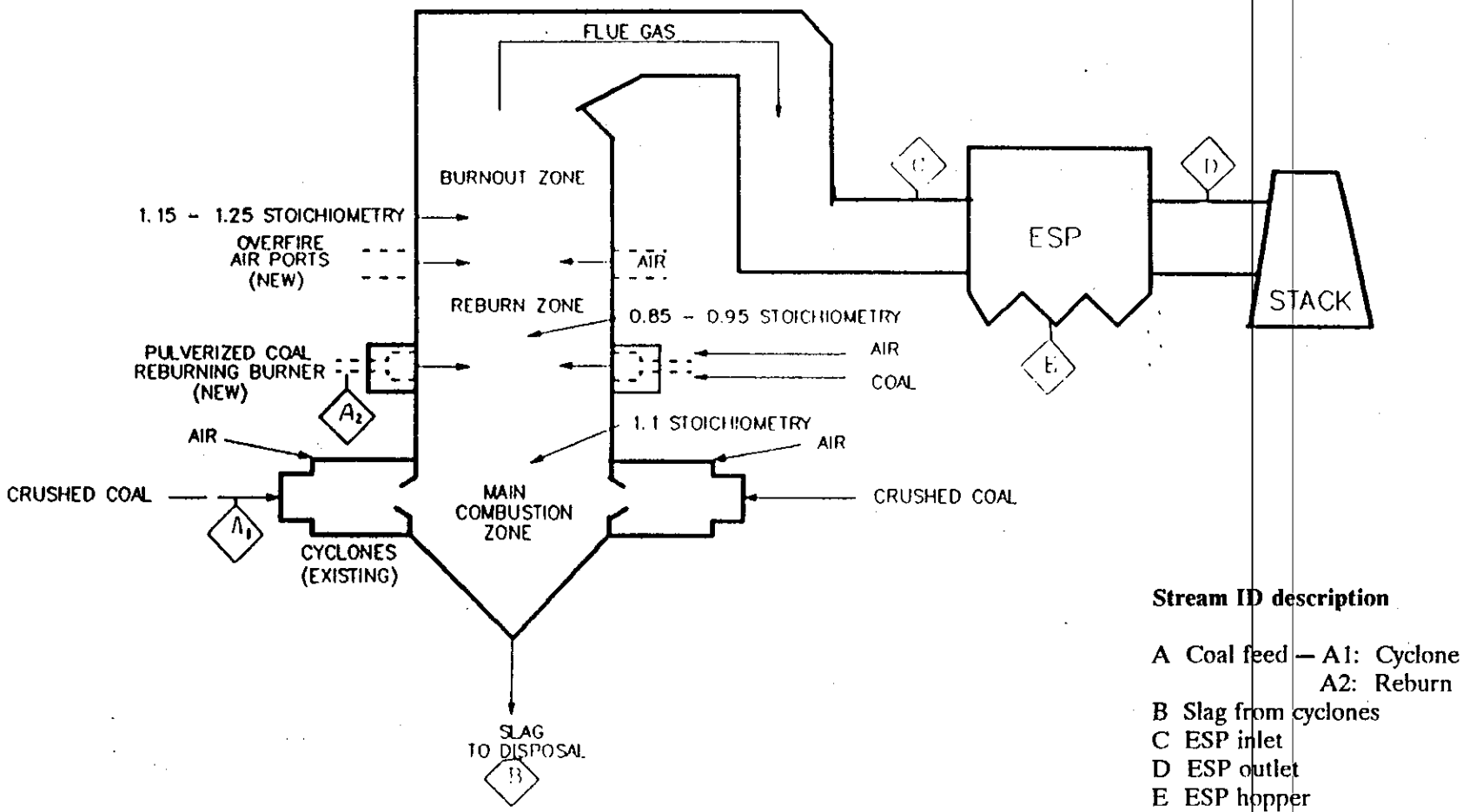
TEST PLAN

3.1 TEST MATRIX

The test plan was developed to obtain flue gas emissions of trace metals, acid gases, semi-volatile and volatile organics, and aldehydes, and to quantify trace metal partitioning around the furnace and the ESP A schematic of sample locations is shown on Figure 3-1. The primary sampling stations are:

- A_1: Crushed coal from the cyclone gravimetric weigh feeder,
- A_2: Reburn coal pulverizer outlet,
- B: Furnace molten slag tap into quench tanks
- C: Flue gas sampling ports (8) at ESP inlet (divided duct),
- D: Flue gas sampling ports (10) at ESP outlet (divided duct),
- E: ESP hopper ash.

Grab samples of the inlet and outlet streams, A_1, A_2, B, and E were taken periodically during the run and composited to one sample per stream per run. At the coal feeders, pulverizer outlet, and ESP hoppers, where multiple solid sampling stations exist, a rotational sequence was established so that all stations would be sampled at least once during the run. At the slag quench tanks which were sampled only twice per run, each of the two tanks was sampled for each grab cycle and composited for analysis. The following extractive flue gas samples were taken upstream and downstream of the ESP to determine partitioning and emission rates:



Stream ID description

A Coal feed — A1: Cyclone
A2: Reburn
B Slag from cyclones
C ESP inlet
D ESP outlet
E ESP hopper

Figure 3-1. Sampling locations

Upstream	Downstream
Particulate loading (M17)	Particulate loading (M5)
Multiple metals	Multiple metals
	Acid gases
	Aldehydes
	Semi-volatile organics
	Volatile organics.

In addition, continuous emission monitors were required throughout the duration of the test, as was downloading of boiler process data. The overall sampling and analysis matrix is summarized in Table 3-1. The sampling and analysis protocols were based on standard EPA protocols or other documented methods for the constituents and concentrations of interest. The sample run times indicated on Table 3-1 were selected based on the sample volumes needed to obtain a target detectable limit using the results of prior testing at the same boiler for estimates, and on the known coal composition. These run times had a margin of safety so that when two runs were required in a single day, the maximum run time per test could be reduced to 4 hours.

The longest scheduled run time was at the ESP outlet in order to obtain detectable limits of low concentration metals in the flue gas after particulate collection. A 6-hour run time was normally used. Because of the necessity to simultaneously traverse for multiple metals, particulate and semi-volatile organics, the run times for these 3 trains was increased to nominally 6 hours so the respective traverses over the 6 open ports could be synchronized.

The sampling upstream of the ESP was generally scheduled to coincide with the central period of downstream sampling, so inlet-outlet comparisons would be most representative. For this reason, inlet sampling times were extended in some cases to cover a larger period of outlet sampling times.

The unit has divided ducts downstream of the primary preheater. Figure 3-2 shows the orientation of the ducts and the sampling ports relative to the ESP. The flue gas in the sampling

Table 3-1. Test matrix for air toxics testing

Sample	Location	Sampling Protocol	Analytical Protocol	Sample Time
Coal	Cyclone inlet; pulverizer outlet	Daily composite	ASTM D3178, Percent Carbon ASTM D1989-91, HHV ASTM D3176-89, Ultimate ASTM D5142-90, Proximate EPA 7060, 7091, 7131, 7191, 7421, 7520, 7450 7740, AA or 6010 ICP ASTM D 3684-78, Hg CVAA	Grab samples each 60 to 90 minutes
Cyclone slag	Slag quench	Daily composite	ASTM D3178, Percent Carbon EPA 7060, 7091, 7131, 7191, 7421, 7520 7450, 7740, AA or 6010 ICP ASTM D 3684-78, HG CVAA	Two grab samples per run
EPA hopper ash	Hopper ash conveyors	Daily composite	ASTM D3178, Percent Carbon EPA 7060, 7091, 7131, 7191, 7421, 7520, 7450, 7740, AA or 6010 ICP ASTM D 3684-78, Hg CVAA	Grab samples each 60 to 90 minutes
Particle loading	ESP inlet ESP inlet	EPA Method 17, isokinetic EPA Method 5, isokinetic	EPA Method 17, gravimetric EPA Method 5, gravimetric	1-5 hour 4 hours
Metals loading	ESP inlet ESP outlet	EPA Multiple Metals (As, Be, Cd, Cr, Pb, Ni, Mg, Se, Hg)	EPA Multiple Metals—ICP, AA	4 & 6 hours
Semivolatile organics, PAHs	ESP outlet	EPA Modified Method 5, XAD resin, SW-846 0010, isokinetic	EPA MM 5, gravimetric, XAD resin EPA 8270 GC/MS, PAHs	4 hours
Volatile organics, benzene, toluene	ESP outlet	EPA Method 0030, VOST modified w/CMS sorbent	EPA SW-846 Method 5041, GC/MS capillary	3 hours (6 tubes, 0.5 hr each)
Formaldehyde	ESP outlet	CARB 430, DNPH midget	HPLC	4 hours
Acid gases, HCl, HF	ESP outlet	CARB 421, Carbonate impingers	CARB 421, ion chromatography for Cl, F	4 hours
Criteria gases	ESP outlet	EPA Methods 3A, 6C, 7E, 10	O_2, CO_2, CO, NO_x, SO_2	2 hours

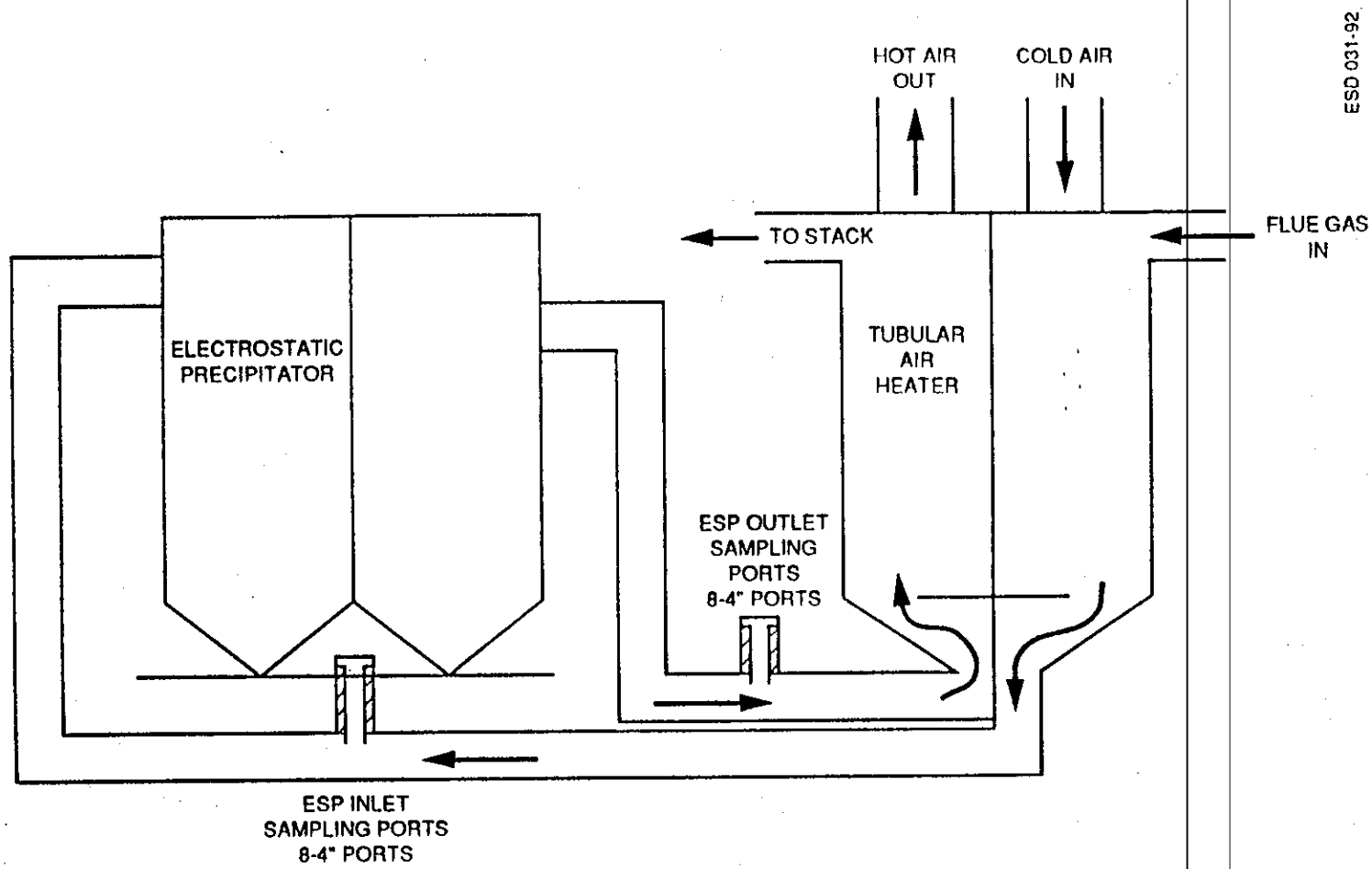


Figure 3-2. Orientation of sampling ports

region was at 20 in. H_2O pressure and above 500°F. Each of the ducts upstream and downstream of the ESP was fitted with 4 vertical sampling ports, 4 in. ID with a flange at the opening. One of the downstream ports on each of the ducts was also used for the continuous emissions monitor (CEM) tap, so 6 of the 8 ports were used for traversing. Two ports were installed in the side wall of each outlet duct for use in these tests to sample gaseous species not requiring isokinetic traverse.

3.2 SAMPLING PROCEDURES

3.2.1 Continuous Emission Monitoring

Prior to the HAP testing, the boiler had been operating with an Acurex Environmental DiluCEM 500 continuous emission monitoring system installed in May, 1992. Figure 3-3 shows a schematic of the CEM system. The unit had been operating in the automatic mode and was converted to manual operation for the HAP testing. The CEM sample was drawn from the sampling ports downstream of the ESP. During previous tests, traverses of the emission stratification in the ducting was made and an average emission point identified in each duct. For this test, the CEM sample was extracted from this average emissions point in each of the downstream ducts and blended in approximately equal quantities for analysis by the CEM. The CEM system was housed in a trailer adjacent to the ESP.

Prior to the start of each test run, the CEM system was calibrated and evaluated for bias and drift according to EPA protocols 7E and 6C. Following calibration, and before the start of the extractive sampling trains, the CEM system was brought on-line and run during the duration of the sampling. At the conclusion of the sample run, the system was again calibrated.

3.2.2 Particulate Loading Upstream of ESP: Method 17

Method 17 was used for the upstream particulate sampling because of the high particulate loading. This method had been used for the three earlier field tests on this unit. A schematic of the trains is shown on Figure 3-4. Although only a single M17 train was required per test run, duplicate runs were made because of the importance of this parameter in interpreting reburn

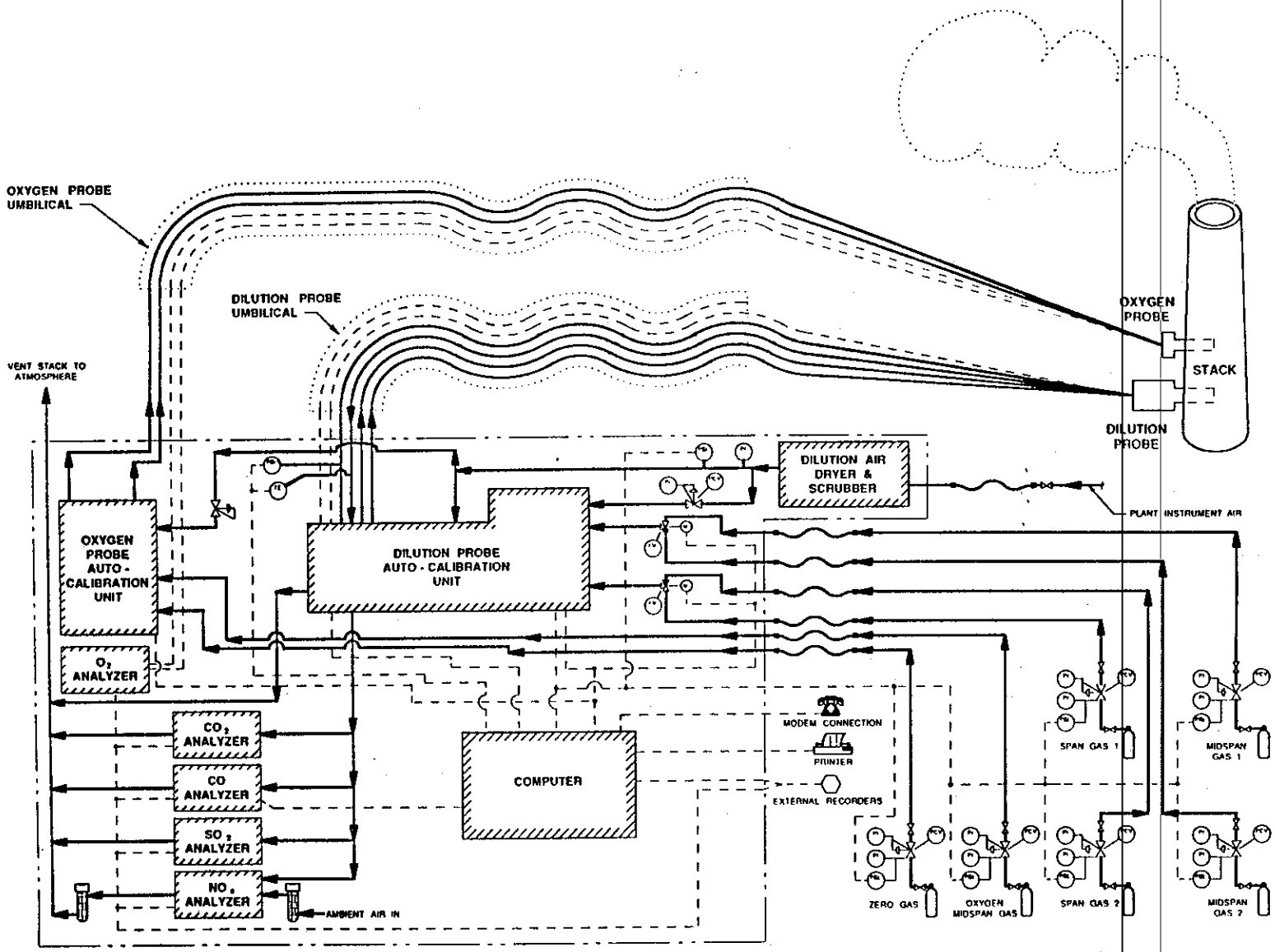


Figure 3-3. Continuous emission monitoring system

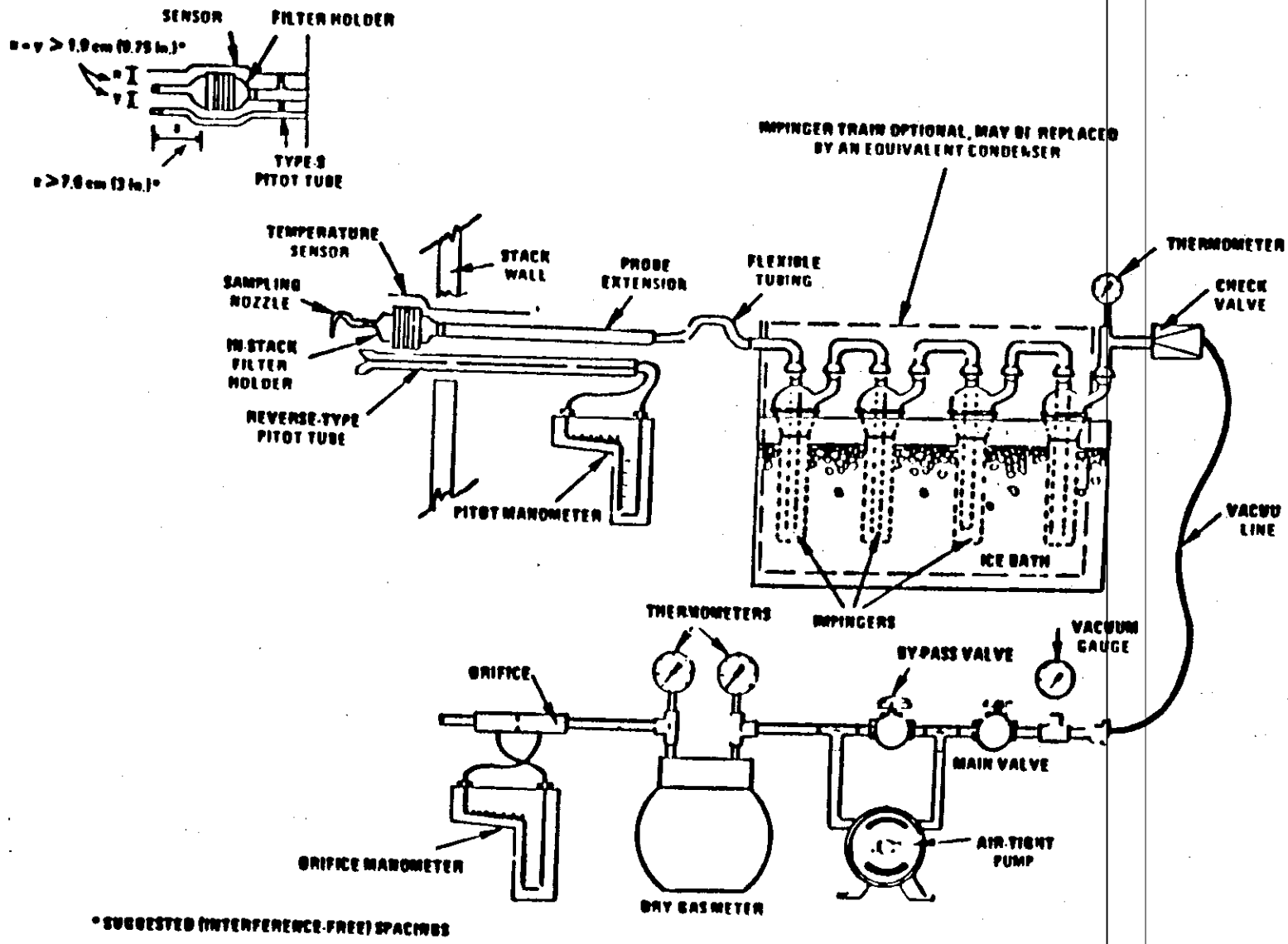


Figure 3-4. Method 17 particulate train

performance relative to baseline. Two 90 minute isokinetic traverses of the two ducts were done successively.

3.2.3 Downstream ESP: Semivolatile Organics

Semi-volatile organics, principally polycyclic organics, were sampled with the modified Method 5 (MM5) train fitted with the organic resin trap. A schematic of the train, designated SW-846 Method 0010, is shown on Figure 3-5. The XAD-2 organics sorbent was prepared and subjected to QA procedures at the Acurex Environmental laboratory. The MM5 train was sequentially traversed with the M5/acids Method 421 train and the multiple metals train over the 6 ESP downstream ports.

3.2.4 Downstream ESP: Volatile Organics

Volatile organics were sampled with a modification of the Volatile Organics Sampling Train (VOST), designated SW-846 Method 0030, and shown on Figure 3-6. Since the sampled compounds are gaseous, no isokinetic traverse was required. Since some stratification can exist between the two ducts, however, each duct was sampled sequentially. The modification implemented for the present test was to use carbon molecular sieve (CMS) sorbent cartridges rather than the Tenax traps specified in Method 0030. The substitution was motivated by the well known problem of Tenax evolving benzene and toluene as decomposition products. The CMS is also considerably less sensitive to contamination than Tenax. The use of CMS is routine with method TO-02. Three sorbent tubes were sampled at each duct with a sampling time of 30 minutes per tube. A special port on each duct was provided for this sampling so the activity would not need to be synchronized with the particulate, metals, and semi-volatile organics sampling. Three tubes were sampled on the left duct and the train was moved to the right duct for the required three samples there. Following sampling, the cartridges were stored in isolated containers and kept isolated from reagents and other volatiles prior to shipment to the laboratory.

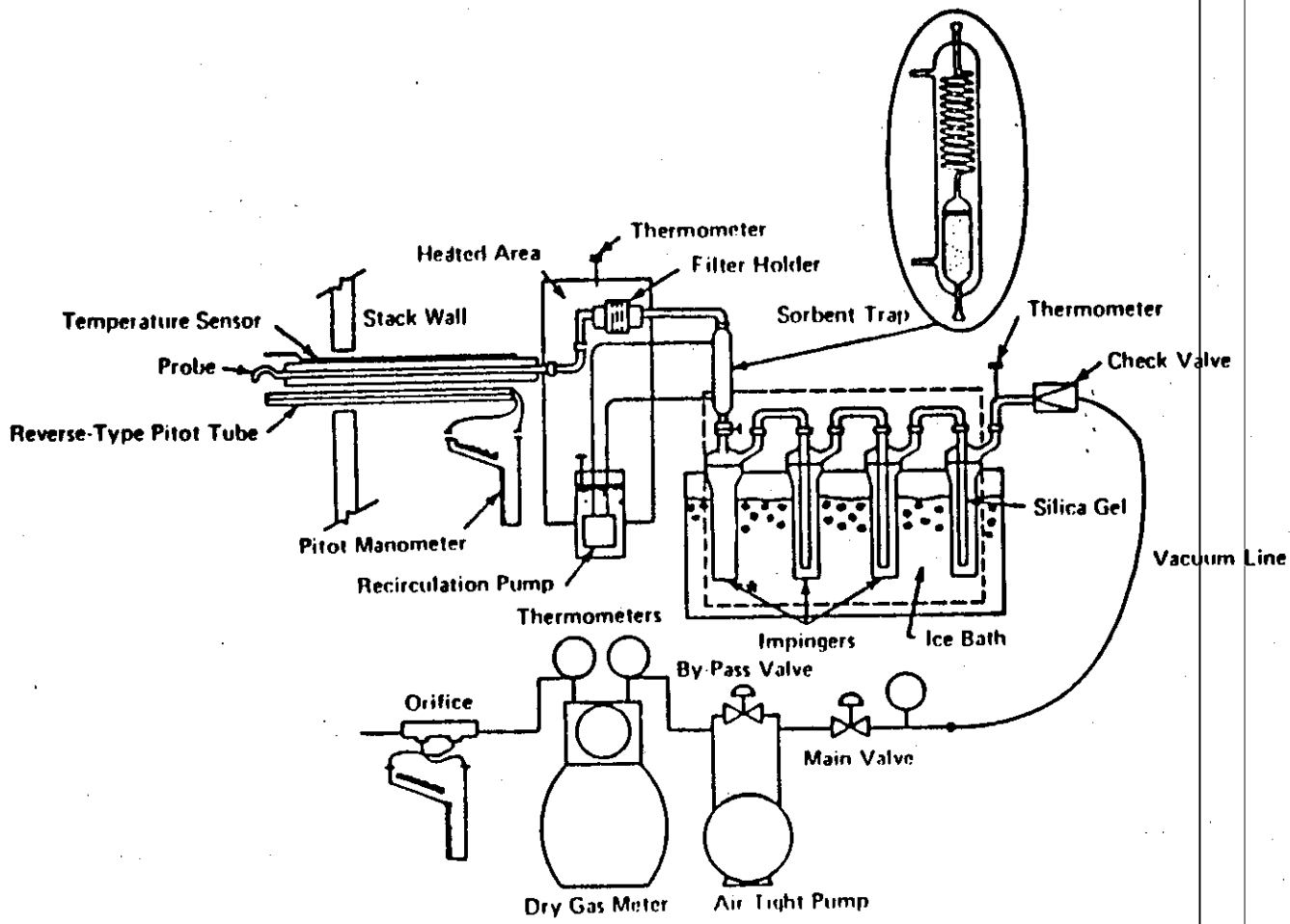


Figure 3-5. Modified Method 5 organics train

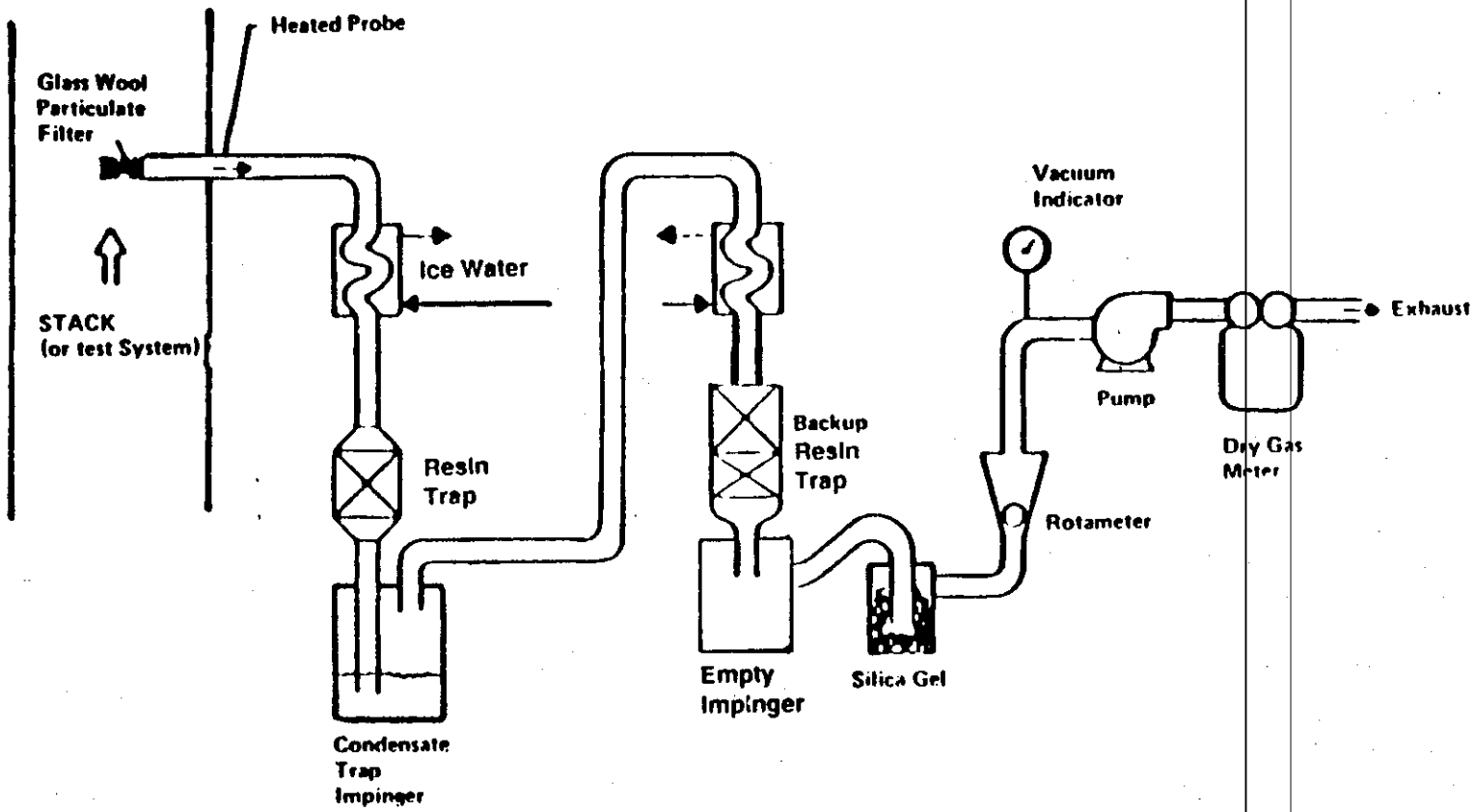


Figure 3-6. Volatile organics sampling train

3.2.5 Upstream ESP: Multiple Metals Method

Trace metals emissions were sampled with the multiple metals train developed for EPA's Boiler and Industrial Furnace (BIF) standard and designated as SW-846 Method 0012. Figure 3-7 shows a schematic of the sampling train.

The train was run for a total of 4 hours and was started one-hour after the downstream train to better span the longer downstream schedule. Because of the high particulate loading upstream of the ESP, filter changes were sometimes required as triggered by the filter pressure drop. A complete isokinetic traverse was made over the 8 ports of the two ducts. A sampling rate of 0.75 dscfm was used. No gravimetric post-test analysis were made of the metals train filter to avoid possible loss of volatile metals during filter desiccation.

3.2.6 Downstream ESP: Multiple Metals Train

Downstream metals quantitation was made with the Method 0012 train as used at the upstream ports. The downstream train was the schedule-pacing item for the entire test run in order to obtain a detectable concentrations of metals identified in the coal. Prior metals train runs at this boiler by Acurex Environmental showed detectable levels of all metals of concern with 90 minutes sampling time. A 6 hour run was selected to provide a considerable safety margin of detectability.

3.2.7 Downstream ESP: Method 5 and Method 421 Acid Gases

The test matrix required both M5 particulate loading and acid gases, Cl and F, downstream of the ESP. These parameters were sampled simultaneously by using carbonate impingers with the M5 particulate train. This dual function is acceptable since only the front half catch is used for particulate loading, and the back half is used for acid gases. The protocol and configuration for this type of sampling is CARB 421. Figure 3-8 shows a schematic of the train.

The M5/acid gases train was run for 6 hours at a sample rate of 0.75 dscfm and traversed isokinetically over the 6 available ports at the ESP outlet. The traverse was coordinated with the other two isokinetic trains at the ESP outlet: semivolatile organics MM5, and multiple metals.

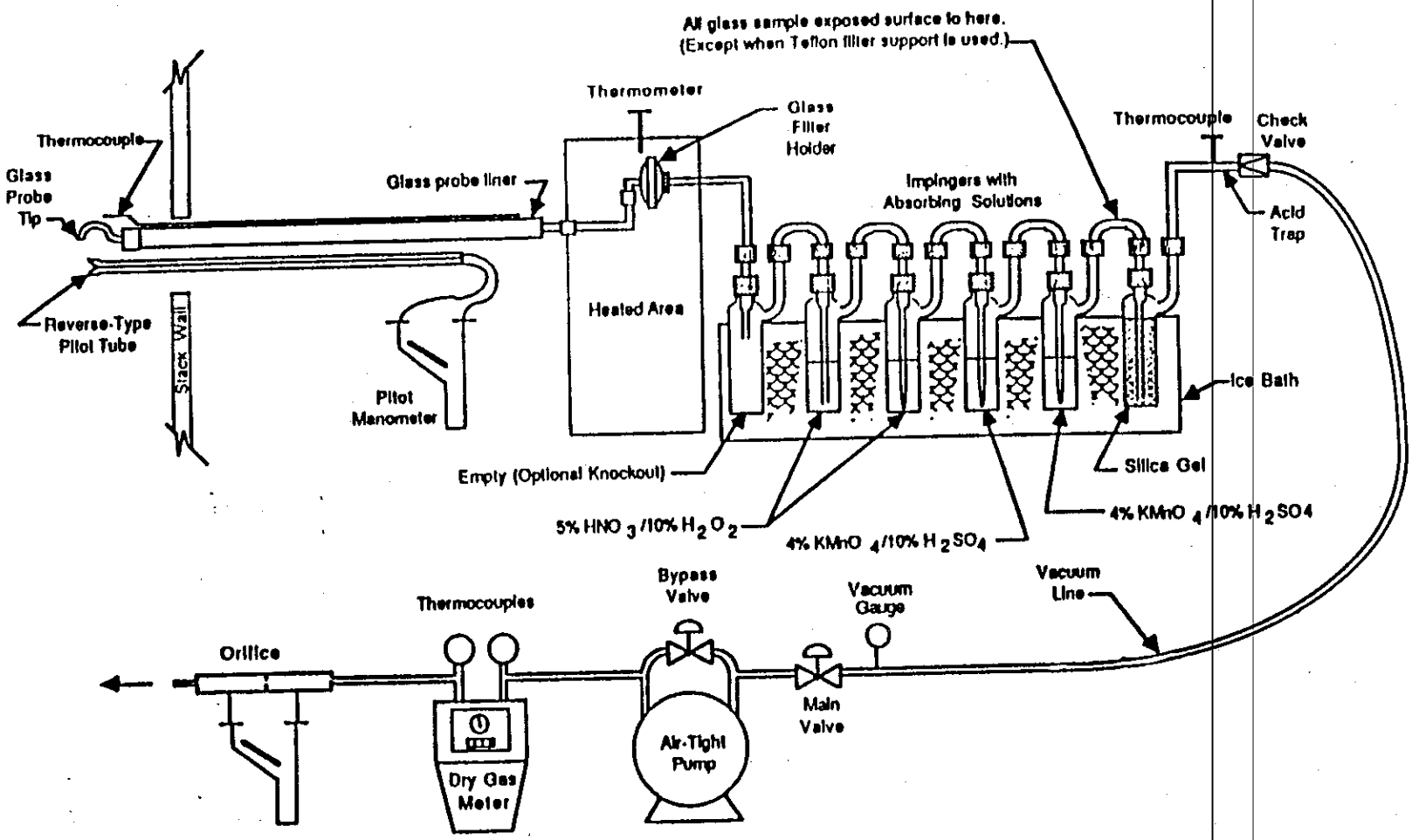


Figure 3-7. Metals sampling train

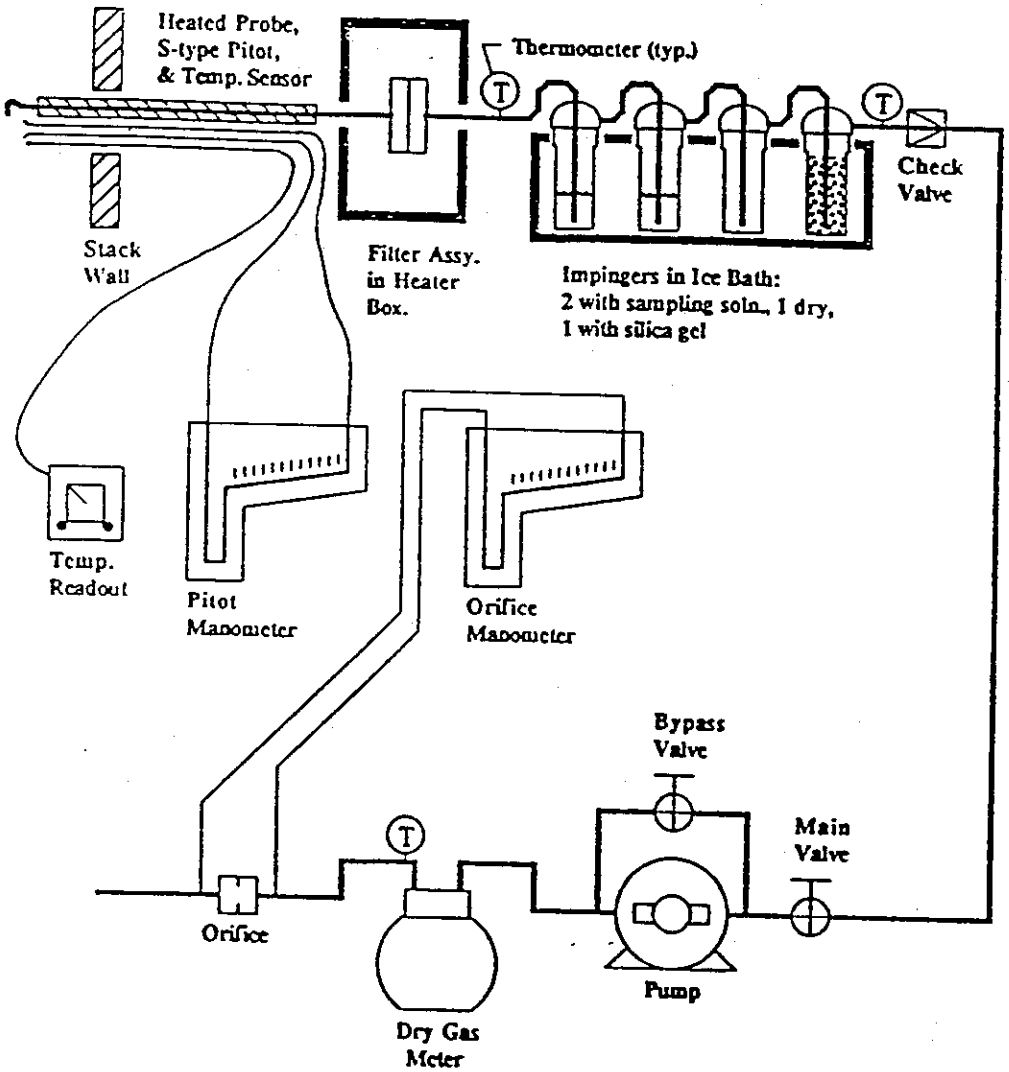


Figure 3-8. Method 5-421 acid gas sampling train

3.2.8 Downstream ESP Aldehydes

Aldehyde sampling was done with the CARB 430 train which uses impingers of 2,4-dinitrophenyl1-hydrazine (DNPH) as a reagent for flue gas aldehydes. This procedure does not require isokinetic sampling, but did require sequential sampling of both ducts. A sampling rate of 1 L/min was used for a total run time of one hour on each duct. Figure 3-9 shows a schematic of the CARB 430 train. The DNPH was prepared according to protocol and used within 48 hours of preparation. Expended DNPH impingers were shipped daily to the lab for analysis.

3.2.9 Solids Sampling

Coal samples into the cyclone were done at the gravimetric feeder. A grab sample of 250 mL was taken approximately each 90 minutes and composited at the end of the day to one 500 mL sample using equal portions from each grab sample.

Coal sampling at the pulverizer outlet was done with a special probe which inserts into the coal duct and scalps the coal with a cyclone from which the catch deposited into a glass sample jar. Approximately 100 mL of catch was sampled each 90 minutes over the run time and composited at the end of the day to 250 mL. Sampling was sequenced rotationally around the pulverizer outlet lines.

Particulate from the ESP hoppers was sampled each 90 minutes by pulling the ash so the catch was representative of recent particulate collection. To promote obtaining a fresh sample, the ash was pulled at the start of each run so the collected samples were representative of full load operation. Samples of 250 mL were taken each 90 minutes and composited at the end of the day to 500 mL total sample. Different hoppers from each of the three ESP banks were sampled during each 90 minute grab sample to obtain a more representative sampling of partitioning through the ESP. The downstream bank seldom yielded significant sample, since the two upstream banks apparently captured nearly all particulate which was caught.

The furnace slag was collected from the sluice tanks at the slag tap quench. Approximately equal samples were taken from each of the two tanks and composited. Blanks of the sluice water

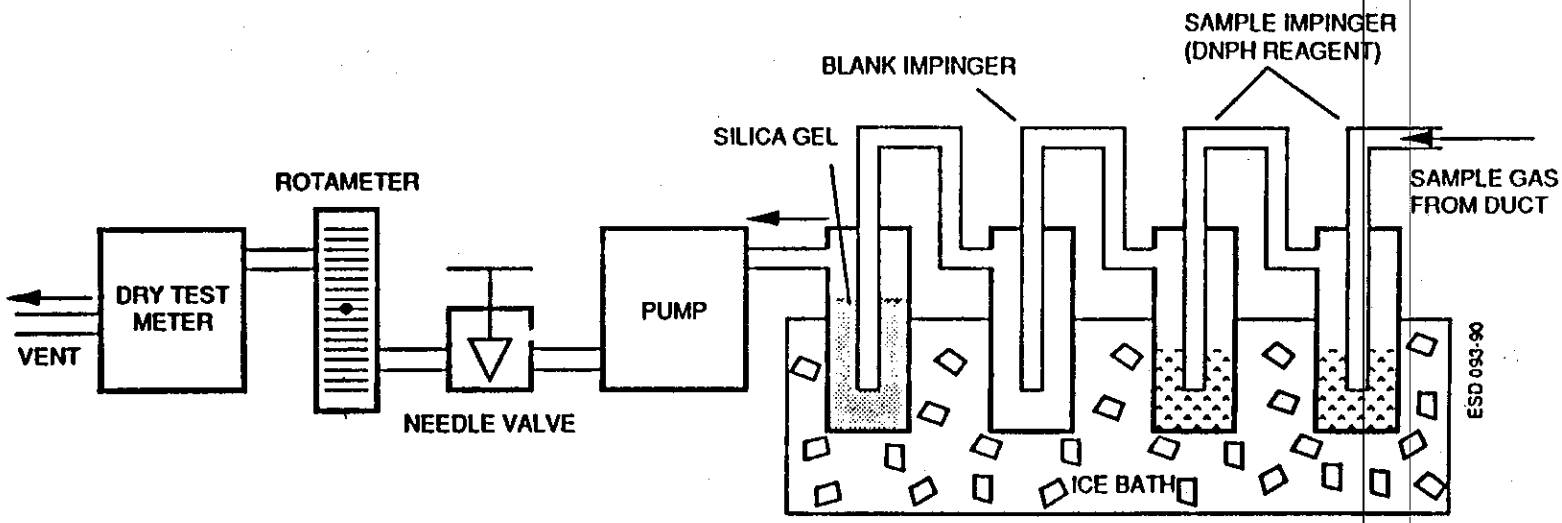


Figure 3-9. Method 430 sampling train for formaldehyde and acetaldehyde

were also taken for contingency in case leaching was indicated in data analysis. A blank of plant makeup water was also taken as an archive sample. Because of the time required to accumulate a sufficient slag catch in the quench tanks, it was possible to sample the quench tanks only twice during each run. The tanks were drained at the start of the test, but no sample was collected. The tanks were again drained at the mid-point and end of the run and slag and water samples were collected from each tank.

3.2.10 Quality Assurance.

A separate QA plan was prepared prior to the test and distributed to each crew member prior to the test. Each crew members responsibilities for pre-test, on-site and post test QA were discussed at the test kick-off. The basis of the QA plan, is adherence to the specific sampling and analysis protocols for each of the key parameters. Key QA procedures, in addition to the triplicate sampling specified in the test plan, were:

- Field audit by the Acurex Environmental QA Manager of each sampling train procedure and overall sample recovery and custody procedures.
- Use of trip, field and lab blanks for all extractive trains
- Blind NIST flyash audit sample
- Matrix spikes and trip spikes to determine analytical recoveries
- System calibrations per protocols

SECTION 4

TEST RESULTS

The summary of the test schedule and conditions tested is shown on Table 4-1. All overall test objectives were achieved.

Triplicate baseline and reburn runs were made essentially at full load and as near as possible to replicated operating conditions. For the Method 17 particle sampling upstream of the ESP, the particle loading was sufficiently high to permit duplicate runs for each of the downstream runs. The baseline and reburn runs were staggered to obtain data on both sequential testing at the same condition as well as the precision to which results would track earlier tests. On November 4, two reburn runs were made. This was necessitated by the limited coal supply which could not accommodate a full day per run. Results of the individual measurements are summarized in the following text. Detailed run summaries and selected analytical results are presented in the appendices.

Table 4-1 Test Run Summary

Run	Date 1992	Time	Designation	Load MW	Reburn %	O_2 %	NO_x ppm	SO_2 ppm
1	11/2	08:00-16:30	Baseline A	110	0	2.78	572	1,085
2	11/3	08:00-16:00	Baseline B	111	0	3.37	582	1,640
3	11/4	08:00-13:00	Reburn A	112	30	2.84	277	1,330
4	11/4	14:00-21:00	Reburn B	111	30	2.89	274	1,110
5	11/5	09:30-16:30	Baseline C	111	0	3.32	584	1,073
6	11/6	08:00-15:15	Reburn C	111	30	2.63	282	1,048

4.1 CONTINUOUS EMISSIONS MONITORING

The gaseous emissions results cited on Table 4-1 are averages over the run, as measured. More detailed tabulations of the CEM results are given in Appendix A. The NO_x data show a good degree of repeatability for both the baseline and reburn conditions. Generally, as shown in Appendix A, the NO_x emissions showed little variability over the duration of the run. This indicates the boiler was well controlled and that the variations in coal quality did not strongly affect the combustion process. The only exception was the start of the initial reburn test, run 3. Some short term excursions in CO were experienced during the stabilization of the reburn firing rate. These excursions were under control before extractive sampling was started and they did not repeat on subsequent runs.

The NO_x reduction experienced with reburn was above 50 percent in all cases. The variability in SO_x emissions, however, indicates coal quality variability both between runs and over the duration of a single run. The excursions in SO_x corresponded to different barges used for the coal supply and the depletion of the final Lamar coal stock. The variability in SO_x was also reflected in other coal properties and trace metal concentrations fed into the boiler. Table 4-2 lists the proximate, ultimate and trace specie analyses of the composite coal samples taken during the six runs. The variability in coal sulfur generally tracks with the observed SO_2 variations from the CEM measurements. Also, as shown in Appendix A, the SO_2 emissions during the first three runs varied by 40 to 50 percent during the course of a single run. This coal quality variability is probably significant over the course of the six-hour operation of the extractive trains to sample trace metals or organics.

4.2 PARTICULATE MEASUREMENTS

Results for particulate loading upstream and downstream of the ESP are shown in Table 4-3. Two runs were made at the ESP inlet during the single long run at the outlet to accommodate the higher particulate loading at the inlet. The ESP efficiency shows the average collection experienced over the 6 hour run. For the present series of runs, soot blowing was curtailed during the period

Table 4-2. Coal analyses

Test Run	1	2	3	4	5	6
Proximate Analysis						
HHV, Btu/lb	11092	11680	11954	11453	11389	11657
Moisture, %	15.68	13.81	12.0	12.94	17.28	12.51
Vol. Mtr, % dry	39.84	40.34	40.0	39.36	39.03	38.81
Fixed C, % dry	52.57	49.65	51.8	51.4	52.56	51.79
Ash, % dry	7.59	10.01	8.21	9.2	8.41	9.40
Ultimate Analysis, percent dry basis						
Carbon	72.9	72.19	72.15	71.57	73.15	71.76
Hydrogen	5.1	5.11	5.11	5.05	5.19	5.08
Nitrogen	1.37	1.27	1.24	1.21	1.27	1.03
Sulfur	1.34	2.32	1.72	1.37	1.57	1.43
Oxygen, Diff.	11.71	9.10	11.6	11.6	10.41	11.3
Ash	7.59	10.01	8.21	9.20	8.41	9.40
Trace Species, ppm, as received						
Arsenic	6.02	19.8	2.69	9.21	5.14	9.33
Beryllium	2.94	3.13	3.04	2.84	3.13	2.69
Cadmium	<1	1.11	70.4	52.2	93.9	<1
Chromium	4.91	11.8	8.6	7.3	11.6	8.8
Mercury	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	20.5	22.2	29	23.4	24.3	18.7
Nickel	13	13.9	49	37.4	42.3	34.8
Lead	38.5	39.5	10.7	18.1	14.9	11.9
Selenium	<1	<1	<1	<1	<1	<1
Chlorine	58.1	23.2	90.9	65.5	65.3	83.4
Fluoride	<4.74	<3.48	<3.4	<3.45	<4.83	<3.43
Chloride	<17.8	<18.6	<19.3	<17.2	<19.3	<18.3

Table 4-3. Particulate Results at ESP Inlet and Outlet

Date 1992	Series	ESP Inlet		ESP Outlet		ESP Efficiency %
		gr/dscf	lb/hr	gr/dscf	lb/hr	
11/2	Baseline 1A	0.48	1,110	0.019	41	96.1
	Baseline 2A	0.45	973			
11/3	Baseline 1B	0.73	1,600	0.013	25	98.6
	Baseline 2B	0.75	1,990			
11/5	Baseline 1C	0.47	1,000	0.018	38	97.1
	Baseline 2C	0.78	1,620			
11/4	Reburn 1A	1.36	2,840	0.0038	7.5	99.7
	Reburn 2A	0.96	1,960			
11/4	Reburn 1B	1.52	3,220	0.009	18	99.4
	Reburn 2B	1.11	2,340			
11/6	Reburn 1C	1.38	2,860	0.018	37	98.6
	Reburn 2C	1.11	2,220			

the trains were run. This gave tighter control on trace emission variability, but gave somewhat lower emission rates than some earlier runs where soot was blown intermittently as is the routine practice. Either practice, testing with or without soot blowing, causes some data variations which must be attributed to the varying state of soot buildup between runs. The results show that, as expected, the reburn increases particulate loading into the ESP due to the pulverized reburn displacing the proportion normally taken out the cyclone slag tap. The ESP outlet data show, however, that the reburn particulate emissions to the atmosphere, downstream of the ESP, are lower than baseline. This is probably due to the particle sizing being larger with reburn which favors capture by the ESP, as evidenced by the higher collection efficiency. With the baseline cyclone, however, a disproportionate level of fines escape the cyclone which are more resistant to capture in the ESP.

4.3 TRACE METALS

Trace metals emissions rates were measured at the inlet and outlet of the ESP and concentrations were analyzed at the coal feed and the slag and hopper ash discharge streams. Trace metals flow rates from the solid streams were estimated using an ash materials balance which partitioned the ash in the coal feed between the slag tap and the ESP inlet. The slag ash flow rate was computed by difference between the coal feed and the particle loading measured at the ESP inlet. The hopper ash flow rate was computed by difference between the measured particle loading at the ESP inlet and outlet. Table 4-4 lists the flue gas trace metals concentrations at the ESP outlet. Appendices D and E give the sampling train data for the six runs at each location. Generally the flue gas measurements were more reliable than the solid stream analyses because extending the run time to 6 hours allowed metals concentrations well within the detectable range. With the solid streams, however, some metals concentrations were near or below the detectable range. Appendix F lists the concentrations at the three solid streams and the flue gas streams. These results are summarized in Table 4-5. The partitioning mass balance was computed using the ash mass balance described above. A mass balance was computed around the furnace and a separate balance was computed around the ESP. Where concentrations were below the detectable limit, they were taken at the detection limit for purposes of the mass balance.

The trace metals results exhibited considerable scatter. As expected, the volatile metals, arsenic, selenium, and mercury exhibited the most variability. For these metals, the flue gas concentrations showed less variation between runs than the solid streams. The concentrations in the solid streams, and hence the mass balances for the volatile metals, is complicated by the low or non-detectable concentrations. Microwave digestion was used for these analyses to enhance the detection. An additional factor was the significant variation in the metals concentration in the coal feed as shown on Table 4-2. Concentrations of some metals varied by up to an order of magnitude between runs. This variability, combined with the transient buildup of trace metals within the boiler between soot blowing cycles could produce significant excursions in metals concentrations in both

Table 4-4. Trace metal emissions results at ESP outlet

Trace Metals Emissions at ESP Outlet: $\mu g/dscm$

Run	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
1 Base A	9.14	4.24	2.12	26.8	28.8	150	73.8	126	2.79
2 Base B	4.31	2.12	2.19	12.6	18.1	77.6	166	439	10.4
5 Base C	19.5	4.48	7.62	22.0	46.6	122	141	505	7.41
3 Reburn A	9.11	0.53	2.08	4.80	12.3	23.7	61.8	437	8.83
4 Reburn B	13.4	1.41	3.49	6.60	25.8	43.2	90.4	51.2	4.2
6 Reburn C	13.7	1.98	1.55	10.8	31.3	82.2	81.9	166	3.95

Table 4-5. Metals partitioning results, Baseline A

	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Mass Flows Baseline A									
Coal, g/s	0.070	0.034	<0.012	0.057	0.24	0.15	0.45	<0.012	<0.0012
Slag, g/s	<0.0007	0.0050	0.0029	0.036	0.34	0.28	0.0013	<0.0007	<0.0004
ESP Inlet, g/s	0.0070	0.0073	0.0034	0.0427	0.0531	0.2403	0.2337	0.0010	0.0013
Hopper Ash, g/s	0.0392	0.0054	<0.0023	0.0288	0.0411	0.1561	0.1327	<0.0046	<0.0001
ESP Out, g/s	0.0011	0.0005	0.0002	0.0031	0.0034	0.0175	0.0086	0.0148	0.0003
Mass Balances									
Coal/(Slag + ESPin)	9.09*	2.77	1.84*	0.73	0.61	0.29	1.91	6.49*	0.71*
ESPin/(Hopper + ESPout)	0.17	1.24	1.34*	1.34	1.19	1.38	1.65	0.05*	3.21*

*For the mass balances, non-detectable concentrations were taken at the detection limit

Table 4-5. Metals partitioning results, Baseline B (continued)

	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Mass Flows Baseline B									
Coal, g/s	0.23	0.037	0.013	0.14	0.26	0.16	0.46	<0.012	<0.0012
Slag, g/s	<0.001	0.0075	0.0048	0.089	0.42	0.40	0.012	<0.0010	<0.0005
ESP Inlet, g/s	0.011	0.0065	0.0042	0.034	0.060	0.21	0.22	0.0017	0.0015
Hopper Ash, g/s	0.065	0.0069	0.0028	0.035	0.054	0.25	0.19	<0.0002	<0.0001
ESP Out, g/s	0.0005	0.0002	0.0003	0.0015	0.0021	0.0091	0.020	0.051	0.0012
Mass Balances									
Coal/(Slag + ESPin)	19.1*	2.62	1.43	1.12	0.54	0.27	2.0	4.29*	0.57*
ESPin/(Hopper + ESPout)	0.17	0.91	1.41	0.92	1.06	0.83	1.02	0.034*	1.17*

*For the mass balances, non-detectable concentrations were taken at the detection limit

Table 4-5. Metals partitioning results, Reburn A (continued)

	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Mass Flows Rebum A									
Coal, g/s	0.032	0.037	0.85	0.10	0.35	0.59	0.13	<0.012	<0.0012
Slag, g/s	<.0006	<0.011	<0.11	0.051	0.24	0.20	0.0063	<0.0006	<0.0001
ESP Inlet, g/s	0.0562	0.0155	0.0102	0.0682	0.1422	0.1321	0.4164	0.0236	0.0011
Hopper Ash, g/s	0.095	0.011	<0.057	0.047	0.069	0.30	0.20	0.0024	0.00004
ESP Out, g/s	0.0010	0.0001	0.0002	0.0005	0.0014	0.0026	0.0068	0.0481	0.0010
Mass Balances									
Coal/(Slag + ESPin)	0.57*	1.40*	6.9*	0.87	0.91	1.78	0.30	0.50*	1.03*
ESPin/(Hopper + ESPout)	0.59	1.47	0.18*	1.46	2.00	0.43	2.00	0.47*	1.08*

*For the mass balances, non-detectable concentrations were taken at the detection limit

Table 4-5. Metals partitioning results, Baseline C (continued)

	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Mass Flows Baseline C									
Coal, g/s	0.061	0.037	1.11	0.14	0.29	0.50	0.18	<0.012	<0.0012
Slag, g/s	0.0023	0.0041	0.0019	0.052	0.35	0.32	<0.0008	0.0083	<0.0004
ESP Inlet, g/s	0.053	0.0072	0.0037	0.051	0.092	0.27	0.27	0.0098	0.0009
Hopper Ash, g/s	0.019	0.0015	0.0008	0.014	0.025	0.085	0.063	<0.0001	<.00004
ESP Out, g/s	0.0023	0.0005	0.0009	0.0026	0.0054	0.014	0.017	0.059	0.0009
Mass Balances									
Coal/(Slag+ESPin)	1.10	3.25	198	1.32	0.65	0.81	0.65*	0.65	0.88
ESPin/(Hopper+ESPout)	2.54	3.63	2.16	3.09	3.06	3.00	3.38	0.165*	1.04

*For the mass balances, non-detectable concentrations were taken at the detection limit

Table 4-5. Metals partitioning results, Reburn B (continued)

	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Mass Flows Reburn B									
Coal, g/s	0.112	0.035	0.63	0.089	0.285	0.45	0.22	<0.012	<0.0012
Slag, g/s	<.0007	0.0031	0.0020	0.023	0.37	0.21	0.0056	<0.0007	<0.0004
ESP Inlet, g/s	0.016	0.0016	0.0014	0.0073	0.019	0.046	0.036	0.021	0.0007
Hopper Ash, g/s	0.13	0.0113	0.0043	0.056	0.14	0.39	0.24	<0.0004	<0.0002
ESP Out, g/s	0.0016	0.0002	0.0004	0.0008	0.0030	0.0050	0.011	0.0060	0.0005
Mass Balances									
Coal/(Slag + ESPin)	6.67*	7.31	185	2.94	0.72	1.74	5.26	0.55*	1.11*
ESPin/(Hopper + ESPout)	0.12	0.14	0.31	0.13	0.13	0.12	0.14	3.36*	1.07*

*For the mass balances, non-detectable concentrations were taken at the detection limit

Table 4-5. Metals partitioning results, Reburn C (concluded)

	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Mass Flows Reburn C									
Coal, g/s	0.11	0.032	<0.012	0.11	0.22	0.42	0.14	<0.012	<0.0012
Slag, g/s	0.032	0.0035	0.0014	0.041	0.25	0.21	0.0054	<0.0008	<0.0004
ESP Inlet, g/s	0.0026	0.0007	0.0008	0.0047	0.0217	0.0270	0.0359	0.0054	0.0007
Hopper Ash, g/s	0.090	0.0100	<0.0064	0.0562	0.1181	0.3131	0.2341	0.00121	<0.0002
ESP Out, g/s	0.0015	0.0002	0.0002	0.0012	0.0034	0.009	0.0105	0.0181	0.0004
Mass Balances									
Coal/(Slag + ESPin)	3.22	7.59	5.59*	2.33	0.82	1.75	3.45	1.93*	1.11*
ESPin/(Hopper + ESPout)	0.029	0.070	0.12*	0.082	0.18	0.084	0.15	0.28*	1.15*

*For the mass balances, non-detectable concentrations were taken at the detection limit

the ash and flue gas streams. The volatile metals, particularly selenium and mercury showed a stronger tendency to enrich to the smaller particles which escaped the ESP than did the heavier metals.

For the heavier metals, with the exception of cadmium, the concentrations were generally well within the detectable limits and the mass balances for the most part were within the range of 0.5 to 2.0. No major effect of reburning on trace metals partitioning was discernable.

4.4 VOLATILE ORGANICS

Six carbon molecular sieve traps were collected for each run and desorbed onto a GC/MS for post test analyses. Twenty-six priority pollutant compounds were targeted for quantitation in the GC/MS chromatograms. Of these compounds, only toluene and benzene were detectable. Table 4-6 lists the benzene and toluene analytical results for the six runs. Appendix I tabulates the VOST train run conditions and Appendix J contains representative chromatograms to illustrate the low levels of volatile organics experienced. A list of retention times of the targeted compounds and internal standards is also provided to interpret the peaks on the chromatograms. A exploratory search of some of the unidentified compounds on the chromatograms was made and typical results are shown at the back of Appendix J. Table 4-6 indicate considerable scatter in benzene and toluene emission, well above the detectable limit of about 4 nanograms. Table 4-7 lists the average benzene and toluene emissions for each baseline and reburn run. There does not appear to be a major trend of volatile organic emissions with reburn.

4.5 SEMI-VOLATILE ORGANICS

The XAD sorbent from the organics module was extracted and analyzed by GC/MS for 16 targeted PAH compounds. The results showed the 16 compounds were non-detectable to the 1 ppb level for all six runs. Table 4-7 summarizes the overall results and details on the sampling train and GC/MS procedure is given in Appendices G and H. Specifically, Appendix H gives the retention times for the internal standards and system monitoring compounds, which were spiked as QA checks on the internal standards. The retention times of the targeted PAH compounds

Table 4-6. Volatile organics results at ESP outlet

Trap	Baseline A				Baseline B				Baseline C			
	Benzene ng	Toluene ng	Bz ppb	To ppb	Bz ng	To ng	Bz ppb	To ppb	Bz ng	To ng	Bz ppb	To ppb
1					110	35	2.09	0.56	11	15	0.21	0.24
2	17	8	0.33	0.13	9	4	0.17	0.07	21	47	0.40	0.76
3	194	47	3.76	0.77	32	8	0.55	0.12	21	13	0.40	0.21
4	103	22	1.99	0.36	105	73	1.97	1.16	15	17	0.28	0.27
5	24	10	0.46	0.16					16	14	0.30	0.23
6	14	11	0.27	0.18	67	20	1.26	0.32	75	33	1.42	0.53

Trap	Reburn A				Reburn B				Reburn C			
	Benzene ng	Toluene ng	Bz ppb	To ppb	Bz ng	To ng	Bz ppb	To ppb	Bz ng	To ng	Bz ppb	To ppb
1	12	10	0.23	0.16	18	18	0.34	0.29	12	11	0.23	0.18
2	23	14	0.43	0.23	28	14	0.53	0.22	16	8	0.30	0.13
3	25	13	0.48	0.21	19	10	0.36	0.16	26	8	0.50	0.13
4	49	18	0.93	0.29	33	39	0.63	0.63	9	9	0.17	0.14
5	23	22	0.44	0.35	44	12	0.84	0.19	13	7	0.25	0.11
6	30	19	0.57	0.31	22	11	0.41	0.18	20	39	0.38	0.63

Table 4-7. Organics results at ESP outlet

Run	Volatiles		Semivolatiles
	Toluene[a] ppb	Benzene[a] ppb	PNA[b] ppb
1-Baseline A	0.27	1.14	<1.18
2-Baseline B	0.37	1.00	<1.16
5-Baseline C	0.50	0.37	<1.22
3-Reburn A	0.51	0.26	<2.02
4-Reburn B	0.52	0.28	<1.61
6-Reburn C	0.30	0.22	<1.18

[a] Average concentration from 6 traps analyzed per run.
[b] Concentration of each of the 16 target compounds, based on MW=250.

which were specifically searched in the analytical routine for the organic XAD extract are also listed to help interpret the chromatograms. The representative chromatograms indicate that most of the peaks are due to internal standards. No significant emissions of the target compounds are seen. Additionally, the chromatograms for baseline and reburn appear similar with no major departures for either run condition. Because of the extended run time, detection limits in the parts-per-billion range were achieved. Even with this level of detection, the target PAH compounds were non-detectable. The compounds which were detected were generally not identified since they were not on the priority pollutant computer library listing. A post-analysis evaluation of the unidentified peaks was made to determine if there was any cause for concern. Typical results of that search are included at the back of Appendix H. No such concern was raised from the results of this fragmentary search.

4.6 ALDEHYDES

The CARB 430 train with the DNPH impingers extracted aldehyde samples from both ducts at the ESP outlet. The DNPH impinger solution was analyzed for formaldehyde and acetaldehyde to the 3 ppbv and 2 ppbv detection limit respectively. The results are listed in Table 4-8. The only detectable sample was for run 1 which gave concentrations only marginally higher than the detection limit.

4.7 CHLORIDES AND FLUORIDES

Chloride/fluoride emission rates were sampled at the ESP outlet with a Method 421 train, and inlet coal feed concentrations were analyzed for the composite coal sample. Table 4-9 summarizes the analytical results and shows mass flow computations for the inlet and outlet streams. The range in inlet Cl flow is the upper and lower bound depending on whether the non detectable inlet Cl is taken as zero or as the detectable limit. The results indicate that the majority of the chlorine compounds partition to the flue gas stream. No solid ash stream samples were taken to confirm this. The high levels of fluorine reported for the final reburn runs is erroneous because an unidentified compound was eluting at nearly the same time in higher quantities, masking the true fluorine concentrations.

Table 4-8. Aldehyde Results at ESP Outlet

Run	Formaldehyde ppbv	Acetaldehyde ppbv
1-Baseline A	3.9	4.3
2-Baseline B	<2.8	<1.9
5-Baseline C	<2.8	<1.9
3-Reburn A	<2.8	<1.9
4-Reburn B	<2.8	<1.9
6-Reburn C	<2.8	<1.9

Table 4-9. Chloride/fluoride emission results — ESP outlet

Run	Coal Inlet Feed Stream					Flue Gas	
	Concentrations, ppm			Flow, g/s		Flow, g/s	
	Cl_2	Cl	F	Cl	F	Cl	F
Base A	58.1	<17.8	<4.7	0.96-1.25	<0.078	0.72	0.010
Base B	23.2	<18.6	<3.5	0.33-0.59	<0.049	0.67	0.012
Base C	65.3	<19.3	<3.4	0.94-1.22	<0.07	0.82	0.011
Reburn A	90.9	<17.2	<3.4	1.23-1.49	<0.047	0.83	0.014
Reburn B	65.5	<19.3	<4.8	0.93-1.17	<0.048	1.12	0.36[a]
Reburn C	83.4	<18.3	<3.4	1.15-1.41	<0.048	0.96	0.31[a]

[a] Fluoride results for runs 4 and 6 are biased high by an unknown ion which coeluted with the fluoride peak

Table 4-10 summarizes the flue gas concentrations of chlorides and fluorides along with particulate and trace metals.

4.8 QUALITY ASSSURANCE

A QA Project Plan was prepared for the testing which specified sampling and analysis methods, data quality objectives, precision, accuracy, and completeness objectives. The completion objective of 90% was met. The method detection limits; MDL, objectives for the flue gas sampling are listed on Table 4-11. These objectives were also met or exceeded.

An on-site audit was performed by the Acurex Environmental QA Manager on-site during the tests. The audit consisted of examining the continuous emission monitoring, sampling, sample recovery, organization, and interviewing each crew member about responsibilities and protocol issues. No major concerns were found. All field personnel were familiar with the test methods of sampling and recovery, and had copies of the QA Project Plan, the Test Plan and the relevant

Table 4-10. Flue gas emissions summary at ESP outlet

Run No.	Particulate		Organics			Halogens	
	Inlet	Outlet	Benzene[a]	Toluene[a]	Semi-vols	Chlorides	Fluorides
	mg/dscm	mg/dscm	μg/dscm	μg/dscm	μg/dscm	mg/dscm	mg/dscm
1 - Baseline 1A Baseline 2A	1.09 1.02	0.0437	4.7	1.3	<13	6.14	0.088
2 - Baseline 1B Baseline 2B	1.66 2.18	0.0291	4.2	1.8	<13	6.07	0.105
5 - Baseline 1C Baseline 2C	1.08 1.78	0.0401	1.8	1.5	<14	6.91	0.088
3 - Reburn 1A Reburn 2A	3.11 2.21	0.0087	1.8	1.1	<23	7.59	0.13
4 - Reburn 1B Reburn 2B	3.49 2.54	0.0195	1.8	1.1	<18	9.53	3.09[b]
6 - Reburn 1C Reburn 2C	3.16 2.54	0.0421	1.1	0.92	<13	8.83	2.92[b]

[a] Volatile organic results are averages of six separate samples
[b] Fluoride results for runs 4 and 6 are biased high by an unknown ion which coeluted with the fluoride peak

Table 4-11. QA objectives for MDLs

Measurement Parameter	Analytical Method	Method Detection Limit
O_2 monitor	Paramagnetic	0.1%
CO, CO_2 monitor	Nondispersive infrared (NDIR)	0.05 ppm; 0.1%
NO_x monitor	Chemiluminescent	0.01 ppm
SO_2 monitor	Pulsed fluorescense	0.1 ppm
Flue gas particulate	Isokinetic sampling	0.02 mg/dscm
Metals Be, Cd, Cr, Mn, Ni, Pb	ICAP	0.03 to 6.2 ug/dscm
As, Se	Graphite Furnace AA	0.3 ug/dscm
Mercury	Cold Vapor AA	0.03 ug/dscm
Semivolatile organics, PAHs	GC/MS	2 ppbv
VOCs - benzene, toluene	GC/MS	0.5 ppbv
Formaldehyde	HPLC	7 ppbv
HCl, HF	IC	2 ppbv

protocols. Field data sheets were used to record flows, volumes, temperatures, leak checks, reagents, sample fractions, and comments. A field notebook was used to record all samples collected, their fractions, volumes, time, date, location, and method used. Chain of custody forms were used properly to monitor sample dispersal to the chemistry laboratories for analysis.

The continuous emission monitoring was performed for O_2 CO_2, CO, NO_x, and SO_2. All instruments were calibrated prior to testing, and checked during and after the test. No problems occurred at any time during the tests, and all calibration checks were within acceptable limits for the methods. The CEM system used instrumentation typically employed for ambient concentrations. The sample gas stream was diluted to ambient levels prior to the CEM system. An online data logger collected the instrument output and stored each data point onto a computer hard drive. In addition, the operator maintained a hand written copy of data points at 15 min. intervals. At the beginning and end of each test day a zero, high level span, and a mid-level span

calibration gas was used to check calibration for each instrument. All calibration gases were certified EPA Protocol gases. The calibration error test, which introduces a calibration gas upstream of the analyzers, is included in the daily calibration routine. The calibration gases are introduced at the probe as the primary analyzer calibration procedure, therefore eliminating the need to perform the system bias check. The interference checks were not performed. The zero and calibration drift tests are based on repeating the zero, and calibration checks after each test run, and comparing their percent differences. Table 4-12 is a compilation of each test CEM performance results.

The solid samples (coal, ash, slag) were collected during each test as planned, and composited at the laboratory prior to analysis. All composited samples were given new lab sample identifications and recorded in a notebook. All of the solid samples were analyzed by Galbraith Labs of Knoxville, TN. All metals except mercury were analyzed at detection limits of 1 ppm. All of the coal samples were prepared by Parr oxygen bomb extraction procedure to completely solubilize the bound metals. Graphite furnace AA and ICP was used for the analysis. The ash and slag samples were digested using the microwave procedure, and analyzed by Graphite furnace AA and ICP. A NIST SRM flyash sample was submitted and the average recoveries for 5 metals were 75.5% with a standard deviation of 13.2%. The metals analysis precision (25%), accuracy (70-130%), and completeness (90%) were met. The metals train and chloride/fluoride samples were analyzed by Triangle Labs of Research Triangle Park, NC. A NIST SRM metals solution was prepared by dilution and submitted for analysis. The average recoveries for the analytes was 94.1%. The recoveries for the NIST standard flyash samples are shown on Tables 4-13 and 4-14.

The VOCs sampling for benzene and toluene went smoothly and without problems. All samples were collected, and shipped to and received by the laboratory properly. Benzene-d_6 was spiked onto each adsorbent sample tube prior to sampling to evaluate quantitative sampling. A breakthrough test were performed in the laboratory by injecting a known amount of benzene onto a sample tube, then passing 15 liter of air through the tube at 0.5 liter/min for 30 min, which

Table 4-12. CEM Performance Checks

Test Number	1	2	3	4	5	6
CO						
span drift	-0.30 %	2.00 %	1.80 %	-0.30 %	1.20 %	0.13 %
zero drift	0.20 %	0.60 %	2.00 %	0.60 %	0.10 %	0.10 %
CO_2						
span drift	0.12 %	1.60 %	0 %	0 %	0 %	-1.40 %
zero drift	0.25 %	0 %	0.30 %	0 %	0 %	0 %
NO						
span drift	0.43 %	0.70 %	0 %	0.60 %	0 %	0 %
zero drift	0.20%	0 %	2.00 %	0.10 %	2.20 %	0 %
SO_2						
span drift	-0.30 %	0.64 %	0.40 %	0.20 %	-0.50 %	0 %
zero drift	0.20 %	0 %	0 %	3.00 %	0.40 %	0.10 %
O_2						
span drift	0 %	0 %	0 %	0 %	0 %	0 %
zero drift	0 %	0 %	0 %	0 %	0 %	0 %

Table 4-13. Metals train/acid gas audit sample

Triangle Labs	NIST Traceable QC Amount, ug/L	% Recovery
Chlorine	1,000	110
Arsenic	200	86.0
Beryllium	10	80.0
Cadmium	100	96.0
Chromium	100	95.0
Manganese	100	91.0
Nickel	100	108
Lead	100	67.0
Selenium	500	114
Average % Recovery		94.1

Table 4-14. Coal, ash, and slag samples audit sample

Galbraith Labs	NIST Flyash Amount, ppm	% Recovery
Mercury	0.16	Below detection limit
Arsenic	145	66.2
Cadmium	1.0	Below detection limit
Chromium	196	77.6
Manganese	179	88.6
Nickel	127	89.0
Lead	72	58.3
Selenium	10	Below detection limit
Average % Recovery		**75.5**

represented the sampling conditions. Analysis of the tube resulted in greater than 95 percent recovery of the benzene. As an additional quality control procedure, the laboratory also injected a known amount of d_8-toluene onto each sample tube during the analysis. The percent recoveries for all 40 sample tubes analyzed for d_8-toluene was 97 percent, with a standard deviation of 10. This shows good precision and accuracy for the analytical procedure. The d_6-benzene spiked recoveries were 37 percent, with a standard deviation of 40. This recovery was lower than expected, but it is still within the data quality objective of 37-151% recovery. The field blank showed less than 0.5 ppbv of benzene and toluene, which were the expected detection limits. The volatile organics recovery QA results are listed on Table 4-15.

Polynuclear aromatic hydrocarbons (PAHs) were sampled using the MM5 train XAD adsorbent cartridges. Each cartridge was spiked prior to sampling with d_{12}-benzo(a)pyrene to determine breakthrough and recovery efficiency. All precision (50%), accuracy (10-220%), and completeness (90%) objectives were met for the PAH measurements. Table 4-15 shows the surrogate recoveries.

Table 4-15. Average surrogate recoveries

Volatile Organics by Carbon Molecular Seive and Modified Method 5/XAD-2 Polynuclear Aromatic Hydrocarbon Samples

Acurex Lab	% Recoveries @ 50 ngs
d6-Benzene	37 ± 40
d8- Toluene	97 ± 10
Benzene (15 L breakthrough check)	> 95
d5-Nitrobenzene	91 ± 12
2-Fluorobiphenyl	95 ± 5
d12-Terphenyl	92 ± 5
d12-Benzo(a)pyrene (spiked in lab and taken through sampling, extraction, analysis)	93 ± 3

Aldehyde samples were recovered and shipped that same day to Air Toxics, Ltd. in California, with overnight delivery. The formaldehyde matrix spike quality control sample had a recovery of 68%, which was outside the objective, but the blanks and trip spikes were within the objective for precision and accuracy of 25% and 80%, respectively. All blanks showed non-detectable concentrations. The method detection limit of 0.5 ug was achieved for the aldehyde analyses, and the lab spike recoveries for formaldehyde and acetaldehyde were 100%, and 87%. Table 4-16 shows the results of the trip spikes.

Table 4-16. Percent recovery of aldehyde trip spikes

Sample Number	01D	02D	03D	05D
Formaldehyde	84	89	109	93
Acetaldehyde	94	83	101	84

APPENDIX A

CONTINUOUS EMISSIONS MONITORING DATA SUMMARY — ESP OUTLET

EPRI/B&W Cassville Toxics Test Seri

(manually recorded data)

2 November, 1992
Test 1

(PPM by Volume)

	Time	[CO]	[CO2]	[NOx]	[SO2]	[O2]
1	813	2	13.4	557	997	2.86
2	830	23	13.6	553	1023	2.69
3	845	3	13.5	568	1189	2.74
4	900	3	13.4	574	1242	2.64
5	915	2	13.4	571	1207	2.76
6	930	4	13.6	574	1034	2.67
7	945	6	13.6	594	954	2.67
8	1000	1	13.5	554	899	2.73
9	1015	2	13.5	557	1020	2.75
10	1030	3	13.6	561	1044	2.71
11	1045	0	13.7	569	1119	2.85
12	1100	3	13.8	567	1051	2.73
13	1115	0	13.6	562	1076	2.88
14	1130	8	13.6	559	1060	2.64
15	1145	3	13.7	565	1098	2.72
16	1200	4	13.6	564	1088	2.79
17	1215	3	13.6	565	1196	2.70
18	1230	7	13.6	570	1212	2.63
19	1245	3	13.4	564	1172	2.73
20	1300	2	13.4	566	938	2.73
21	1315	7	13.6	576	910	2.70
22	1330	2	13.7	583	1004	2.70
23	1345	2	13.6	602	1051	2.75
24	1400	5	13.8	595	1097	2.81
25	1415	2	13.5	587	1234	2.88
26	1430	5	13.5	584	1310	2.76
27	1445	1	13.5	571	1365	3.05
28	1500	4	13.5	564	1364	3.36
29	1515	0	13.5	566	1398	3.38
30	1530	0	13.5	563	1308	3.37
31	1545	0	13.4	573	1429	3.38
32	1600	2	13.6	588	1220	3.39
33	1615	0	13.6	584	1378	3.51
34	1630	0	13.4	571	1403	3.35
	Avg.	3	13.5	571	1150	2.88

EPRI/B&W Cassville Toxics Test Seri

(manually recorded data)

3 November, 1992
Test 2

(PPM by Volume)

Time	[CO]	[CO2]	[NOx]	[SO2]	[O2]
815	6	13.6	571	994	3.25
830	3	13.9	590	1005	3.27
845	6	13.9	589	979	3.35
900	5	13.9	599	1379	3.35
915	8	13.7	587	1531	3.51
930	5	13.7	590	1590	3.23
945	8	13.6	589	1661	3.57
1000	10	13.9	585	1674	3.35
1015	5	13.6	585	1690	3.58
1030	13	13.9	587	1667	3.28
1045	7	13.9	586	1652	3.49
1100	8	14.0	582	1560	3.36
1115	11	13.7	583	1593	3.41
1130	11	13.8	583	1698	3.23
1145	8	14.1	580	1694	3.59
1200	9	14.1	584	1650	3.37
1215	12	13.8	570	1693	3.65
1230	9	13.7	568	1681	3.39
1245	10	14.1	564	1612	3.47
1300	11	14.0	561	1573	3.58
1315	10	14.2	567	1464	3.82
1330	9	14.0	565	1471	3.21
1345	16	13.9	567	1454	3.36
1400	14	13.8	562	1491	3.35
1415	16	13.8	563	1523	3.33
1430	16	14.1	558	1313	3.81
1445	14	14.0	563	1216	3.25
1500	10	14.0	582	1024	3.32
1515	15	13.8	560	1009	3.07
1530	11	14.0	563	1073	3.33
1545	15	13.7	549	1039	3.23
1600	8	13.7	546	1053	3.24
Avg.	10	13.9	574	1428	3.39

EPRI/B&W Cassville Toxics Test Seri

(manually recorded data)

4 November, 1992
Test 3

(PPM by Volume)

Time	[CO]	[CO2]	[NOx]	[SO2]	[O2]
815	27	14.2	274	1122	2.55
830	35	14.6	265	1197	2.41
845	976	15.4	208	1292	1.16
900	84	14.5	249	1202	2.57
915	548	15.1	212	1302	1.68
930	52	14.3	263	1287	2.74
945	27	14.4	268	1349	2.86
1000	31	14.1	274	1340	2.74
1015	42	14.4	281	1399	2.73
1030	35	14.2	277	1344	2.86
1045	43	14.3	279	1355	2.85
1100	33	14.3	279	1362	2.94
1115	27	14.3	269	1260	2.85
1130	26	14.4	277	1223	2.90
1145	26	14.3	276	1187	2.82
1200	21	14.3	274	1235	2.78
1215	26	14.3	270	1266	2.82
1230	29	14.3	269	1250	2.82
1245	24	14.3	272	1233	2.85
1300	23	14.2	268	1193	2.89
1315	40	14.3	269	1183	2.84
1330	32	14.3	278	1166	2.80
1345	20	14.5	274	1188	2.96
1400	21	14.5	274	1180	2.95
1415	16	14.4	282	1173	3.35
Avg.	91	14.4	267	1252	2.71

EPRI/B&W Cassville Toxics Test Seri

(manually recorded data)

4 November, 1992
Test 4

(PPM by Volume)

Time	[CO]	[CO2]	[NOx]	[SO2]	[O2]
1515	33	14.0	277	1108	3.02
1530	28	14.1	275	1094	2.84
1545	14	14.0	287	1098	3.09
1600	21	14.1	283	1109	3.21
1615	48	14.0	293	1096	3.07
1630	54	14.1	287	1075	2.96
1645	247	14.2	268	1094	2.71
1700	77	14.3	271	1107	2.86
1715	586	14.4	250	1124	3.45
1730	80	14.5	274	1108	2.95
1745	96	14.4	265	1109	2.82
1800	144	14.4	263	1102	2.86
1815	108	14.5	267	1101	2.85
1830	99	14.4	263	1085	2.85
1845	248	14.4	265	1097	2.79
1900	61	14.4	277	1107	2.95
1915	52	14.3	275	1117	2.85
1930	27	14.0	274	1123	3.21
1945	25	14.2	271	1136	3.21
2000	27	14.5	265	1144	3.17
2015	58	14.2	267	1103	2.98
2030	97	14.3	278	1117	2.92
2045	113	14.1	272	1109	3.17
2100	25	14.2	295	1113	3.22
2115	18	14.5	282	1123	3.1
2130	95	14.2	288	1096	3.12
2145	100	14.1	280	1098	3.21
2200	48	14.3	294	1102	3.29
Avg.	94	14.3	275	1107	3.03

EPRI/B&W Cassville Toxics Test Seri

(manually recorded data)

5 November, 1992
Test 5

(PPM by Volume)

Time	[CO]	[CO2]	[NOx]	[SO2]	[O2]
930	2	13.4	586	1092	3.41
945	3	13.6	587	1110	3.35
1000	2	13.6	587	1083	3.19
1015	6	13.5	582	993	3.49
1030	3	13.5	578	1018	3.23
1045	6	13.6	588	969	3.35
1100	3	13.8	583	980	3.29
1115	7	13.6	576	1030	3.31
1130	4	13.6	588	1023	3.33
1145	8	13.8	578	1100	3.18
1200	5	13.7	586	1179	3.31
1215	4	13.7	591	1150	3.26
1230	27	13.8	590	1069	3.35
1245	10	13.7	605	1102	3.31
1300	9	13.7	583	1061	3.35
1315	6	13.7	575	1064	3.38
1330	6	13.6	577	1086	3.49
1345	8	13.8	588	1091	3.51
1400	11	13.7	560	1032	3.33
1415	7	13.8	560	1064	3.23
1430	9	13.9	560	1058	3.3
1445	5	13.7	577	1078	3.31
1500	3	13.8	580	1107	3.45
1515	10	13.8	578	1078	3.41
1530	9	13.7	580	1068	3.35
1545	7	13.6	586	1087	3.29
1600	3	13.6	580	1082	3.34
1615	6	13.8	594	1083	3.41
1630	9	13.8	592	1066	3.32
Avg.	7	13.7	582	1069	3.34

EPRI/B&W Cassville Toxics Test Seri

~~(manually recorded data)~~

6 November, 1992
Test 6

(PPM by Volume)

Time	[CO]	[CO2]	[NOx]	[SO2]	[O2]
800	59	13.7	267	936	2.62
815	25	14.0	283	986	2.64
830	23	14.1	279	1014	2.61
845	25	14.0	282	1017	2.68
900	35	14.1	285	1019	2.71
915	22	14.1	287	1024	2.54
930	38	14.3	279	1012	2.49
945	36	14.5	281	1008	2.73
1000	24	14.4	285	994	2.56
1015	19	14.4	285	1028	2.59
1030	25	14.5	282	1048	2.59
1045	25	14.5	286	1052	2.61
1100	32	14.3	283	1023	2.85
1115	51	14.4	288	1020	2.58
1130	22	14.2	288	1063	2.50
1145	22	14.2	286	1069	2.61
1200	18	14.0	288	1046	2.61
1215	22	14.0	281	1054	2.73
1230	18	14.3	282	1067	2.59
1245	20	14.2	279	1080	2.66
1300	23	14.4	282	1041	2.57
1315	102	14.2	282	1069	2.61
1330	26	14.0	276	1153	2.71
1345	30	13.9	273	1066	2.69
1400	23	14.2	274	1081	2.62
1415	88	13.9	286	1060	2.57
1430	25	13.9	276	1103	2.58
1445	17	14.0	275	1076	2.69
1500	21	14.2	311	1067	2.68
1515	18	14.0	278	1031	2.59
Avg.	31	14.2	282	1044	2.63

APPENDIX B

METHOD 17 PARTICULATE TRAIN AT ESP INLET: DATA RUN SUMMARY

DOE/B&W/WP&L, Toxics Test Series, November, 1992

ESP Inlet Method 17 Samples

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek
Date: 11/2/92 Printed 19-Nov — Test No./Type: M17-1A
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1024-1215

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.00
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		901.41
Gas Meter Final Reading (cu ft)		973.91
Net Gas Sample Volume (cu ft)	V(m)	(72.50)
Vol of Liquid Collected (ml)	Vl(c)	85.6
Vol of Liq @ Std. Conds. (scf)	V(w std)	(4.029)
Wt. of Filter Particulate (gm)		2.1385
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(2.1385)
O2 Concentration (by CEM)	% O2	2.88
CO2 Concentration (by CEM)	% CO2	13.50
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.62)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.40	2.21	453.00	66.0	67.0	1.1832
2	4.00	1.30	2.05	471.00	67.0	67.0	1.1402
3	4.00	1.60	2.53	479.00	67.0	67.0	1.2649
B1	4.00	1.30	2.05	450.00	70.0	68.0	1.1402
2	4.00	1.10	1.74	475.00	70.0	68.0	1.0488
3	4.00	1.20	1.90	498.00	77.0	70.0	1.0954
C1	4.00	1.40	2.21	430.00	79.0	71.0	1.1832
2	4.00	1.30	2.05	440.00	80.0	72.0	1.1402
3	4.00	1.60	2.53	473.00	83.0	72.0	1.2649
D1	4.00	1.60	2.53	450.00	81.0	73.0	1.2649
2	4.00	1.40	2.21	456.00	86.0	74.0	1.1832
3	4.00	1.40	2.21	488.00	81.0	75.0	1.1832
E1	4.00	1.40	2.21	431.00	84.0	76.0	1.1832
2	4.00	1.30	2.05	437.00	86.0	76.0	1.1402
3	4.00	1.30	2.05	450.00	87.0	76.0	1.1402
F1	4.00	1.30	2.05	480.00	87.0	77.0	1.1832
2	4.00	1.40	2.21	495.00	87.0	77.0	1.1832
3	4.00	1.40	2.21	511.00	88.0	78.0	1.2649
G1	4.00	1.60	2.53	439.00	82.0	77.0	1.2649
2	4.00	1.60	2.53	453.00	84.0	77.0	1.2649
3	4.00	1.30	2.05	481.00	85.0	77.0	1.1402
H1	4.00	1.30	2.05	516.00	83.0	77.0	1.1402
2	4.00	1.60	2.53	525.00	83.0	77.0	1.2649
3	4.00	1.30	2.05	536.00	82.0	76.0	1.1402
TOTALS	96.00	33.40	52.76	11317.00	1925.00	1765.0	28.4025

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.392
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	2.199
Avg Stack Temperature (degF)	T(s avg)	=	471.5
Average Meter Temperature (degF)	T(m avg)	=	76.9
Avg SQRT(dP)		=	1.183

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	69.40
Stack Gas Water Vapor Proportion	B(wo)	=	0.055
Mol. Wt., Stack Gas Dry	M(d)	=	30.28
Mol. Wt., Stack Gas Wet	M(s)	=	29.60
Abs Stack Pressure (in Hg)	P(s)	=	30.47
Avg Stack Velocity (ft/sec)	V(s avg)	=	86.4
Isokineticity (%)	% I	=	92.7
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	271398
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	497469
Percent XS Air	PEA	=	15.0
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.4755
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	841
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.3674
Heat Input Rate, MBtu/hr		=	1429.73
Particulate Emission Rate(lb/hr)	E(p)	=	1105.950
Particulate Emission Rate(lb/MBtu)		=	0.7737

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek
Date: 11/2/92 Printed 19-Nov — Test No./Type: M17-1B
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1400-1540

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.00
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		974.10
Gas Meter Final Reading (cu ft)		1048.00
Net Gas Sample Volume (cu ft)	V(m)	(73.90)
Vol of Liquid Collected (ml)	Vl(c)	167.2
Vol of Liq @ Std. Conds. (scf)	V(w std)	(7.870)
Wt. of Filter Particulate (gm)		2.0740
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(2.0740)
O2 Concentration (by CEM)	% O2	2.88
CO2 Concentration (by CEM)	% CO2	13.50
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.62)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.20	1.90	446.00	62.0	64.0	1.0954
2	4.00	1.30	2.05	463.00	62.0	64.0	1.1402
3	4.00	1.20	1.90	488.00	65.0	63.0	1.0954
B1	4.00	1.30	2.05	496.00	67.0	64.0	1.1402
2	4.00	1.20	1.90	481.00	71.0	64.0	1.0954
3	4.00	1.20	1.90	506.00	72.0	64.0	1.0954
C1	4.00	1.50	2.37	463.00	70.0	65.0	1.2247
2	4.00	1.20	1.90	489.00	73.0	65.0	1.0954
3	4.00	1.50	2.37	517.00	73.0	66.0	1.2247
D1	4.00	1.80	2.84	460.00	73.0	66.0	1.3416
2	4.00	1.40	2.21	483.00	73.0	66.0	1.1832
3	4.00	1.20	1.90	505.00	73.0	67.0	1.0954
E1	4.00	1.40	2.21	475.00	73.0	67.0	1.1832
2	4.00	1.40	2.21	504.00	74.0	67.0	1.1832
3	4.00	1.30	2.05	512.00	76.0	67.0	1.1402
F1	4.00	1.30	2.05	528.00	75.0	68.0	1.1402
2	4.00	1.30	2.05	534.00	74.0	68.0	1.1402
3	4.00	1.30	2.05	539.00	74.0	68.0	1.2247
G1	4.00	1.50	2.37	480.00	74.0	68.0	1.2247
2	4.00	1.50	2.37	512.00	74.0	68.0	1.2247
3	4.00	1.50	2.37	520.00	74.0	68.0	1.2247
H1	4.00	1.50	2.37	522.00	76.0	68.0	1.2247
2	4.00	1.40	2.21	529.00	76.0	68.0	1.1832
3	4.00	1.40	2.21	531.00	76.0	68.0	1.1832
TOTALS	96.00	32.80	51.82	11983.00	1730.00	1591.0	28.1045

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.367
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	2.159
Avg Stack Temperature (degF)	T(s avg)	=	499.3
Average Meter Temperature (degF)	T(m avg)	=	69.2
Avg SQRT(dP)		=	1.171

CALCULATED VALUES

Meter Volume (std. cu. ft.)	V(m std)	=	71.75
Stack Gas Water Vapor Proportion	B(wo)	=	0.099
Mol. Wt., Stack Gas Dry	M(d)	=	30.28
Mol. Wt., Stack Gas Wet	M(s)	=	29.06
Abs Stack Pressure (in Hg)	P(s)	=	30.47
Avg Stack Velocity (ft/sec)	V(s avg)	=	87.5
Isokineticity (%)	% I	=	102.1
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	254659
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	504144
Percent XS Air	PEA	=	15.0
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.4460
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	788
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.3446
Heat Input Rate, MBtu/hr		=	1341.55
Particulate Emission Rate(lb/hr)	E(p)	=	973.338
Particulate Emission Rate(lb/MBtu)		=	0.7257

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek
Date: 11/3/92 Printed 19-Nov — Test No./Type: M17-2A
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 0930-1356

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.00
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		50.51
Gas Meter Final Reading (cu ft)		120.61
Net Gas Sample Volume (cu ft)	V(m)	(70.10)
Vol of Liquid Collected (ml)	Vl(c)	112.0
Vol of Liq @ Std. Conds. (scf)	V(w std)	(5.272)
Wt. of Filter Particulate (gm)		3.2804
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(3.2804)
O2 Concentration (by CEM)	% O2	3.39
CO2 Concentration (by CEM)	% CO2	13.90
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(82.71)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.30	2.05	450.00	65.0	65.0	1.1402
2	4.00	1.10	1.74	458.00	64.0	64.0	1.0488
3	4.00	1.30	2.05	476.00	67.0	65.0	1.1402
B1	4.00	1.30	2.05	464.00	55.0	60.0	1.1402
2	4.00	1.10	1.74	484.00	55.0	58.0	1.0488
3	4.00	1.20	1.90	506.00	59.0	60.0	1.0954
C1	4.00	1.40	2.21	463.00	60.0	59.0	1.1832
2	4.00	1.30	2.05	469.00	60.0	57.0	1.1402
3	4.00	1.30	2.05	485.00	60.0	57.0	1.1402
D1	4.00	1.60	2.53	450.00	60.0	57.0	1.2649
2	4.00	1.40	2.21	476.00	57.0	56.0	1.1832
3	4.00	1.40	2.21	488.00	57.0	55.0	1.1832
E1	4.00	1.40	2.21	424.00	55.0	54.0	1.1832
2	4.00	1.40	2.21	463.00	56.0	54.0	1.1832
3	4.00	1.20	1.90	472.00	56.0	54.0	1.0954
F1	4.00	1.20	1.90	487.00	57.0	54.0	1.0954
2	4.00	1.20	1.90	495.00	56.0	53.0	1.0954
3	4.00	1.20	1.90	504.00	56.0	53.0	1.1832
G1	4.00	1.40	2.21	449.00	52.0	51.0	1.1832
2	4.00	1.50	2.37	467.00	52.0	51.0	1.1832
3	4.00	1.20	1.90	474.00	52.0	51.0	1.0954
H1	4.00	1.20	1.90	490.00	51.0	50.0	1.0954
2	4.00	1.20	1.90	493.00	51.0	50.0	1.0954
3	4.00	1.20	1.90	499.00	51.0	49.0	1.0954
TOTALS	96.00	31.00	48.98	11386.00	1364.00	1337.0	27.2927

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.292
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	2.041
Avg Stack Temperature (degF)	T(s avg)	=	474.4
Average Meter Temperature (degF)	T(m avg)	=	56.3
Avg SQRT(dP)		=	1.137

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	69.75
Stack Gas Water Vapor Proportion	B(wo)	=	0.070
Mol. Wt., Stack Gas Dry	M(d)	=	30.36
Mol. Wt., Stack Gas Wet	M(s)	=	29.49
Abs Stack Pressure (in Hg)	P(s)	=	30.47
Avg Stack Velocity (ft/sec)	V(s avg)	=	83.3
Isokineticity (%)	% I	=	98.5
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	256629
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	479664
Percent XS Air	PEA	=	18.4
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.7257
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	1320
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.5769
Heat Input Rate, MBtu/hr		=	1313.67
Particulate Emission Rate(lb/hr)	E(p)	=	1596.047
Particulate Emission Rate(lb/MBtu)		=	1.2152

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek
Date: 11/3/92 Printed 19-Nov — Test No./Type: M17-2B
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1400

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.00
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		123.41
Gas Meter Final Reading (cu ft)		190.91
Net Gas Sample Volume (cu ft)	V(m)	(67.50)
Vol of Liquid Collected (ml)	Vl(c)	159.0
Vol of Liq @ Std. Conds. (scf)	V(w std)	(7.484)
Wt. of Filter Particulate (gm)		4.1099
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(4.1099)
O2 Concentration (by CEM)	% O2	3.39
CO2 Concentration (by CEM)	% CO2	13.90
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(82.71)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter,dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.10	1.74	442.00	47.0	47.0	1.0488
2	4.00	1.00	1.58	461.00	48.0	47.0	1.0000
3	4.00	1.10	1.74	480.00	52.0	48.0	1.0488
B1	4.00	1.30	2.05	453.00	55.0	49.0	1.1402
2	4.00	1.00	1.58	482.00	58.0	50.0	1.0000
3	4.00	1.00	1.58	500.00	60.0	52.0	1.0000
C1	4.00	1.20	1.90	467.00	62.0	54.0	1.0954
2	4.00	1.10	1.74	477.00	65.0	55.0	1.0488
3	4.00	1.30	2.05	491.00	66.0	56.0	1.1402
D1	4.00	1.60	2.53	448.00	67.0	58.0	1.2649
2	4.00	1.20	1.90	469.00	69.0	59.0	1.0954
3	4.00	1.10	1.74	486.00	69.0	60.0	1.0488
E1	4.00	1.40	2.21	442.00	70.0	61.0	1.1832
2	4.00	1.40	2.21	448.00	71.0	62.0	1.1832
3	4.00	1.20	1.90	459.00	72.0	63.0	1.1402
F1	4.00	1.30	2.05	494.00	74.0	64.0	1.0954
2	4.00	1.20	1.90	496.00	75.0	65.0	1.0954
3	4.00	1.20	1.90	504.00	73.0	65.0	1.1832
G1	4.00	1.40	2.21	490.00	69.0	65.0	1.1832
2	4.00	1.40	2.21	445.00	67.0	64.0	1.1832
3	4.00	1.30	2.05	454.00	66.0	64.0	1.1402
H1	4.00	1.30	2.05	485.00	65.0	63.0	1.1402
2	4.00	1.10	1.74	492.00	66.0	63.0	1.0488
3	4.00	1.10	1.74	502.00	68.0	63.0	1.0488
TOTALS	96.00	29.30	46.29	11367.00	1554.00	1397.0	26.5565

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.221
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	1.929
Avg Stack Temperature (degF)	T(s avg)	=	473.6
Average Meter Temperature (degF)	T(m avg)	=	61.5
Avg SQRT(dP)		=	1.107

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	66.47
Stack Gas Water Vapor Proportion	B(wo)	=	0.101
Mol. Wt., Stack Gas Dry	M(d)	=	30.36
Mol. Wt., Stack Gas Wet	M(s)	=	29.11
Abs Stack Pressure (in Hg)	P(s)	=	30.47
Avg Stack Velocity (ft/sec)	V(s avg)	=	81.5
Isokineticity (%)	% I	=	99.1
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	243084
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	469580
Percent XS Air	PEA	=	18.4
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.9540
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	1735
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.7564
Heat Input Rate, MBtu/hr		=	1244.33
Particulate Emission Rate(lb/hr)	E(p)	=	1987.422
Particulate Emission Rate(lb/MBtu)		=	1.5975

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek
Date: 11/4/92 Printed 19-Nov — Test No./Type: M17-3A
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 0950-1130

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.10
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		191.11
Gas Meter Final Reading (cu ft)		256.51
Net Gas Sample Volume (cu ft)	V(m)	(65.40)
Vol of Liquid Collected (ml)	Vl(c)	119.5
Vol of Liq @ Std. Conds. (scf)	V(w std)	(5.625)
Wt. of Filter Particulate (gm)		5.6365
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(5.6365)
O2 Concentration (by CEM)	% O2	2.71
CO2 Concentration (by CEM)	% CO2	14.40
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(82.89)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.00	1.58	454.00	60.0	61.0	1.0000
2	4.00	0.92	1.45	458.00	59.0	61.0	0.9592
3	4.00	1.00	1.58	465.00	61.0	61.0	1.0000
B1	4.00	1.10	1.74	430.00	63.0	61.0	1.0488
2	4.00	0.90	1.42	449.00	66.0	62.0	0.9487
3	4.00	1.00	1.58	469.00	68.0	62.0	1.0000
C1	4.00	1.20	1.90	430.00	69.0	63.0	1.0954
2	4.00	1.20	1.90	453.00	71.0	64.0	1.0954
3	4.00	1.40	2.21	466.00	73.0	64.0	1.1832
D1	4.00	1.40	2.21	437.00	74.0	66.0	1.1832
2	4.00	1.30	2.05	438.00	76.0	66.0	1.1402
3	4.00	1.20	1.90	461.00	78.0	67.0	1.0954
E1	4.00	1.20	1.90	430.00	75.0	68.0	1.0954
2	4.00	1.20	1.90	440.00	76.0	67.0	1.0954
3	4.00	1.10	1.74	450.00	74.0	67.0	1.0488
F1	4.00	1.10	1.74	464.00	73.0	67.0	1.0488
2	4.00	1.10	1.74	476.00	73.0	67.0	1.0954
3	4.00	1.20	1.90	490.00	73.0	67.0	1.1402
G1	4.00	1.30	2.05	434.00	73.0	67.0	1.1402
2	4.00	1.30	2.05	443.00	74.0	66.0	1.1402
3	4.00	1.10	1.74	457.00	74.0	66.0	1.0488
H1	4.00	1.10	1.74	484.00	75.0	67.0	1.0488
2	4.00	1.10	1.74	494.00	74.0	66.0	1.0488
3	4.00	1.10	1.74	504.00	74.0	66.0	1.0488
TOTALS	96.00	27.52	43.48	10976.00	1706.00	1559.0	25.7493

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.147
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	1.812
Avg Stack Temperature (degF)	T(s avg)	=	457.3
Average Meter Temperature (degF)	T(m avg)	=	68.0
Avg SQRT(dP)		=	1.073

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	63.81
Stack Gas Water Vapor Proportion	B(wo)	=	0.081
Mol. Wt., Stack Gas Dry	M(d)	=	30.41
Mol. Wt., Stack Gas Wet	M(s)	=	29.41
Abs Stack Pressure (in Hg)	P(s)	=	30.57
Avg Stack Velocity (ft/sec)	V(s avg)	=	77.8
Isokineticity (%)	% I	=	95.5
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	242280
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	448290
Percent XS Air	PEA	=	14.1
Particulate Loading, dry(gr/dscf)	C(s std)	=	1.3630
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	2367
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	1.0433
Heat Input Rate, MBtu/hr		=	1288.38
Particulate Emission Rate(lb/hr)	E(p)	=	2630.094
Particulate Emission Rate(lb/MBtu)		=	2.1970

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek
Date: 11/4/92 Printed 19-Nov — Test No./Type: M17-3B
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1205-

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.10
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		256.71
Gas Meter Final Reading (cu ft)		322.90
Net Gas Sample Volume (cu ft)	V(m)	(66.20)
Vol of Liquid Collected (ml)	Vl(c)	143.8
Vol of Liq @ Std. Conds. (scf)	V(w std)	(6.769)
Wt. of Filter Particulate (gm)		4.0280
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(4.0280)
O2 Concentration (by CEM)	% O2	2.71
CO2 Concentration (by CEM)	% CO2	14.40
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(82.89)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter,dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.10	1.74	440.00	60.0	61.0	1.0488
2	4.00	1.00	1.58	450.00	60.0	60.0	1.0000
3	4.00	1.00	1.58	473.00	62.0	60.0	1.0000
B1	4.00	1.10	1.74	450.00	63.0	61.0	1.0488
2	4.00	1.00	1.58	478.00	66.0	61.0	1.0000
3	4.00	1.00	1.58	493.00	64.0	61.0	1.0000
C1	4.00	1.20	1.90	455.00	65.0	61.0	1.0954
2	4.00	1.20	1.90	460.00	67.0	61.0	1.0954
3	4.00	1.10	1.74	465.00	68.0	61.0	1.0488
D1	4.00	1.20	1.90	468.00	69.0	61.0	1.0954
2	4.00	1.10	1.74	475.00	70.0	62.0	1.0488
3	4.00	1.30	2.05	485.00	71.0	62.0	1.1402
E1	4.00	1.20	1.90	457.00	70.0	62.0	1.0954
2	4.00	1.20	1.90	484.00	73.0	63.0	1.0954
3	4.00	1.10	1.74	491.00	75.0	64.0	1.0488
F1	4.00	1.10	1.74	501.00	77.0	65.0	1.0954
2	4.00	1.20	1.90	504.00	79.0	66.0	1.0954
3	4.00	1.20	1.90	514.00	80.0	67.0	1.1832
G1	4.00	1.40	2.21	460.00	78.0	68.0	1.1832
2	4.00	1.50	2.37	502.00	81.0	69.0	1.1832
3	4.00	1.10	1.74	509.00	82.0	70.0	1.0488
H1	4.00	1.20	1.90	515.00	82.0	71.0	1.0954
2	4.00	1.20	1.90	525.00	84.0	72.0	1.0954
3	4.00	1.10	1.74	525.00	84.0	72.0	1.0488
TOTALS	96.00	27.80	43.92	11579.00	1730.00	1541.0	25.8905

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.158
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	1.830
Avg Stack Temperature (degF)	T(s avg)	=	482.5
Average Meter Temperature (degF)	T(m avg)	=	68.1
Avg SQRT(dP)		=	1.079

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	64.57
Stack Gas Water Vapor Proportion	B(wo)	=	0.095
Mol. Wt., Stack Gas Dry	M(d)	=	30.41
Mol. Wt., Stack Gas Wet	M(s)	=	29.23
Abs Stack Pressure (in Hg)	P(s)	=	30.57
Avg Stack Velocity (ft/sec)	V(s avg)	=	79.6
Isokineticity (%)	% I	=	98.6
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	237409
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	458222
Percent XS Air	PEA	=	14.1
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.9625
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	1686
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.7368
Heat Input Rate, MBtu/hr		=	1262.47
Particulate Emission Rate(lb/hr)	E(p)	=	1958.352
Particulate Emission Rate(lb/MBtu)		=	1.5515

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek

Date: 11/4/92 Printed 19-Nov — Test No./Type: M17-4A

Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1620-1830

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.10
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		323.11
Gas Meter Final Reading (cu ft)		391.00
Net Gas Sample Volume (cu ft)	V(m)	(67.90)
Vol of Liquid Collected (ml)	Vl(c)	129.6
Vol of Liq @ Std. Conds. (scf)	V(w std)	(6.100)
Wt. of Filter Particulate (gm)		6.5056
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(6.5056)
O2 Concentration (by CEM)	% O2	3.03
CO2 Concentration (by CEM)	% CO2	14.30
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(82.67)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.20	1.90	448.00	63.0	63.0	1.0954
2	4.00	1.10	1.74	471.00	63.0	63.0	1.0488
3	4.00	1.10	1.74	477.00	64.0	63.0	1.0488
B1	4.00	1.10	1.74	450.00	67.0	64.0	1.0488
2	4.00	0.97	1.53	470.00	70.0	64.0	0.9849
3	4.00	0.98	1.55	489.00	71.0	65.0	0.9899
C1	4.00	1.30	2.05	435.00	72.0	66.0	1.1402
2	4.00	1.30	2.05	439.00	73.0	66.0	1.1402
3	4.00	1.20	1.90	445.00	75.0	66.0	1.0954
D1	4.00	1.20	1.90	430.00	75.0	66.0	1.0954
2	4.00	1.40	2.21	479.00	75.0	67.0	1.1832
3	4.00	1.40	2.21	489.00	76.0	67.0	1.1832
E1	4.00	1.20	1.90	458.00	76.0	68.0	1.0954
2	4.00	1.30	2.05	471.00	76.0	68.0	1.1402
3	4.00	1.10	1.74	482.00	78.0	68.0	1.0954
F1	4.00	1.20	1.90	492.00	78.0	69.0	1.0954
2	4.00	1.20	1.90	499.00	79.0	69.0	1.0954
3	4.00	1.20	1.90	509.00	89.0	70.0	1.1832
G1	4.00	1.40	2.21	460.00	78.0	70.0	1.1832
2	4.00	1.40	2.21	468.00	80.0	71.0	1.1832
3	4.00	1.20	1.90	471.00	81.0	71.0	1.0954
H1	4.00	1.20	1.90	490.00	82.0	72.0	1.0954
2	4.00	1.10	1.74	503.00	83.0	73.0	1.0488
3	4.00	1.20	1.90	514.00	83.0	73.0	1.0954
TOTALS	96.00	28.95	45.74	11339.00	1807.00	1622.0	26.4611

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.206
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	1.906
Avg Stack Temperature (degF)	T(s avg)	=	472.5
Average Meter Temperature (degF)	T(m avg)	=	71.4
Avg SQRT(dP)		=	1.103

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	65.83
Stack Gas Water Vapor Proportion	B(wo)	=	0.085
Mol. Wt., Stack Gas Dry	M(d)	=	30.41
Mol. Wt., Stack Gas Wet	M(s)	=	29.36
Abs Stack Pressure (in Hg)	P(s)	=	30.57
Avg Stack Velocity (ft/sec)	V(s avg)	=	80.7
Isokineticity (%)	% I	=	96.9
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	246140
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	464860
Percent XS Air	PEA	=	16.1
Particulate Loading, dry(gr/dscf)	C(s std)	=	1.5248
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	2718
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	1.1879
Heat Input Rate, MBtu/hr		=	1285.88
Particulate Emission Rate(lb/hr)	E(p)	=	3216.412
Particulate Emission Rate(lb/MBtu)		=	2.5017

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek
Date: 11/4/92 Printed 19-Nov — Test No./Type: M17-4B
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1845-

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.10
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		392.40
Gas Meter Final Reading (cu ft)		456.61
Net Gas Sample Volume (cu ft)	V(m)	(64.21)
Vol of Liquid Collected (ml)	Vl(c)	109.1
Vol of Liq @ Std. Conds. (scf)	V(w std)	(5.135)
Wt. of Filter Particulate (gm)		4.4056
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(4.4056)
O2 Concentration (by CEM)	% O2	3.03
CO2 Concentration (by CEM)	% CO2	14.30
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(82.67)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.00	1.58	434.00	75.0	75.0	1.0000
2	4.00	1.00	1.58	458.00	77.0	75.0	1.0000
3	4.00	0.94	1.49	468.00	76.0	75.0	0.9695
B1	4.00	0.96	1.52	490.00	82.0	76.0	0.9798
2	4.00	0.97	1.53	495.00	84.0	77.0	0.9849
3	4.00	0.96	1.52	501.00	85.0	77.0	0.9798
C1	4.00	1.50	2.37	450.00	85.0	78.0	1.2247
2	4.00	1.50	2.37	455.00	86.0	78.0	1.2247
3	4.00	1.40	2.21	461.00	87.0	79.0	1.1832
D1	4.00	1.30	2.05	476.00	88.0	79.0	1.1402
2	4.00	1.20	1.90	489.00	89.0	79.0	1.0954
3	4.00	1.20	1.90	434.00	77.0	78.0	1.0954
E1	4.00	1.20	1.90	445.00	76.0	77.0	1.0954
2	4.00	1.30	2.05	459.00	78.0	77.0	1.1402
3	4.00	1.10	1.74	472.00	81.0	78.0	1.0488
F1	4.00	1.10	1.74	480.00	83.0	78.0	1.0954
2	4.00	1.20	1.90	489.00	85.0	79.0	1.0954
3	4.00	1.20	1.90	497.00	85.0	79.0	1.1832
G1	4.00	1.40	2.21	456.00	85.0	80.0	1.1832
2	4.00	1.30	2.05	467.00	85.0	80.0	1.1832
3	4.00	1.20	1.90	474.00	87.0	80.0	1.0954
H1	4.00	1.20	1.90	469.00	88.0	80.0	1.0954
2	4.00	1.10	1.74	480.00	88.0	81.0	1.0488
3	4.00	1.20	1.90	500.00	88.0	81.0	1.0954
TOTALS	96.00	28.43	44.92	11299.00	2000.00	1876.0	26.2379

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.185
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	1.872
Avg Stack Temperature (degF)	T(s avg)	=	470.8
Average Meter Temperature (degF)	T(m avg)	=	80.8
Avg SQRT(dP)		=	1.093

CALCULATED VALUES

Meter Volume (std. cu. ft.)	V(m std)	=	61.18
Stack Gas Water Vapor Proportion	B(wo)	=	0.077
Mol. Wt., Stack Gas Dry	M(d)	=	30.41
Mol. Wt., Stack Gas Wet	M(s)	=	29.45
Abs Stack Pressure (in Hg)	P(s)	=	30.57
Avg Stack Velocity (ft/sec)	V(s avg)	=	79.8
Isokineticity (%)	% I	=	90.2
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	245865
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	459811
Percent XS Air	PEA	=	16.
Particulate Loading, dry(gr/dscf)	C(s std)	=	1.1112
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	1981
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.8657
Heat Input Rate, MBtu/hr		=	1284.44
Particulate Emission Rate(lb/hr)	E(p)	=	2341.320
Particulate Emission Rate(lb/MBtu)		=	1.8231

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek

Date: 11/5/92 Printed 19-Nov — Test No./Type: M17-5A

Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 0930-1135

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.14
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		457.31
Gas Meter Final Reading (cu ft)		528.70
Net Gas Sample Volume (cu ft)	V(m)	(71.40)
Vol of Liquid Collected (ml)	Vl(c)	139.8
Vol of Liq @ Std. Conds. (scf)	V(w std)	(6.580)
Wt. of Filter Particulate (gm)		2.0812
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(2.0812)
O2 Concentration (by CEM)	% O2	3.34
CO2 Concentration (by CEM)	% CO2	13.70
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(82.96)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.10	1.74	438.00	75.0	78.0	1.0488
2	4.00	1.10	1.74	459.00	75.0	78.0	1.0488
3	4.00	0.97	1.53	463.00	75.0	78.0	0.9849
B1	4.00	0.96	1.52	470.00	76.0	77.0	0.9798
2	4.00	1.10	1.74	480.00	78.0	77.0	1.0488
3	4.00	1.10	1.74	485.00	79.0	77.0	1.0488
C1	4.00	1.30	2.05	436.00	79.0	77.0	1.1402
2	4.00	1.30	2.05	440.00	81.0	77.0	1.1402
3	4.00	1.30	2.05	447.00	83.0	77.0	1.1402
D1	4.00	1.30	2.05	475.00	84.0	78.0	1.1402
2	4.00	1.30	2.05	481.00	85.0	78.0	1.1402
3	4.00	1.30	2.05	487.00	86.0	78.0	1.1402
E1	4.00	1.50	2.37	451.00	84.0	79.0	1.2247
2	4.00	1.60	2.53	460.00	86.0	79.0	1.2649
3	4.00	1.10	1.74	466.00	87.0	79.0	1.0954
F1	4.00	1.20	1.90	460.00	87.0	79.0	1.0954
2	4.00	1.20	1.90	487.00	87.0	80.0	1.0954
3	4.00	1.20	1.90	496.00	87.0	80.0	1.1832
G1	4.00	1.40	2.21	450.00	86.0	80.0	1.1832
2	4.00	1.50	2.37	453.00	87.0	80.0	1.1832
3	4.00	1.10	1.74	458.00	87.0	80.0	1.0488
H1	4.00	1.20	1.90	460.00	89.0	81.0	1.0954
2	4.00	1.10	1.74	474.00	89.0	81.0	1.0488
3	4.00	1.10	1.74	496.00	89.0	81.0	1.0488
TOTALS	96.00	29.33	46.34	11172.00	2001.00	1889.0	26.5685

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.222
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	1.931
Avg Stack Temperature (degF)	T(s avg)	=	465.5
Average Meter Temperature (degF)	T(m avg)	=	81.0
Avg SQRT(dP)		=	1.107

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	68.09
Stack Gas Water Vapor Proportion	B(wo)	=	0.088
Mol. Wt., Stack Gas Dry	M(d)	=	30.33
Mol. Wt., Stack Gas Wet	M(s)	=	29.24
Abs Stack Pressure (in Hg)	P(s)	=	30.61
Avg Stack Velocity (ft/sec)	V(s avg)	=	80.8
Isokineticity (%)	% I	=	99.6
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	247825
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	465629
Percent XS Air	PEA	=	18.0
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.4716
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	855
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.3739
Heat Input Rate, MBtu/hr		=	1272.22
Particulate Emission Rate(lb/hr)	E(p)	=	1001.618
Particulate Emission Rate(lb/MBtu)		=	0.7874

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek
Date: 11/5/92 Printed 19-Nov — Test No./Type: M17-5B
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1245-

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.14
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		533.80
Gas Meter Final Reading (cu ft)		600.00
Net Gas Sample Volume (cu ft)	V(m)	(66.20)
Vol of Liquid Collected (ml)	Vl(c)	154.9
Vol of Liq @ Std. Conds. (scf)	V(w std)	(7.291)
Wt. of Filter Particulate (gm)		3.1998
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(3.1998)
O2 Concentration (by CEM)	% O2	3.34
CO2 Concentration (by CEM)	% CO2	13.70
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(82.96)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.10	1.74	431.00	71.0	73.0	1.0488
2	4.00	1.20	1.90	439.00	71.0	72.0	1.0954
3	4.00	1.10	1.74	449.00	73.0	72.0	1.0488
B1	4.00	1.00	1.58	480.00	75.0	72.0	1.0000
2	4.00	1.10	1.74	495.00	77.0	72.0	1.0488
3	4.00	1.00	1.58	501.00	78.0	73.0	1.0000
C1	4.00	1.40	2.21	450.00	78.0	73.0	1.1832
2	4.00	1.40	2.21	442.00	80.0	73.0	1.1832
3	4.00	1.30	2.05	451.00	82.0	74.0	1.1402
D1	4.00	1.30	2.05	447.00	83.0	74.0	1.1402
2	4.00	1.30	2.05	470.00	83.0	75.0	1.1402
3	4.00	1.20	1.90	492.00	84.0	75.0	1.0954
E1	4.00	1.30	2.05	451.00	82.0	76.0	1.1402
2	4.00	1.20	1.90	467.00	82.0	76.0	1.0954
3	4.00	1.10	1.74	478.00	84.0	76.0	1.0954
F1	4.00	1.20	1.90	460.00	86.0	78.0	1.0488
2	4.00	1.10	1.74	482.00	86.0	78.0	1.0488
3	4.00	1.10	1.74	504.00	85.0	77.0	1.1832
G1	4.00	1.40	2.21	459.00	84.0	78.0	1.1832
2	4.00	1.50	2.37	477.00	84.0	78.0	1.1832
3	4.00	1.20	1.90	482.00	84.0	78.0	1.0954
H1	4.00	1.10	1.74	460.00	85.0	78.0	1.0488
2	4.00	1.20	1.90	491.00	85.0	78.0	1.0954
3	4.00	1.20	1.90	501.00	84.0	78.0	1.0954
TOTALS	96.00	29.00	45.82	11259.00	1946.00	1807.0	26.4378

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.208
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	1.909
Avg Stack Temperature (degF)	T(s avg)	=	469.1
Average Meter Temperature (degF)	T(m avg)	=	78.2
Avg SQRT(dP)		=	1.102

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	63.47
Stack Gas Water Vapor Proportion	B(wo)	=	0.103
Mol. Wt., Stack Gas Dry	M(d)	=	30.33
Mol. Wt., Stack Gas Wet	M(s)	=	29.06
Abs Stack Pressure (in Hg)	P(s)	=	30.61
Avg Stack Velocity (ft/sec)	V(s avg)	=	80.9
Isokineticity (%)	% I	=	94.7
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	242862
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	465711
Percent XS Air	PEA	=	18.0
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.7779
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	1411
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.6167
Heat Input Rate, MBtu/hr		=	1246.75
Particulate Emission Rate(lb/hr)	E(p)	=	1619.040
Particulate Emission Rate(lb/MBtu)		=	1.2988

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek

Date: 11/6/92 Printed 19-Nov — Test No./Type: M17-6A

Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 0840-

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.00
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		601.30
Gas Meter Final Reading (cu ft)		667.11
Net Gas Sample Volume (cu ft)	V(m)	(65.81)
Vol of Liquid Collected (ml)	Vl(c)	116.6
Vol of Liq @ Std. Conds. (scf)	V(w std)	(5.488)
Wt. of Filter Particulate (gm)		5.6026
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(5.6026)
Concentration (by CEM)	% O2	2.63
Concentration (by CEM)	% CO2	14.20
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.17)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.10	1.74	428.00	74.0	77.0	1.0488
2	4.00	1.10	1.74	435.00	72.0	76.0	1.0488
3	4.00	0.96	1.52	440.00	74.0	75.0	0.9798
B1	4.00	0.98	1.55	450.00	76.0	74.0	0.9899
2	4.00	0.91	1.44	454.00	78.0	76.0	0.9539
3	4.00	0.96	1.52	460.00	79.0	76.0	0.9798
C1	4.00	1.10	1.74	424.00	78.0	75.0	1.0488
2	4.00	1.20	1.90	437.00	80.0	76.0	1.0954
3	4.00	1.20	1.90	442.00	82.0	76.0	1.0954
D1	4.00	1.20	1.90	462.00	83.0	76.0	1.0954
2	4.00	1.20	1.90	466.00	84.0	77.0	1.0954
3	4.00	1.20	1.90	473.00	84.0	77.0	1.0954
E1	4.00	1.30	2.05	423.00	84.0	78.0	1.1402
2	4.00	1.30	2.05	445.00	84.0	79.0	1.1402
3	4.00	1.00	1.58	456.00	87.0	79.0	1.0954
F1	4.00	1.20	1.90	484.00	88.0	80.0	1.0954
2	4.00	1.20	1.90	502.00	89.0	81.0	1.0954
3	4.00	1.20	1.90	501.00	90.0	81.0	1.0954
G1	4.00	1.20	1.90	460.00	89.0	82.0	1.0954
2	4.00	1.10	1.74	463.00	90.0	82.0	1.0954
3	4.00	1.20	1.90	470.00	91.0	83.0	1.0954
H1	4.00	1.20	1.90	483.00	92.0	83.0	1.0954
2	4.00	1.10	1.74	494.00	92.0	84.0	1.0488
3	4.00	1.10	1.74	509.00	91.0	83.0	1.0488
TOTALS	96.00	27.21	42.99	11061.00	2011.00	1886.0	25.6687

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.134
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	1.791
Avg Stack Temperature (degF)	T(s avg)	=	460.9
Average Meter Temperature (degF)	T(m avg)	=	81.2
Avg SQRT(dP)		=	1.070

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	62.42
Stack Gas Water Vapor Proportion	B(wo)	=	0.081
Mol. Wt., Stack Gas Dry	M(d)	=	30.38
Mol. Wt., Stack Gas Wet	M(s)	=	29.38
Abs Stack Pressure (in Hg)	P(s)	=	30.47
Avg Stack Velocity (ft/sec)	V(s avg)	=	77.9
Isokineticity (%)	% I	=	93.9
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	240836
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	448710
Percent XS Air	PEA	=	13.6
Particulate Loading, dry(gr/dscf)	C(s std)	=	1.3849
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	2415
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	1.0554
Heat Input Rate, MBtu/hr		=	1286.33
Particulate Emission Rate(lb/hr)	E(p)	=	2858.305
Particulate Emission Rate(lb/MBtu)		=	2.2224

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Janek
Date: 11/6/92 Printed 19-Nov — Test No./Type: M17-6B
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1105-

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.225
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9990
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(96.00)
Barometric Pressure (in Hg)	P(b)	29.00
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		668.11
Gas Meter Final Reading (cu ft)		734.00
Net Gas Sample Volume (cu ft)	V(m)	(65.89)
Vol of Liquid Collected (ml)	Vl(c)	126.0
Vol of Liq @ Std. Conds. (scf)	V(w std)	(5.931)
Wt. of Filter Particulate (gm)		4.4550
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(4.4550)
O2 Concentration (by CEM)	% O2	2.63
CO2 Concentration (by CEM)	% CO2	14.20
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.17)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A1	4.00	1.00	1.58	435.00	78.0	79.0	1.0000
2	4.00	0.99	1.56	450.00	79.0	79.0	0.9950
3	4.00	0.94	1.49	466.00	82.0	80.0	0.9695
B1	4.00	0.95	1.50	470.00	85.0	80.0	0.9747
2	4.00	0.92	1.45	475.00	86.0	80.0	0.9592
3	4.00	1.10	1.74	478.00	86.0	81.0	1.0488
C1	4.00	1.30	2.05	454.00	87.0	81.0	1.1402
2	4.00	1.20	1.90	469.00	88.0	81.0	1.0954
3	4.00	1.20	1.90	475.00	89.0	81.0	1.0954
D1	4.00	1.20	1.90	480.00	89.0	82.0	1.0954
2	4.00	1.30	2.05	489.00	89.0	82.0	1.1402
3	4.00	1.20	1.90	493.00	89.0	82.0	1.0954
E1	4.00	1.20	1.90	483.00	88.0	82.0	1.0954
2	4.00	1.10	1.74	499.00	89.0	83.0	1.0488
3	4.00	1.10	1.74	505.00	90.0	83.0	1.0488
F1	4.00	1.10	1.74	512.00	91.0	83.0	1.0954
2	4.00	1.20	1.90	514.00	90.0	83.0	1.0954
3	4.00	1.20	1.90	523.00	91.0	83.0	1.0954
G1	4.00	1.20	1.90	461.00	87.0	82.0	1.0954
2	4.00	1.30	2.05	478.00	88.0	82.0	1.0954
3	4.00	1.10	1.74	489.00	88.0	82.0	1.0488
H1	4.00	1.10	1.74	514.00	88.0	82.0	1.0488
2	4.00	1.10	1.74	520.00	87.0	82.0	1.0488
3	4.00	1.10	1.74	528.00	86.0	82.0	1.0488
TOTALS	96.00	27.10	42.82	11660.00	2090.00	1957.0	25.4748

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.129
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	1.784
Avg Stack Temperature (degF)	T(s avg)	=	485.8
Average Meter Temperature (degF)	T(m avg)	=	84.3
Avg SQRT(dP)		=	1.061

CALCULATED VALUES

Meter Volume (std. cu. ft.)	V(m std)	=	62.14
Stack Gas Water Vapor Proportion	B(wo)	=	0.087
Mol. Wt., Stack Gas Dry	M(d)	=	30.38
Mol. Wt., Stack Gas Wet	M(s)	=	29.30
Abs Stack Pressure (in Hg)	P(s)	=	30.47
Avg Stack Velocity (ft/sec)	V(s avg)	=	78.5
Isokineticity (%)	% I	=	96.0
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	234536
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	451917
Percent XS Air	PEA	=	13.6
Particulate Loading, dry(gr/dscf)	C(s std)	=	1.1062
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	1929
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.8430
Heat Input Rate, MBtu/hr		=	1252.69
Particulate Emission Rate(lb/hr)	E(p)	=	2223.352
Particulate Emission Rate(lb/MBtu)		=	1.7752

APPENDIX C

METHOD 5 PARTICULATE AT ESP OUTLET AND METHOD 421 ACID GASES: DATA RUN SUMMARY

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-2-92

Performed by: C. Franco
Sample Location: Unit #2 (Outlet)

Test No./Type: #1 M5/421
Start/Stop Time: 0927

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.248
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	0.9900
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(360.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		771.59
Gas Meter Final Reading (cu ft)		1086.68
Net Gas Sample Volume (cu ft)	V(m)	(315.10)
Vol of Liquid Collected (ml)	Vl(c)	596.3
Vol of Liq @ Std. Conds. (scf)	V(w std)	(28.068)
Wt. of Front Half Particulate (gm)		0.3937
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.3937)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	1.252
Avg Orifice Meter Reading (in H2O)	dH(avg) =	2.723
Avg Stack Temperature (degF)	T(s avg)=	514.8
Average Meter Temperature (degF)	T(m avg)=	62.2
Avg SQRT(dP)	=	1.113

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	317.40
Stack Gas Water Vapor Proportion	B(wo) =	0.081
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.36
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	82.0
Isokineticity (%)	% I =	101.9
Stack Gas STD Vol Flow (dscfm)	Q(s) =	247749
Actual Stack Gas Vol Flow (acfm)	Q(a) =	472326
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0191
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0149
Particulate Emission Rate(lb/hr)	E(p) =	40.636

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter,dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
3-1	20	1.000	2.17	499	53	53	1.0000
2	20	1.000	2.19	503	68	57	1.0000
3	20	1.250	2.82	504	72	62	1.1180
4-1	20	1.260	2.78	506	72	63	1.1225
2	20	1.300	2.84	516	71	63	1.1402
3	20	1.300	2.84	516	70	63	1.1402
5-1	20	0.800	1.74	518	69	63	0.8944
2	20	0.800	1.71	537	66	61	0.8944
3	20	0.820	1.75	538	69	61	0.9055
7-1	20	1.200	2.55	541	62	60	1.0954
2	20	1.500	3.26	512	62	67	1.2247
3	20	1.500	3.26	513	64	67	1.2247
8-1	20	1.500	3.26	514	64	58	1.2247
2	20	1.480	3.20	513	62	57	1.2166
3	20	1.450	3.14	513	61	56	1.2042
1-1	20	1.470	3.19	509	61	55	1.2124
2	20	1.460	3.17	508	60	53	1.2083
3	20	1.450	3.14	507	60	54	1.2042
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	22.540	49.01	9267	1166	1073	20.0306

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-3-92

Performed by: C. Franco
Sample Location: Unit #2 (Outlet)

Test No./Type: #2 M5/421
Start/Stop Time: 0903

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.248
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	0.9900
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(360.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		143.74
Gas Meter Final Reading (cu ft)		438.71
Net Gas Sample Volume (cu ft)	V(m)	(294.98)
Vol of Liquid Collected (ml)	Vl(c)	575.5
Vol of Liq @ Std. Conds. (scf)	V(w std)	(27.089)
Wt. of Front Half Particulate (gm)		0.2493
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.2493)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	1.094
Avg Orifice Meter Reading (in H2O)	dH(avg) =	2.392
Avg Stack Temperature (degF)	T(s avg)=	490.8
Average Meter Temperature (degF)	T(m avg)=	51.7
Avg SQRT(dP)	=	1.038

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	302.98
Stack Gas Water Vapor Proportion	B(wo) =	0.082
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.35
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	75.5
Isokineticity (%)	% I =	103.1
Stack Gas STD Vol Flow (dscfm)	Q(s) =	233750
Actual Stack Gas Vol Flow (acfm)	Q(a) =	435030
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0127
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0099
Particulate Emission Rate(lb/hr)	E(p) =	25.433

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter,dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
5-1	20	0.750	1.61	482	38	38	0.8660
2	20	0.850	1.84	490	53	41	0.9220
3	20	0.850	1.86	491	57	46	0.9220
7-1	20	0.600	1.31	493	59	49	0.7746
2	20	0.600	1.32	481	51	47	0.7746
3	20	0.900	1.98	482	56	48	0.9487
8-1	20	1.300	2.86	486	57	48	1.1402
2	20	1.400	3.18	458	59	49	1.1832
3	20	1.350	3.02	473	59	51	1.1619
1-1	20	1.250	2.71	496	50	45	1.1180
2	20	1.450	3.14	497	55	48	1.2042
3	20	1.250	2.72	499	58	50	1.1180
3-1	20	1.150	2.49	500	58	50	1.0724
2	20	1.050	2.27	499	57	49	1.0247
3	20	1.100	2.39	502	59	50	1.0488
4-1	20	1.300	2.82	502	58	51	1.1402
2	20	1.300	2.82	502	57	50	1.1402
3	20	1.250	2.72	501	58	52	1.1180
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	19.700	43.06	8834	999	862	18.6776

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-4-92

Performed by: C. Franco
Sample Location: Unit #2 (Outlet)

Test No./Type: #3 M5/421
Start/Stop Time: 0950

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.248
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	0.9900
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(234.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		459.76
Gas Meter Final Reading (cu ft)		646.29
Net Gas Sample Volume (cu ft)	V(m)	(186.53)
Vol of Liquid Collected (ml)	Vl(c)	388.2
Vol of Liq @ Std. Conds. (scf)	V(w std)	(18.273)
Wt. of Front Half Particulate (gm)		0.0467
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0467)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter,dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
5-1	13	0.600	1.29	474	38	36	0.7746
2	13	0.700	1.49	498	50	41	0.8367
3	13	0.750	1.61	501	57	43	0.8660
7-1	13	0.800	1.73	504	58	46	0.8944
2	13	0.850	1.83	504	59	49	0.9220
3	13	0.900	1.94	508	59	49	0.9487
8-1	13	0.900	1.94	509	59	49	0.9487
2	13	1.500	3.20	510	60	49	1.2247
3	13	1.500	3.27	497	61	50	1.2247
1-1	13	1.450	3.18	498	63	50	1.2042
2	13	1.100	2.40	499	64	50	1.0488
3	13	1.150	2.54	484	64	50	1.0724
3-1	13	1.250	2.76	485	60	49	1.1180
2	13	1.250	2.75	487	63	50	1.1180
3	13	1.200	2.65	487	61	50	1.0954
4-1	13	1.200	2.65	486	61	54	1.0954
2	13	1.400	3.08	489	62	55	1.1832
3	13	1.420	3.10	497	61	54	1.1916
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	234	19.920	43.41	8917	1060	874	18.7677

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	1.107
Avg Orifice Meter Reading (in H2O)	dH(avg) =	2.412
Avg Stack Temperature (degF)	T(s avg)=	495.4
Average Meter Temperature (degF)	T(m avg)=	53.7
Avg SQRT(dP)	=	1.043

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	190.85
Stack Gas Water Vapor Proportion	B(wo) =	0.087
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.28
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	76.2
Isokineticity (%)	% I =	100.2
Stack Gas STD Vol Flow (dscfm)	Q(s) =	233215
Actual Stack Gas Vol Flow (acfm)	Q(a) =	438677
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0038
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0029
Particulate Emission Rate(lb/hr)	E(p) =	7.548

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-4-92

Performed by: C. Franco
Sample Location: Unit #2 (Outlet)

Test No./Type: #4 M5/421
Start/Stop Time: 1640

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.248
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	0.9900
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(234.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		647.08
Gas Meter Final Reading (cu ft)		840.51
Net Gas Sample Volume (cu ft)	V(m)	(193.43)
Vol of Liquid Collected (ml)	Vl(c)	413.8
Vol of Liq @ Std. Conds. (scf)	V(w std)	(19.478)
Wt. of Front Half Particulate (gm)		0.1091
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.1091)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
1-1	13	1.200	2.56	490	42	40	1.0954
2	13	1.150	2.48	490	52	42	1.0724
3	13	1.250	2.72	490	60	42	1.1180
3-1	13	1.100	2.39	499	62	47	1.0488
2	13	1.100	2.37	501	62	48	1.0488
3	13	1.150	2.50	500	63	50	1.0724
4-1	13	1.250	2.43	500	64	51	1.1180
2	13	1.350	2.94	501	63	52	1.1619
3	13	1.400	3.05	502	63	51	1.1832
5-1	13	1.250	2.72	502	63	51	1.1180
2	13	1.200	2.61	502	64	52	1.0954
3	13	1.250	2.66	525	64	50	1.1180
7-1	13	1.000	2.30	509	41	40	1.0000
2	13	1.100	2.33	514	60	43	1.0488
3	13	1.100	2.35	509	62	48	1.0488
8-1	13	1.500	3.27	500	56	49	1.2247
2	13	1.520	3.31	500	62	50	1.2329
3	13	1.450	3.18	493	60	54	1.2042
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	234	22.320	48.17	9027	1063	860	20.0099

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	1.240
Avg Orifice Meter Reading (in H2O)	dH(avg) =	2.676
Avg Stack Temperature (degF)	T(s avg)=	501.5
Average Meter Temperature (degF)	T(m avg)=	53.4
Avg SQRT(dP)	=	1.112

CALCULATED VALUES

Meter Volume (std. cu. ft.)	V(m std)=	198.15
Stack Gas Water Vapor Proportion	B(wo) =	0.089
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.25
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	81.5
Isokineticity (%)	% I =	98.0
Stack Gas STD Vol Flow (dscfm)	Q(s) =	247395
Actual Stack Gas Vol Flow (acfm)	Q(a) =	469417
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0085
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0066
Particulate Emission Rate(lb/hr)	E(p) =	18.019

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-5-92

Performed by: C. Franco
Sample Location: Unit #2 (Outlet)

Test No./Type: #5 M5/421
Start/Stop Time: 0949

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.248
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	0.9900
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(360.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		852.61
Gas Meter Final Reading (cu ft)		1160.60
Net Gas Sample Volume (cu ft)	V(m)	(307.99)
Vol of Liquid Collected (ml)	Vl(c)	603.9
Vol of Liq @ Std. Conds. (scf)	V(w std)	(28.426)
Wt. of Front Half Particulate (gm)		0.3584
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.3584)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	1.249
Avg Orifice Meter Reading (in H2O)	dH(avg) =	2.732
Avg Stack Temperature (degF)	T(s avg)=	491.8
Average Meter Temperature (degF)	T(m avg)=	53.1
Avg SQRT(dP)	=	1.112

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	315.74
Stack Gas Water Vapor Proportion	B(wo) =	0.083
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.34
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	81.0
Isokineticity (%)	% I =	100.4
Stack Gas STD Vol Flow (dscfm)	Q(s) =	250210
Actual Stack Gas Vol Flow (acfm)	Q(a) =	466446
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0175
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0136
Particulate Emission Rate(lb/hr)	E(p) =	37.559

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter,dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
5-1	20	0.700	1.49	492	42	39	0.8367
2	20	1.220	2.63	498	55	44	1.1045
3	20	1.200	2.60	500	57	48	1.0954
7-1	20	0.850	1.84	501	58	51	0.9220
2	20	1.000	2.19	490	57	51	1.0000
3	20	1.050	2.30	492	59	51	1.0247
8-1	20	1.550	3.39	495	60	52	1.2450
2	20	1.750	3.97	464	62	51	1.3229
3	20	1.500	3.40	463	60	52	1.2247
1-1	20	1.150	2.53	461	59	51	1.0724
2	20	1.250	2.74	494	59	50	1.1180
3	20	1.500	3.29	494	60	51	1.2247
3-1	20	1.100	2.41	496	57	50	1.0488
2	20	1.300	2.81	500	55	50	1.1402
3	20	1.300	2.81	502	56	50	1.1402
4-1	20	1.400	3.03	503	55	50	1.1832
2	20	1.420	3.06	504	55	50	1.1916
3	20	1.250	2.69	504	55	50	1.1180
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	22.490	49.18	8853	1021	891	20.0131

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-6-92

Performed by: C. Franco
Sample Location: Unit #2 (Outlet)

Test No./Type: #6 M5/421
Start/Stop Time: 0826

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.248
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	0.9900
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H20)	P(stack)	21.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(360.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		231.22
Gas Meter Final Reading (cu ft)		510.74
Net Gas Sample Volume (cu ft)	V(m)	(279.52)
Vol of Liquid Collected (ml)	Vl(c)	698.5
Vol of Liq @ Std. Conds. (scf)	V(w std)	(32.878)
Wt. of Front Half Particulate (gm)		0.3407
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.3407)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

Sample Point	dClock Time	Velocity Head, dP (in H20)	Orifice Meter, dH (in H20)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
1-1	20	0.900	1.99	458	37	37	0.9487
2	20	1.050	2.36	462	55	41	1.0247
3	20	1.200	2.70	463	56	43	1.0954
3-1	20	0.950	2.13	465	60	48	0.9747
2	20	1.100	2.41	487	54	47	1.0488
3	20	1.000	2.20	486	60	48	1.0000
4-1	20	1.400	3.07	490	61	49	1.1832
2	20	1.500	3.28	501	65	51	1.2247
3	20	1.200	2.62	501	67	54	1.0954
5-1	20	1.050	2.29	502	62	58	1.0247
2	20	0.950	2.03	526	65	54	0.9747
3	20	0.850	1.81	526	65	53	0.9220
7-1	20	0.950	2.02	529	65	52	0.9747
2	20	0.950	2.02	530	63	52	0.9747
3	20	0.850	1.80	532	64	50	0.9220
8-1	20	1.250	2.71	511	67	50	1.1180
2	20	1.500	3.24	513	67	49	1.2247
3	20	1.450	3.10	523	67	49	1.2042
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	20.100	43.78	9005	1100	885	18.9353

FIELD DATA AVERAGES

Avg Velocity Head (in H20)	dP(avg) =	1.117
Avg Orifice Meter Reading (in H20)	dH(avg) =	2.432
Avg Stack Temperature (degF)	T(s avg)=	500.3
Average Meter Temperature (degF)	T(m avg)=	55.1
Avg SQRT(dP)	=	1.052

CALCULATED VALUES

Meter Volume (std. cu. ft.)	V(m std)=	285.21
Stack Gas Water Vapor Proportion	B(wo) =	0.103
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.08
Abs Stack Pressure (in Hg)	P(s) =	31.46
Avg Stack Velocity (ft/sec)	V(s avg)=	77.4
Isokineticity (%)	% I =	98.2
Stack Gas STD Vol Flow (dscfm)	Q(s) =	231100
Actual Stack Gas Vol Flow (acfm)	Q(a) =	445750
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0184
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0143
Particulate Emission Rate(lb/hr)	E(p) =	36.509

APPENDIX D

METALS TRAIN AT ESP INLET: DATA RUN SUMMARY

DOE/B&W/WP&L, Toxics Test Series, November, 1992

ESP Inlet Multiple Metals Samples

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Squier
Date: 11/2/92 Printed 11-Nov — Test No./Type: IM-1
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1037-

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.188
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9980
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(180.00)
Barometric Pressure (in Hg)	P(b)	29.00
Stack Static Pressure (in H20)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		335.10
Gas Meter Final Reading (cu ft)		433.51
Net Gas Sample Volume (cu ft)	V(m)	(98.41)
Vol of Liquid Collected (ml)	Vl(c)	85.6
Vol of Liq @ Std. Conds. (scf)	V(w std)	(4.029)
Wt. of Filter Particulate (gm)		0.0000
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.23
CO2 Concentration (by CEM)	% CO2	15.46
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(81.31)

Sample Point	dClock Time	Velocity Head, dP (in H20)	Orifice Meter,dH (in H20)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A3	10.00	1.30	1.04	511.00	63.0	61.0	1.1402
2	10.00	1.20	0.96	512.00	69.0	62.0	1.0954
1	10.00	1.20	0.96	512.00	71.0	64.0	1.0954
B3	10.00	1.20	0.96	518.00	68.0	64.0	1.0954
2	10.00	1.20	0.96	519.00	72.0	65.0	1.0954
1	10.00	1.20	0.96	521.00	71.0	65.0	1.0954
C3	10.00	1.60	1.30	518.00	68.0	64.0	1.2649
2	10.00	1.30	1.00	519.00	70.0	64.0	1.1402
1	10.00	1.40	1.10	520.00	71.0	64.0	1.1832
D3	10.00	1.60	1.30	528.00	67.0	63.0	1.2649
2	10.00	1.30	1.00	527.00	69.0	63.0	1.1402
1	10.00	1.50	1.20	527.00	70.0	64.0	1.2247
E3	10.00	1.40	1.10	562.00	56.0	56.0	1.1832
2	10.00	1.20	0.96	560.00	61.0	56.0	1.0954
1	10.00	1.30	1.00	559.00	62.0	56.0	1.1402
F3	10.00	1.30	1.00	565.00	60.0	56.0	1.1402
2	10.00	1.20	0.96	563.00	65.0	57.0	1.0954
1	10.00	1.40	1.10	556.00	61.0	57.0	1.1832
TOTALS	180.00	23.80	18.86	9597.00	1194.0	1101.0	20.6732

FIELD DATA AVERAGES

Avg Velocity Head (in H20)	dP(avg)	=	1.322
Avg Orifice Meter Reading (in H20)	dH(avg)	=	1.048
Avg Stack Temperature (degF)	T(s avg)	=	533.2
Average Meter Temperature (degF)	T(m avg)	=	63.8
Avg SQRT(dP)		=	1.149

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	96.18
Stack Gas Water Vapor Proportion	B(wo)	=	0.040
Mol. Wt., Stack Gas Dry	M(d)	=	30.60
Mol. Wt., Stack Gas Wet	M(s)	=	30.10
Abs Stack Pressure (in Hg)	P(s)	=	30.47
Avg Stack Velocity (ft/sec)	V(s avg)	=	85.8
Isokineticity (%)	% I	=	103.7
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	256907
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	494388
Percent XS Air	PEA	=	17.7
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.0000
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	0
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.0000
Heat Input Rate, MBtu/hr		=	1327.11
Particulate Emission Rate(lb/hr)	E(p)	=	0.000
Particulate Emission Rate(lb/MBtu)		=	0.0000

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Squier
Date: 11/3/92 Printed 11-Nov — Test No./Type: IM-2
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 0952-1240

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.188
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9980
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(120.00)
Barometric Pressure (in Hg)	P(b)	29.00
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		434.50
Gas Meter Final Reading (cu ft)		500.71
Net Gas Sample Volume (cu ft)	V(m)	(66.21)
Vol of Liquid Collected (ml)	Vl(c)	85.6
Vol of Liq @ Std. Conds. (scf)	V(w std)	(4.029)
Wt. of Filter Particulate (gm)		0.0000
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.23
CO2 Concentration (by CEM)	% CO2	15.46
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(81.31)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A3	5.00	1.30	1.00	500.00	60.0	60.0	1.1402
2	5.00	1.10	0.90	502.00	64.0	60.0	1.0488
1	5.00	1.20	1.00	503.00	67.0	61.0	1.0954
B3	5.00	1.10	0.90	508.00	68.0	63.0	1.0488
2	5.00	1.00	0.80	509.00	73.0	63.0	1.0000
1	5.00	1.10	0.90	510.00	74.0	64.0	1.0488
C3	5.00	1.40	1.10	507.00	72.0	64.0	1.1832
2	5.00	1.20	1.00	506.00	77.0	66.0	1.0954
1	5.00	1.30	1.00	505.00	77.0	67.0	1.1402
D3	5.00	1.30	1.00	502.00	69.0	65.0	1.1402
2	5.00	1.20	1.00	501.00	72.0	64.0	1.0954
1	5.00	1.30	1.00	501.00	72.0	64.0	1.1402
E3	5.00	1.30	1.00	517.00	66.0	61.0	1.1402
2	5.00	1.20	1.00	517.00	72.0	62.0	1.0954
1	5.00	1.20	1.00	515.00	73.0	63.0	1.1402
F3	5.00	1.30	1.00	520.00	67.0	63.0	1.0954
2	5.00	1.20	1.00	519.00	71.0	63.0	1.1832
1	5.00	1.40	1.10	517.00	71.0	63.0	1.1832
G3	5.00	1.40	1.10	516.00	64.0	60.0	1.1832
2	5.00	1.30	1.00	516.00	70.0	61.0	1.1832
1	5.00	1.20	1.00	510.00	70.0	61.0	1.0954
H3	5.00	1.40	1.10	463.00	65.0	60.0	1.1832
2	5.00	1.30	1.00	464.00	69.0	60.0	1.1402
1	5.00	1.40	1.10	465.00	68.0	60.0	1.1832
TOTALS	120.00	30.10	24.00	12093.00	1671.00	1498.0	26.9828

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.254
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	1.000
Avg Stack Temperature (degF)	T(s avg)	=	503.9
Average Meter Temperature (degF)	T(m avg)	=	66.0
Avg SQRT(dP)		=	1.124

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	64.42
Stack Gas Water Vapor Proportion	B(wo)	=	0.059
Mol. Wt., Stack Gas Dry	M(d)	=	30.60
Mol. Wt., Stack Gas Wet	M(s)	=	29.86
Abs Stack Pressure (in Hg)	P(s)	=	30.47
Avg Stack Velocity (ft/sec)	V(s avg)	=	83.1
Isokineticity (%)	% I	=	106.5
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	251303
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	478643
Percent XS Air	PEA	=	17.7
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.0000
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	0
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.0000
Heat Input Rate, MBtu/hr		=	1298.16
Particulate Emission Rate(lb/hr)	E(p)	=	0.000
Particulate Emission Rate(lb/MBtu)		=	0.0000

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Squier
Date: 11/4/92 Printed 11-Nov — Test No./Type: IM-3
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1043-1302

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.188
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9980
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(120.00)
Barometric Pressure (in Hg)	P(b)	29.10
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		502.61
Gas Meter Final Reading (cu ft)		567.30
Net Gas Sample Volume (cu ft)	V(m)	(64.70)
Vol of Liquid Collected (ml)	Vl(c)	85.6
Vol of Liq @ Std. Conds. (scf)	V(w std)	(4.029)
Wt. of Filter Particulate (gm)		0.0000
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.23
CO2 Concentration (by CEM)	% CO2	15.46
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(81.31)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A3	5.00	1.20	1.00	492.00	54.0	54.0	1.0954
2	5.00	1.00	0.80	492.00	58.0	54.0	1.0000
1	5.00	1.00	0.80	493.00	60.0	54.0	1.0000
B3	5.00	1.00	0.80	496.00	58.0	54.0	1.0000
2	5.00	1.10	0.90	495.00	64.0	54.0	1.0488
1	5.00	1.00	0.80	497.00	64.0	55.0	1.0000
C3	5.00	1.30	1.00	494.00	61.0	55.0	1.1402
2	5.00	1.20	1.00	495.00	66.0	56.0	1.0954
1	5.00	1.20	1.00	495.00	66.0	56.0	1.0954
D3	5.00	1.20	1.00	500.00	63.0	56.0	1.0954
2	5.00	1.30	1.00	500.00	66.0	56.0	1.1402
1	5.00	1.20	1.00	500.00	66.0	56.0	1.0954
E3	5.00	1.30	1.00	524.00	60.0	55.0	1.1402
2	5.00	1.20	1.00	524.00	66.0	56.0	1.0954
1	5.00	1.10	0.90	524.00	66.0	56.0	1.0954
F3	5.00	1.20	1.00	524.00	66.0	57.0	1.0954
2	5.00	1.20	1.00	523.00	66.0	57.0	1.1402
1	5.00	1.30	1.00	524.00	66.0	56.0	1.0954
G3	5.00	1.20	1.00	532.00	63.0	56.0	1.0954
2	5.00	1.20	1.00	531.00	67.0	57.0	1.0954
1	5.00	1.20	1.00	531.00	67.0	57.0	1.0954
H3	5.00	1.30	1.00	532.00	67.0	57.0	1.1402
2	5.00	1.20	1.00	530.00	67.0	57.0	1.0954
1	5.00	1.30	1.00	531.00	67.0	57.0	1.1402
TOTALS	120.00	28.40	23.00	12279.00	1534.00	1338.0	26.1306

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.183
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	0.958
Avg Stack Temperature (degF)	T(s avg)	=	511.6
Average Meter Temperature (degF)	T(m avg)	=	59.8
Avg SQRT(dP)		=	1.089

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	63.91
Stack Gas Water Vapor Proportion	B(wo)	=	0.059
Mol. Wt., Stack Gas Dry	M(d)	=	30.60
Mol. Wt., Stack Gas Wet	M(s)	=	29.86
Abs Stack Pressure (in Hg)	P(s)	=	30.57
Avg Stack Velocity (ft/sec)	V(s avg)	=	80.7
Isokineticity (%)	% I	=	109.4
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	242699
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	464667
Percent XS Air	PEA	=	17.7
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.0000
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	0
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.0000
Heat Input Rate, MBtu/hr		=	1253.71
Particulate Emission Rate(lb/hr)	E(p)	=	0.000
Particulate Emission Rate(lb/MBtu)		=	0.0000

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Squier
Date: 11/4/92 Printed 11-Nov — Test No./Type: IM-4
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1715-1927

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.188
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9980
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(120.00)
Barometric Pressure (in Hg)	P(b)	29.10
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		567.90
Gas Meter Final Reading (cu ft)		632.91
Net Gas Sample Volume (cu ft)	V(m)	(65.01)
Vol of Liquid Collected (ml)	Vl(c)	85.6
Vol of Liq @ Std. Conds. (scf)	V(w std)	(4.029)
Wt. of Filter Particulate (gm)		0.0000
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.23
CO2 Concentration (by CEM)	% CO2	15.46
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(81.31)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A3	5.00	1.20	1.00	500.00	54.0	54.0	1.0954
2	5.00	1.10	0.90	500.00	58.0	54.0	1.0488
1	5.00	1.10	0.90	499.00	61.0	55.0	1.0488
B3	5.00	1.30	1.00	500.00	62.0	55.0	1.1402
2	5.00	1.20	1.00	500.00	64.0	55.0	1.0954
1	5.00	1.00	0.80	499.00	65.0	56.0	1.0000
C3	5.00	1.40	1.10	504.00	64.0	58.0	1.1832
2	5.00	1.20	1.00	505.00	70.0	59.0	1.0954
1	5.00	1.30	1.00	505.00	71.0	60.0	1.1402
D3	5.00	1.30	1.00	505.00	72.0	61.0	1.1402
2	5.00	1.20	1.00	505.00	73.0	62.0	1.0954
1	5.00	1.20	1.00	505.00	74.0	64.0	1.0954
E3	5.00	1.30	1.00	530.00	70.0	64.0	1.1402
2	5.00	1.20	1.00	529.00	76.0	65.0	1.0954
1	5.00	1.20	1.00	530.00	75.0	66.0	1.1832
F3	5.00	1.40	1.10	529.00	73.0	66.0	1.0488
2	5.00	1.10	0.90	530.00	75.0	66.0	1.0954
1	5.00	1.20	1.00	530.00	74.0	66.0	1.1402
G3	5.00	1.30	1.00	537.00	71.0	66.0	1.1402
2	5.00	1.30	1.00	537.00	76.0	67.0	1.1402
1	5.00	1.30	1.00	534.00	76.0	67.0	1.1402
H3	5.00	1.40	1.10	535.00	76.0	67.0	1.1832
2	5.00	1.20	1.00	535.00	75.0	67.0	1.0954
1	5.00	1.30	1.00	537.00	76.0	68.0	1.1402
TOTALS	120.00	29.70	23.80	12420.00	1681.00	1488.0	26.7212

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.238
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	0.992
Avg Stack Temperature (degF)	T(s avg)	=	517.5
Average Meter Temperature (degF)	T(m avg)	=	66.0
Avg SQRT(dP)		=	1.113

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	63.47
Stack Gas Water Vapor Proportion	B(wo)	=	0.060
Mol. Wt., Stack Gas Dry	M(d)	=	30.60
Mol. Wt., Stack Gas Wet	M(s)	=	29.85
Abs Stack Pressure (in Hg)	P(s)	=	30.57
Avg Stack Velocity (ft/sec)	V(s avg)	=	82.8
Isokineticity (%)	% I	=	106.6
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	247356
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	476642
Percent XS Air	PEA	=	17.7
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.0
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.0
Heat Input Rate, MBtu/hr		=	1277.77
Particulate Emission Rate(lb/hr)	E(p)	=	0.000
Particulate Emission Rate(lb/MBtu)		=	0.0000

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Squier
Date: 11/5/92 Printed 11-Nov — Test No./Type: IM-5
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 1715-1927

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.188
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9980
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(120.00)
Barometric Pressure (in Hg)	P(b)	29.14
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		633.30
Gas Meter Final Reading (cu ft)		699.50
Net Gas Sample Volume (cu ft)	V(m)	(66.20)
Vol of Liquid Collected (ml)	Vl(c)	85.6
Vol of Liq @ Std. Conds. (scf)	V(w std)	(4.029)
Wt. of Filter Particulate (gm)		0.0000
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.23
CO2 Concentration (by CEM)	% CO2	15.46
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(81.31)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A3	5.00	1.20	1.00	494.00	61.0	61.0	1.0954
2	5.00	1.10	0.90	494.00	65.0	61.0	1.0488
1	5.00	1.20	1.00	495.00	69.0	62.0	1.0954
B3	5.00	1.30	1.00	495.00	66.0	62.0	1.1402
2	5.00	1.00	0.80	495.00	73.0	63.0	1.0000
1	5.00	1.20	1.00	496.00	74.0	64.0	1.0954
C3	5.00	1.40	1.10	497.00	71.0	64.0	1.1832
2	5.00	1.30	1.00	497.00	76.0	65.0	1.1402
1	5.00	1.40	1.10	496.00	76.0	66.0	1.1832
D3	5.00	1.40	1.10	496.00	72.0	66.0	1.1832
2	5.00	1.20	1.00	496.00	77.0	66.0	1.0954
1	5.00	1.30	1.00	497.00	77.0	67.0	1.1402
E3	5.00	1.30	1.00	515.00	72.0	67.0	1.1402
2	5.00	1.20	1.00	514.00	77.0	67.0	1.0954
1	5.00	1.30	1.00	513.00	78.0	67.0	1.1832
F3	5.00	1.40	1.10	514.00	74.0	67.0	1.0954
2	5.00	1.20	1.00	514.00	78.0	68.0	1.1402
1	5.00	1.30	1.00	515.00	77.0	68.0	1.1402
G3	5.00	1.30	1.00	517.00	70.0	66.0	1.1402
2	5.00	1.30	1.00	516.00	75.0	66.0	1.1402
1	5.00	1.20	1.00	516.00	75.0	66.0	1.0954
H3	5.00	1.30	1.00	517.00	72.0	65.0	1.1402
2	5.00	1.30	1.00	515.00	73.0	65.0	1.1402
1	5.00	1.40	1.10	516.00	73.0	64.0	1.1832
TOTALS	120.00	30.50	24.20	12130.00	1751.00	1563.0	27.0348

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.271
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	1.008
Avg Stack Temperature (degF)	T(s avg)	=	505.4
Average Meter Temperature (degF)	T(m avg)	=	69.0
Avg SQRT(dP)		=	1.126

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	64.35
Stack Gas Water Vapor Proportion	B(wo)	=	0.059
Mol. Wt., Stack Gas Dry	M(d)	=	30.60
Mol. Wt., Stack Gas Wet	M(s)	=	29.86
Abs Stack Pressure (in Hg)	P(s)	=	30.61
Avg Stack Velocity (ft/sec)	V(s avg)	=	83.1
Isokineticity (%)	% I	=	106.0
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	252150
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	478854
Percent XS Air	PEA	=	17.7
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.0000
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	0
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.0000
Heat Input Rate, MBtu/hr		=	1302.53
Particulate Emission Rate(lb/hr)	E(p)	=	0.000
Particulate Emission Rate(lb/MBtu)		=	0.0000

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: WPL — Performed by: Squier
Date: 11/6/92 Printed 11-Nov — Test No./Type: IM-6
Sample Location: Unit 2, ESP Inlet — Start/Stop Time: 0909-1122

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.188
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(alpha)	0.9980
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
# of Sample Points	#	24
Total Sampling Time (min)	(theta)	(120.00)
Barometric Pressure (in Hg)	P(b)	29.00
Stack Static Pressure (in H2O)	P(stack)	20.000
Gas Meter Initial Reading (cu ft)		699.91
Gas Meter Final Reading (cu ft)		764.40
Net Gas Sample Volume (cu ft)	V(m)	(64.50)
Vol of Liquid Collected (ml)	Vl(c)	85.6
Vol of Liq @ Std. Conds. (scf)	V(w std)	(4.029)
Wt. of Filter Particulate (gm)		0.0000
Wt. of Probe Wash Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.23
CO2 Concentration (by CEM)	% CO2	15.46
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(81.31)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
A3	5.00	1.10	0.90	477.00	62.0	62.0	1.0488
2	5.00	1.00	0.80	477.00	66.0	62.0	1.0000
1	5.00	1.10	0.90	478.00	69.0	62.0	1.0488
B3	5.00	1.10	0.90	478.00	71.0	63.0	1.0488
2	5.00	1.20	1.00	478.00	73.0	64.0	1.0954
1	5.00	1.10	0.90	478.00	74.0	64.0	1.0488
C3	5.00	1.40	1.10	489.00	74.0	66.0	1.1832
2	5.00	1.30	1.00	491.00	80.0	68.0	1.1402
1	5.00	1.30	1.00	494.00	80.0	69.0	1.1402
D3	5.00	1.30	1.00	494.00	81.0	69.0	1.1402
2	5.00	1.20	1.00	495.00	81.0	70.0	1.0954
1	5.00	1.20	1.00	495.00	82.0	71.0	1.0954
E3	5.00	1.20	1.00	526.00	76.0	71.0	1.0954
2	5.00	1.20	0.90	526.00	82.0	72.0	1.0954
1	5.00	1.20	1.00	525.00	82.0	72.0	1.0954
F3	5.00	1.20	1.10	525.00	82.0	72.0	1.0954
2	5.00	1.20	1.00	526.00	82.0	72.0	1.0954
1	5.00	1.20	1.00	526.00	81.0	71.0	1.0954
G3	5.00	1.20	1.00	528.00	75.0	70.0	1.0954
2	5.00	1.20	1.00	528.00	78.0	69.0	1.0954
1	5.00	1.20	1.00	529.00	78.0	68.0	1.0954
H3	5.00	1.20	0.90	530.00	78.0	68.0	1.0954
2	5.00	1.20	1.00	531.00	79.0	68.0	1.0954
1	5.00	1.20	1.00	531.00	79.0	69.0	1.0954
TOTALS	120.00	28.70	23.40	12155.00	1845.00	1632.0	26.2307

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	=	1.196
Avg Orifice Meter Reading (in H2O)	dH(avg)	=	0.975
Avg Stack Temperature (degF)	T(s avg)	=	506.5
Average Meter Temperature (degF)	T(m avg)	=	72.4
Avg SQRT(dP)		=	1.093

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	=	62.00
Stack Gas Water Vapor Proportion	B(wo)	=	0.061
Mol. Wt., Stack Gas Dry	M(d)	=	30.60
Mol. Wt., Stack Gas Wet	M(s)	=	29.83
Abs Stack Pressure (in Hg)	P(s)	=	30.47
Avg Stack Velocity (ft/sec)	V(s avg)	=	80.9
Isokineticity (%)	% I	=	105.7
Stack Gas STD Vol Flow (dscfm)	Q(s)	=	243521
Actual Stack Gas Vol Flow (acfm)	Q(a)	=	466136
Percent XS Air	PEA	=	17.7
Particulate Loading, dry(gr/dscf)	C(s std)	=	0.0[illegible]
Particulate Loading, @7% O2(mg/dscm)	C(s std)	=	
Particulate Loading, dry @ 7 % O2 (gr/dscf)		=	0.0[illegible]
Heat Input Rate, MBtu/hr		=	125[illegible]
Particulate Emission Rate(lb/hr)	E(p)	=	0.000
Particulate Emission Rate(lb/MBtu)		=	0.0000

APPENDIX E

METALS AT ESP OUTLET: DATA RUN SUMMARY

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-2-92

Performed by: J. Rudd
Sample Location: Unit #2 (Outlet)

Test No./Type: Metals #1
Start/Stop Time: 0915

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.252
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	1.0240
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H20)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(360.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		745.46
Gas Meter Final Reading (cu ft)		1065.22
Net Gas Sample Volume (cu ft)	V(m)	(319.75)
Vol of Liquid Collected (ml)	Vl(c)	761.2
Vol of Liq @ Std. Conds. (scf)	V(w std)	(35.830)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H20)	dP(avg) =	1.258
Avg Orifice Meter Reading (in H20)	dH(avg) =	2.592
Avg Stack Temperature (degF)	T(s avg)=	506.3
Average Meter Temperature (degF)	T(m avg)=	63.5
Avg SQRT(dP)	=	1.120

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	332.23
Stack Gas Water Vapor Proportion	B(wo) =	0.097
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.16
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	82.4
Isokineticity (%)	% I =	103.7
Stack Gas STD Vol Flow (dscfm)	Q(s) =	246837
Actual Stack Gas Vol Flow (acfm)	Q(a) =	474777
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0000
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0000
Particulate Emission Rate(lb/hr)	E(p) =	0.000

Sample Point	dClock Time	Velocity Head, dP (in H20)	Orifice Meter,dH (in H20)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
5-1	20	1.200	2.46	504	60	60	1.0954
2	20	1.230	2.54	508	66	64	1.1091
3	20	1.150	2.39	506	68	67	1.0724
7-1	20	1.000	2.08	505	67	68	1.0000
2	20	1.100	2.28	509	68	67	1.0488
3	20	1.090	2.25	512	68	67	1.0440
8-1	20	1.510	3.11	508	64	65	1.2288
2	20	1.600	3.34	500	67	66	1.2649
3	20	1.480	3.09	498	66	65	1.2166
1-1	20	1.250	2.60	496	62	63	1.1180
2	20	1.300	2.71	494	64	63	1.1402
3	20	1.320	2.75	495	63	62	1.1489
3-1	20	1.230	2.51	508	59	60	1.1091
2	20	1.240	2.54	509	63	62	1.1136
3	20	1.200	2.45	511	62	61	1.0954
4-1	20	1.250	2.52	516	58	58	1.1180
2	20	1.240	2.51	517	61	60	1.1136
3	20	1.250	2.53	517	61	60	1.1180
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	22.640	46.66	9113	1147	1138	20.1548

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-3-92

Performed by: J. Rudd
Sample Location: Unit #2 (Outlet)

Test No./Type: Metals #2
Start/Stop Time: 0857

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.252
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	1.0240
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(360.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		128.21
Gas Meter Final Reading (cu ft)		448.41
Net Gas Sample Volume (cu ft)	V(m)	(320.20)
Vol of Liquid Collected (ml)	Vl(c)	688.3
Vol of Liq @ Std. Conds. (scf)	V(w std)	(32.398)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter,dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
1-1	20	1.210	2.52	465	47	47	1.1000
2	20	1.200	2.52	465	52	51	1.0954
3	20	1.200	2.52	470	55	53	1.0954
3-1	20	1.100	2.30	475	55	55	1.0488
2	20	1.250	2.60	481	53	54	1.1180
3	20	1.450	3.02	483	58	56	1.2042
4-1	20	1.500	3.11	483	53	55	1.2247
2	20	1.480	3.07	488	59	57	1.2166
3	20	1.220	2.54	487	60	58	1.1045
5-1	20	1.200	2.44	500	53	54	1.0954
2	20	1.220	2.47	497	57	55	1.1045
3	20	1.280	2.64	498	60	59	1.1314
7-1	20	0.870	1.79	495	57	57	0.9327
2	20	0.900	1.86	494	59	59	0.9487
3	20	0.890	1.84	492	59	59	0.9434
8-1	20	1.600	3.28	495	55	55	1.2649
2	20	1.600	3.34	487	60	59	1.2649
3	20	1.600	3.36	480	60	59	1.2649
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	22.770	47.22	8735	1012	1002	20.1586

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	1.265
Avg Orifice Meter Reading (in H2O)	dH(avg) =	2.623
Avg Stack Temperature (degF)	T(s avg)=	485.3
Average Meter Temperature (degF)	T(m avg)=	55.9
Avg SQRT(dP)	=	1.120

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	337.58
Stack Gas Water Vapor Proportion	B(wo) =	0.088
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.28
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	81.4
Isokineticity (%)	% I =	103.3
Stack Gas STD Vol Flow (dscfm)	Q(s) =	251794
Actual Stack Gas Vol Flow (acfm)	Q(a) =	468708
Particulate Loading, dry (gr/dscf)	C(s std)=	0
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0000
Particulate Emission Rate(lb/hr)	E(p) =	0.000

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-4-92

Performed by: J. Rudd
Sample Location: Unit #2 (Outlet)

Test No./Type: Metals #3
Start/Stop Time: 0950

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.252
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	1.0240
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H20)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(234.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		520.63
Gas Meter Final Reading (cu ft)		721.62
Net Gas Sample Volume (cu ft)	V(m)	(200.99)
Vol of Liquid Collected (ml)	Vl(c)	469.9
Vol of Liq @ Std. Conds. (scf)	V(w std)	(22.118)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H20)	dP(avg) =	1.214
Avg Orifice Meter Reading (in H20)	dH(avg) =	2.502
Avg Stack Temperature (degF)	T(s avg)=	490.2
Average Meter Temperature (degF)	T(m avg)=	54.4
Avg SQRT(dP)	=	1.099

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	212.48
Stack Gas Water Vapor Proportion	B(wo) =	0.094
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.19
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	80.2
Isokineticity (%)	% I =	102.8
Stack Gas STD Vol Flow (dscfm)	Q(s) =	245004
Actual Stack Gas Vol Flow (acfm)	Q(a) =	461826
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0000
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0000
Particulate Emission Rate(lb/hr)	E(p) =	0.000

Sample Point	dClock Time	Velocity Head, dP (in H20)	Orifice Meter,dH (in H20)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
1-1	13	1.280	2.67	460	46	43	1.1314
2	13	1.250	2.63	461	51	48	1.1180
3	13	1.150	2.42	463	53	51	1.0724
3-1	13	1.240	2.62	465	55	54	1.1136
2	13	1.250	2.64	470	57	55	1.1180
3	13	1.260	2.66	471	57	56	1.1225
4-1	13	1.400	2.90	480	52	53	1.1832
2	13	1.410	2.93	486	57	56	1.1874
3	13	1.200	2.50	485	57	56	1.0954
5-1	13	1.130	2.28	505	53	53	1.0630
2	13	1.110	2.26	505	57	56	1.0536
3	13	0.800	1.63	503	57	56	0.8944
7-1	13	1.000	2.02	507	53	54	1.0000
2	13	1.100	2.23	509	57	56	1.0488
3	13	0.980	1.99	511	58	57	0.9899
8-1	13	1.420	2.84	512	52	52	1.1916
2	13	1.450	2.93	514	58	57	1.2042
3	13	1.430	2.88	516	58	57	1.1958
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	234	21.860	45	8823	988	970	19.7834

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-4-92

Performed by: J. Rudd
Sample Location: Unit #2 (Outlet)

Test No./Type: Metals #4
Start/Stop Time: 1630

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.252
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	1.0240
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(234.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		723.56
Gas Meter Final Reading (cu ft)		924.52
Net Gas Sample Volume (cu ft)	V(m)	(200.96)
Vol of Liquid Collected (ml)	Vl(c)	469.9
Vol of Liq @ Std. Conds. (scf)	V(w std)	(22.118)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
5-1	13	1.000	1.98	511	46	45	1.0000
2	13	0.980	1.96	511	53	51	0.9899
3	13	1.080	2.18	510	54	53	1.0392
7-1	13	0.950	1.92	509	55	55	0.9747
2	13	1.100	2.23	509	56	56	1.0488
3	13	1.130	2.29	509	57	57	1.0630
8-1	13	1.500	3.03	505	52	53	1.2247
2	13	1.500	3.06	497	54	54	1.2247
3	13	1.480	3.04	497	57	57	1.2166
1-1	13	1.280	2.65	480	52	52	1.1314
2	13	1.310	2.75	479	58	57	1.1446
3	13	1.290	2.71	478	58	57	1.1358
3-1	13	1.150	2.36	490	54	52	1.0724
2	13	1.200	2.47	493	56	55	1.0954
3	13	1.180	2.43	493	57	56	1.0863
4-1	13	1.320	2.71	498	58	57	1.1489
2	13	1.350	2.77	498	58	57	1.1619
3	13	1.340	2.75	498	58	57	1.1576
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	234	22.140	45.29	8965	993	981	19.9159

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	1.230
Avg Orifice Meter Reading (in H2O)	dH(avg) =	2.516
Avg Stack Temperature (degF)	T(s avg)=	498.1
Average Meter Temperature (degF)	T(m avg)=	54.8
Avg SQRT(dP)	=	1.106

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	212.27
Stack Gas Water Vapor Proportion	B(wo) =	0.094
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.19
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	81.1
Isokineticity (%)	% I =	102.4
Stack Gas STD Vol Flow (dscfm)	Q(s) =	245609
Actual Stack Gas Vol Flow (acfm)	Q(a) =	466855
Particulate Loading, dry (gr/dscf)	C(s std)=	0.
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0000
Particulate Emission Rate(lb/hr)	E(p) =	0.000

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-5-92

Performed by: J. Rudd
Sample Location: Unit #2 (Outlet)

Test No./Type: Metals #5
Start/Stop Time: 0950

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.252
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	1.0240
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(360.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		950.23
Gas Meter Final Reading (cu ft)		1265.88
Net Gas Sample Volume (cu ft)	V(m)	(315.65)
Vol of Liquid Collected (ml)	Vl(c)	814.9
Vol of Liq @ Std. Conds. (scf)	V(w std)	(38.357)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	= 1.255
Avg Orifice Meter Reading (in H2O)	dH(avg)	= 2.612
Avg Stack Temperature (degF)	T(s avg)	= 483.2
Average Meter Temperature (degF)	T(m avg)	= 55.1
Avg SQRT(dP)		= 1.118

CALCULATED VALUES

Meter Volume (std. cu. ft.)	V(m std)	= 333.29
Stack Gas Water Vapor Proportion	B(wo)	= 0.103
Mol. Wt., Stack Gas Dry	M(d)	= 30.36
Mol. Wt., Stack Gas Wet	M(s)	= 29.08
Abs Stack Pressure (in Hg)	P(s)	= 31.54
Avg Stack Velocity (ft/sec)	V(s avg)	= 81.4
Isokineticity (%)	% I	= 103.5
Stack Gas STD Vol Flow (dscfm)	Q(s)	= 248153
Actual Stack Gas Vol Flow (acfm)	Q(a)	= 468938
Particulate Loading, dry (gr/dscf)	C(s std)	= 0.0000
Particulate Loading, dry @7% O2 (gr/dscf)		= 0.0000
Particulate Emission Rate(lb/hr)	E(p)	= 0.000

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
1-1	20	1.20	2.49	468	46	45	1.0954
2	20	1.24	2.59	471	53	51	1.1136
3	20	1.25	2.63	472	57	54	1.1180
3-1	20	1.20	2.52	474	58	56	1.0954
2	20	1.32	2.77	479	61	57	1.1489
3	20	1.37	2.84	493	59	58	1.1705
4-1	20	1.48	3.07	483	55	55	1.2166
2	20	1.42	2.96	486	58	57	1.1916
3	20	1.50	3.09	495	57	57	1.2247
5-1	20	1.20	2.44	496	52	52	1.0954
2	20	1.23	2.53	497	57	56	1.1091
3	20	0.91	1.87	496	56	56	0.9539
7-1	20	1.00	2.05	494	55	55	1.0000
2	20	1.00	2.05	495	56	55	1.0000
3	20	1.05	2.16	495	57	56	1.0247
8-1	20	1.45	3.07	462	53	53	1.2042
2	20	1.40	2.97	463	56	55	1.1832
3	20	1.39	2.91	478	56	55	1.1790
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	22.61	47.01	8697	1002	983	20.12

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-6-92

Performed by: J. Rudd
Sample Location: Unit #2 (Outlet)

Test No./Type: Metals #6
Start/Stop Time: 0840

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.252
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	1.0240
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	21.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(360.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		331.82
Gas Meter Final Reading (cu ft)		629.65
Net Gas Sample Volume (cu ft)	V(m)	(297.83)
Vol of Liquid Collected (ml)	Vl(c)	658.9
Vol of Liq @ Std. Conds. (scf)	V(w std)	(31.014)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	1.136
Avg Orifice Meter Reading (in H2O)	dH(avg) =	2.342
Avg Stack Temperature (degF)	T(s avg)=	487.6
Average Meter Temperature (degF)	T(m avg)=	53.6
Avg SQRT(dP)	=	1.059

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	315.19
Stack Gas Water Vapor Proportion	B(wo) =	0.090
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.25
Abs Stack Pressure (in Hg)	P(s) =	31.46
Avg Stack Velocity (ft/sec)	V(s avg)=	77.2
Isokineticity (%)	% I =	102.4
Stack Gas STD Vol Flow (dscfm)	Q(s) =	237157
Actual Stack Gas Vol Flow (acfm)	Q(a) =	444568
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0
Particulate Emission Rate(lb/hr)	E(p) =	0.000

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter,dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
5-1	20	0.75	1.54	481	48	47	0.8660
2	20	0.80	1.64	489	51	50	0.8944
3	20	0.82	1.68	490	52	51	0.9055
7-1	20	0.80	1.64	492	54	53	0.8944
2	20	0.87	1.78	495	54	53	0.9327
3	20	0.90	1.83	499	55	53	0.9487
8-1	20	1.50	3.06	494	52	52	1.2247
2	20	1.48	3.02	502	57	56	1.2166
3	20	1.46	2.99	498	57	56	1.2083
1-1	20	1.20	2.53	470	55	55	1.0954
2	20	1.20	2.54	469	59	58	1.0954
3	20	1.12	2.36	469	56	56	1.0583
3-1	20	1.10	2.32	470	56	55	1.0488
2	20	1.20	2.52	473	56	55	1.0954
3	20	1.24	2.60	476	57	56	1.1136
4-1	20	1.38	2.78	503	51	51	1.1747
2	20	1.35	2.74	503	45	53	1.1619
3	20	1.28	2.59	504	53	53	1.1314
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	20.45	42.16	8777	968	963	19.07

APPENDIX F

TRACE METAL PARTITIONING SUMMARY FROM FLUE GAS AND SOLID STREAM ANALYSES

Intentionally Blank

TRACE METALS PARTITIONING
WISCONSIN POWER & LIGHT AIR TOXICS TESTING

Run 1 Baseline 1

INPUT PARAMETERS

		Part in Lb/hr	1106	Hopper g/s	134.35
Coal HHV, Btu/lb	11092	Part out Lb/hr	40.7	ESP out g/s	5.133
Coal Flow, Lb/hr	92200	Slag Lb/hr	5892	Flow in dscfm	271398
Ash, %	7.59%	Hopper Lb/hr	1065	Flow out dscfm	247749
Ash Flow, Lb/hr	6998	Coal g/s	11627		
IMMetals Train dscf	96.2	Slag g/s	743		
OMMetals Train dscf	332	ESP in g/s	139.5		

Run 1, Baseline 1	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Concentration Data									
Coal (ug/g)	6.02	2.94	<1	4.91	20.5	13	38.5	1	<0.1
Slag (ug/g)	<1	6.79	3.97	47.9	458	371	1.73	<1	<0.5
ESP Inlet (ug)	148	155	72	908	1130	5110	4970	22.3	26.8
ESP Inlet (ug/dscf)	1.54	1.61	0.75	9.44	11.75	53.12	51.66	0.23	0.28
Hopper Ash (ug/g)	292	40	<17	214	306	1162	988	<34	<0.5
ESP Outlet (ug)	86	40	20	252	271	1410	694	1190	26.2
ESP Outlet (ug/dscf)	0.259	0.120	0.060	0.759	0.816	4.247	2.090	3.584	0.079
Mass Flows									
Coal (g/s)	0.0700	0.0342	<0.0116	0.0571	0.2384	0.1512	0.4477	<0.0116	<0.0012
Slag (g/s)	<0.0007	0.0050	0.0029	0.0356	0.3403	0.2757	0.0013	<0.0007	<0.0004
ESP In (g/s)	0.0070	0.0073	0.0034	0.0427	0.0531	0.2403	0.2337	0.0010	0.0013
Hopper Ash (g/s)	0.0392	0.0054	<0.0023	0.0288	0.0411	0.1561	0.1327	<0.0046	<0.0001
ESP Out (g/s)	0.0011	0.0005	0.0002	0.0031	0.0034	0.0175	0.0086	0.0148	0.0003
Mass Balance									
Coal/(Slag + ESPin)	9.088	2.772	1.835	0.729	0.606	0.293	1.905	6.490	0.713
ESPin/(Hop + ESPout)	0.173	1.241	1.337	1.339	1.195	1.384	1.653	0.054	3.206
1 - ESPout/ESPin	0.846	0.932	0.927	0.927	0.937	0.927	0.963	-13.115	0.741

TRACE METALS PARTITIONING
WISCONSIN POWER & LIGHT AIR TOXICS TESTING

Run 2, Baseline 2

INPUT PARAMETERS

		Part in Lb/hr	1596	Hopper g/s	196.14
Coal HHV, Btu/lb	11680	Part out Lb/hr	40.7	ESP out g/s	5.133
Coal Flow, Lb/hr	92200	Slag Lb/hr	7633	Flow in dscfm	256629
Ash, %	10.01%	Hopper Lb/hr	1555.3	Flow out dscfm	248078
Ash Flow, Lb/hr	9229	Coal g/s	11627		
IMMetals Train dscf	64.42	Slag g/s	963		
OMMetals Train dscf	337.6	ESP in g/s	201		

Run 2, Baseline 2	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Concentration Data									
Coal (ug/g)	19.8	3.15	1.11	11.8	22.2	13.9	39.5	<1	<0.1
Slag (ug/g)	< 1	7.8	4.99	92	432	412	12.6	<1	<0.5
ESP Inlet (ug)	167	97.4	64	505	899	3170	3260	26.3	23.3
ESP Inlet (ug/dscf)	2.592	1.512	0.993	7.839	13.955	49.208	50.605	0.408	0.362
Hopper Ash (ug/g)	332	35	14.1	179	276	1252	983	<1	<0.5
ESP Outlet (ug)	41.2	20.1	20.9	121	173	742	1590	4200	99.9
ESP Outlet (ug/dscf)	0.122	0.060	0.062	0.358	0.512	2.198	4.710	12.441	0.296
Mass Flows									
Coal (g/s)	0.2302	0.0366	0.0129	0.1372	0.2581	0.1616	0.4593	<0.0116	<0.0012
Slag (g/s)	<0.0010	0.0075	0.0048	0.0886	0.4159	0.3966	0.0121	<0.0010	<0.0005
ESP In (g/s)	0.0111	0.0065	0.0042	0.0335	0.0597	0.2105	0.2164	0.0017	0.0015
Hopper Ash (g/s)	0.0651	0.0069	0.0028	0.0351	0.0541	0.2456	0.1928	<0.0002	<0.0001
ESP Out (g/s)	0.0005	0.0002	0.0003	0.0015	0.0021	0.0091	0.0195	0.0514	0.0012
Mass Balance									
Coal/(Slag + ESPin)	19.105	2.621	1.426	1.124	0.543	0.266	2.009	4.292	0.573
ESPin/(Hop + ESPout)	0.169	0.909	1.406	0.916	1.061	0.826	1.020	0.034	1.171
1 - ESPout/ESPin	0.954	0.962	0.940	0.956	0.965	0.957	0.910	-28.457	0.209

TRACE METALS PARTITIONING
WISCONSIN POWER & LIGHT AIR TOXICS TESTING

Run 5, Baseline 3

INPUT PARAMETERS

		Part in Lb/hr	1619	Hopper g/s	77.937
Coal HHV, Btu/lb	11389	Part out Lb/hr	1001	ESP out g/s	126.24
Coal Flow, Lb/hr	93400	Slag Lb/hr	6236	Flow in dscfm	252150
Ash, %	8.41%	Hopper Lb/hr	618	Flow out dscfm	248153
Ash Flow, Lb/hr	7855	Coal g/s	11779		
IMMetals Train dscf	64.4	Slag g/s	786		
OMMetals Train dscf	333.3	ESP in g/s	204.17		

Run 5, Baseline 3	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Concentration Data									
Coal (ug/g)	5.14	3.13	93.9	11.6	24.3	42.3	14.9	<1	<0.1
Slag (ug/g)	2.87	5.21	2.39	66	444	410	<1	10.5	0.5
ESP Inlet (ug)	807	111	56.7	787	1410	4540	4100	150	14.5
ESP Inlet (ug/dscf)	12.531	1.724	0.880	12.220	21.894	70.497	63.665	2.329	0.225
Hopper Ash (ug/g)	237	18.9	10.5	180	316	1085	803	<1	<0.5
ESP Outlet (ug)	184	42.3	71.9	208	439	1150	1330	4770	70.2
ESP Outlet (ug/dscf)	0.552	0.127	0.216	0.624	1.317	3.450	3.990	14.311	0.211
Mass Flows									
Coal (g/s)	0.0605	0.0369	1.1060	0.1366	0.2862	0.4982	0.1755	<0.0118	<0.0012
Slag (g/s)	0.0023	0.0041	0.0019	0.0519	0.3492	0.3224	<0.0008	0.0083	<0.0004
ESP In (g/s)	0.0527	0.0072	0.0037	0.0514	0.0920	0.2963	0.2676	0.0098	0.0009
Hopper Ash (g/s)	0.0185	0.0015	0.0008	0.0140	0.0246	0.0846	0.0626	<0.0001	<0.00004
ESP Out (g/s)	0.0023	0.0005	0.0009	0.0026	0.0054	0.0143	0.0165	0.0592	0.0009
Mass Balance									
Coal/(Slag + ESPin)	1.102	3.251	198.228	1.323	0.649	0.805	0.654	0.653	0.879
ESPin/(Hop + ESPout)	2.537	3.626	2.163	3.092	3.059	2.998	3.383	0.165	1.040
1 - ESPout/ESPin	0.957	0.928	0.759	0.950	0.941	0.952	0.938	-5.047	0.079

TRACE METALS PARTITIONING
WISCONSIN POWER & LIGHT AIR TOXICS TESTING

Run 3 Reburn 1

INPUT PARAMETERS

		Part in Lb/hr	2830	Hopper g/s	355.9
Coal HHV, Btu/lb	11954	Part out Lb/hr	7.54	ESP out g/s	0.9509
Coal Flow, Lb/hr	95200	Slag Lb/hr	4986	Flow in dscfm	242280
Ash, %	8.21%	Hopper Lb/hr	2822	Flow out dscfm	233025
Ash Flow, Lb/hr	7816	Coal g/s	12006		
IMMetals Train dscf	63.91	Slag g/s	628.78		
OMMetals Train dscf	212.5	ESP in g/s	356.89		

Run 3, Reburn 1	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Concentration Data									
Coal (ug/g)	2.69	3.04	70.4	8.6	29	49	10.7	< 1	< 0.1
Slag (ug/g)	1	< 16.7	< 179	80.6	386	317	10	< 1	< 0.1
ESP Inlet (ug)	889	246	162	1080	2250	2090	6590	373	17.5
ESP Inlet (ug/dscf)	13.910	3.849	2.535	16.899	35.206	32.702	103.114	5.836	0.274
Hopper Ash (ug/g)	266	29.6	159	132	195	851	564	6.7	0.1
ESP Outlet (ug)	54.9	3.15	12.5	29	74.2	143	372	2630	53.9
ESP Outlet (ug/dscf)	0.258	0.015	0.059	0.136	0.349	0.673	1.751	12.376	0.254
Mass Flows									
Coal (g/s)	0.0323	0.0365	0.8452	0.1032	0.3482	0.5883	0.1285	<0.0120	< 0.0012
Slag (g/s)	<0.0006	<0.0105	<0.1126	0.0507	0.2427	0.1993	0.0063	<0.0006	< 0.0001
ESP In (g/s)	0.0562	0.0155	0.0102	0.0682	0.1422	0.1321	0.4164	0.0236	0.0011
Hopper Ash (g/s)	0.0947	0.0105	<0.0566	0.0470	0.0694	0.3029	0.2008	0.0024	0.00004
ESP Out (g/s)	0.0010	0.0001	0.0002	0.0005	0.0014	0.0026	0.0068	0.0481	0.0010
Mass Balance									
Coal/(Slag + ESPin)	0.569	1.401	6.884	0.868	0.905	1.775	0.304	0.496	1.027
ESPin/(Hop + ESPout)	0.587	1.467	0.180	1.436	2.009	0.432	2.006	0.467	1.083
1 - ESPout/ESPin	0.982	0.996	0.978	0.992	0.990	0.980	0.984	-1.040	0.109

TRACE METALS PARTITIONING
WISCONSIN POWER & LIGHT AIR TOXICS TESTING

Part in Lb/hr	3216
Part out Lb/hr	18.02
Slag Lb/hr	5653
Hopper Lb/hr	3198
Coal g/s	12157
Slag g/s	712.9
ESP in g/s	405.6
Hopper g/s	403.3
ESP out g/s	2.273
Flow in dscfm	246140
Flow out dscfm	247206

RS

u/lb	11453
Lb/hr	96400
	9.20%
	8869
Lb/hr	63.5
s Train dscf	212.3
ls Train dscf	

n 4. Reburn 2

	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Concentration Data									
Coal (ug/g)	9.21	2.84	52.2	7.3	23.4	37.4	18.1	<1	<0.1
(ug/g)	<1	4.33	2.77	32.1	524	301	7.82	<1	<0.5
Inlet (ug)	249	25.3	22.4	113	297	718	561	331	11.4
ESP Inlet (ug/dscf)	3.921	0.398	0.353	1.780	4.677	11.307	8.835	5.213	0.180
Hopper Ash (ug/g)	318	28	10.6	139	357	955	602	<1	<0.5
ESP Outlet (ug)	81	8.5	21.1	39.7	155	260	543	307	25.2
ESP Outlet (ug/dscf)	0.3815	0.0400	0.0994	0.1870	0.7301	1.2247	2.5577	1.4461	0.1187
Mass Flows									
Coal (g/s)	0.1120	0.0345	0.6346	0.0887	0.2845	0.4547	0.2200	<0.0122	<0.0012
Slag (g/s)	<0.0007	0.0031	0.0020	0.0229	0.3735	0.2146	0.0056	<0.0007	<0.0004
ESP In (g/s)	0.0161	0.0016	0.0014	0.0073	0.0192	0.0464	0.0362	0.0214	0.0007
Hopper Ash (g/s)	0.1282	0.0113	0.0043	0.0561	0.1440	0.3852	0.2428	<0.0004	<0.0002
ESP Out (g/s)	0.0016	0.0002	0.0004	0.0008	0.0030	0.0050	0.0105	0.0060	0.0005
Mass Balance									
Coal/(Slag + ESPin)	6.665	7.313	185.458	2.940	0.724	1.742	5.262	0.550	1.112
ESPin/(Hop + ESPout)	0.124	0.143	0.309	0.128	0.131	0.119	0.143	3.362	1.066
1 - ESPout/ESPin	0.902	0.899	0.717	0.894	0.843	0.891	0.709	0.721	0.336

TRACE METALS PARTITIONING
WISCONSIN POWER & LIGHT AIR TOXICS TESTING

Run 6, Reburn 3

INPUT PARAMETERS

		Part in Lb/hr	2858	Hopper g/s	355.8225
Coal HHV, Btu/lb	11657	Part out Lb/hr	36.5	ESP out g/s	4.603
Coal Flow, Lb/hr	94800	Slag Lb/hr	6053	Flow in dscfm	234536
Ash, %	9.40%	Hopper Lb/hr	2821.5	Flow out dscfm	231039
Ash Flow, Lb/hr	8911	Coal g/s	11955		
IMMetals Train dscf	62	Slag g/s	763		
OMMetals Train dscf	315.2	ESP in g/s	360		

Run 6, Reburn 3	As	Be	Cd	Cr	Mn	Ni	Pb	Se	Hg
Concentration Data									
Coal (ug/g)	9.33	2.69	<1	8.8	18.7	34.8	11.9	< 1	< 0.1
Slag (ug/g)	42	4.62	1.77	53	327	276	7.05	< 1	< 0.5
ESP Inlet (ug)	41.7	11.3	12.5	74.5	344	428	569	86.2	11.1
ESP Inlet (ug/dscf)	0.673	0.182	0.202	1.20	5.55	6.90	9.18	1.39	0.179
Hopper Ash (ug/g)	253	28	<18	158	332	880	658	3.4	< 0.5
ESP Outlet (ug)	122	17.7	14	96	280	736	856	1480	35.2
ESP Outlet (ug/dscf)	0.387	0.056	0.044	0.305	0.888	2.34	2.72	4.70	0.112
Mass Flows									
Coal (g/s)	0.1115	0.0322	<0.0120	0.1052	0.2236	0.4160	0.1423	<0.0120	<0.0012
Slag (g/s)	0.0321	0.0035	0.0014	0.0405	0.2496	0.2107	0.0054	<0.0008	< 0.0004
ESP In (g/s)	0.0026	0.0007	0.0008	0.0047	0.0217	0.0270	0.0359	0.0054	0.0007
Hopper Ash (g/s)	0.0900	0.0100	<0.0064	0.0562	0.1181	0.3131	0.2341	0.0012	<0.0002
ESP Out (g/s)	0.0015	0.0002	0.0002	0.0012	0.0034	0.0090	0.0105	0.0181	0.0004
Mass Balance									
Coal/(Slag + ESPin)	3.215	7.586	5.589	2.330	0.824	1.750	3.448	1.929	1.105
ESPin/(Hop + ESPout)	0.029	0.070	0.120	0.082	0.178	0.084	0.147	0.282	1.151
1 - ESPout/ESPin	0.433	0.696	0.783	0.750	0.842	0.667	0.708	-2.327	0.386

APPENDIX G

MODIFIED METHOD 5 TRAIN FOR SEMIVOLATILE ORGANICS AT ESP OUTLET: DATA RUN SUMMARY

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-2-92

Performed by: B. Nichols
Sample Location: Unit #2 (Outlet)

Test No./Type: #1 MM5
Start/Stop Time: 0938

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.235
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	0.9900
Barometric Pressure (in Hg)	P(b)	29.92
~~Stack Pressure (in H20)~~	~~P(stack)~~	~~22.000~~
# of Sample Points	#	18
~~Total Sampling Time (min)~~	~~(theta)~~	~~(360.00)~~
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		913.45
Gas Meter Final Reading (cu ft)		1178.10
Net Gas Sample Volume (cu ft)	V(m)	(264.65)
Vol of Liquid Collected (ml)	Vl(c)	555.0
Vol of Liq @ Std. Conds. (scf)	V(w std)	(26.124)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H20)	dP(avg) =	1.161
Avg Orifice Meter Reading (in H20)	dH(avg) =	1.940
Avg Stack Temperature (degF)	T(s avg)=	521.9
Average Meter Temperature (degF)	T(m avg)=	60.9
Avg SQRT(dP)	=	1.074

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	266.74
Stack Gas Water Vapor Proportion	B(wo) =	0.089
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.26
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	79.5
Isokineticity (%)	% I =	99.9
Stack Gas STD Vol Flow (dscfm)	Q(s) =	236492
Actual Stack Gas Vol Flow (acfm)	Q(a) =	458095
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0000
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0000
Particulate Emission Rate(lb/hr)	E(p) =	0.000

Sample Point	dClock Time	Velocity Head, dP (in H20)	Orifice Meter,dH (in H20)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
1-1	20	1.500	2.52	492	52	50	1.2247
2	20	1.500	2.54	495	62	54	1.2247
3	20	1.300	2.22	497	68	57	1.1402
3-1	20	1.300	2.23	507	66	59	1.1402
2	20	1.300	2.21	509	71	60	1.1402
3	20	1.300	2.21	511	71	61	1.1402
4-1	20	1.300	2.20	512	71	61	1.1402
2	20	1.300	2.20	514	71	61	1.1402
3	20	1.300	2.20	515	71	61	1.1402
5-1	20	1.000	1.69	537	59	57	1.0000
2	20	1.000	1.63	539	62	56	1.0000
3	20	0.980	1.60	540	64	56	0.9899
7-1	20	0.980	1.60	540	64	56	0.9899
2	20	0.960	1.56	539	63	55	0.9798
3	20	0.960	1.56	538	63	55	0.9798
8-1	20	0.950	1.55	537	63	55	0.9747
2	20	0.960	1.57	536	64	55	0.9798
3	20	1.000	1.63	536	63	55	1.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	20.890	34.92	9394	1168	1024	19.3247

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-3-92

Performed by: B. Nichols
Sample Location: Unit #2 (Outlet)

Test No./Type: #2 MM5
Start/Stop Time: 0854

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.235
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	0.9900
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(360.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		246.60
Gas Meter Final Reading (cu ft)		507.87
Net Gas Sample Volume (cu ft)	V(m)	(261.27)
Vol of Liquid Collected (ml)	Vl(c)	535.0
Vol of Liq @ Std. Conds. (scf)	V(w std)	(25.182)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	1.199
Avg Orifice Meter Reading (in H2O)	dH(avg) =	2.008
Avg Stack Temperature (degF)	T(s avg)=	489.3
Average Meter Temperature (degF)	T(m avg)=	47.1
Avg SQRT(dP)	=	1.089

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	270.55
Stack Gas Water Vapor Proportion	B(wo) =	0.085
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.31
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	79.3
Isokineticity (%)	% I =	97.9
Stack Gas STD Vol Flow (dscfm)	Q(s) =	244930
Actual Stack Gas Vol Flow (acfm)	Q(a) =	456[illegible]
Particulate Loading, dry (gr/dscf)	C(s std)=	0[illegible]
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0000
Particulate Emission Rate(lb/hr)	E(p) =	0.000

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
3-1	20	1.400	2.35	487	49	40	1.1832
2	20	1.500	2.51	491	56	43	1.2247
3	20	1.300	2.18	493	55	43	1.1402
4-1	20	1.400	2.34	495	54	43	1.1832
2	20	1.600	2.67	496	56	44	1.2649
3	20	1.500	2.51	496	60	47	1.2247
5-1	20	0.800	1.34	496	43	41	0.8944
2	20	0.900	1.48	494	47	41	0.9487
3	20	1.100	1.83	491	51	42	1.0488
7-1	20	0.890	1.49	490	52	43	0.9434
2	20	0.950	1.59	491	52	43	0.9747
3	20	0.900	1.51	490	53	44	0.9487
8-1	20	1.300	2.18	488	55	45	1.1402
2	20	1.400	2.36	487	57	46	1.1832
3	20	1.350	2.29	489	59	47	1.1619
1-1	20	1.100	1.84	473	38	37	1.0488
2	20	1.000	1.67	478	44	38	1.0000
3	20	1.200	2.01	483	48	39	1.0954
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	21.590	36.15	8808	929	766	19.6092

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-4-92

Performed by: B. Nichols
Sample Location: Unit #2 (Outlet)

Test No./Type: #3 MM5
Start/Stop Time: 0950

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.235
Pitot Tube Correction Factor	C(p)	0.8400
~~Gas Meter Correction Factor~~	~~(gamma)~~	~~0.9900~~
Barometric Pressure (in Hg)	P(b)	29.92
~~Stack Pressure (in H2O)~~	~~P(stack)~~	~~22.000~~
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(234.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		557.40
Gas Meter Final Reading (cu ft)		708.00
Net Gas Sample Volume (cu ft)	V(m)	(150.60)
Vol of Liquid Collected (ml)	Vl(c)	333.0
Vol of Liq @ Std. Conds. (scf)	V(w std)	(15.674)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	0.997
Avg Orifice Meter Reading (in H2O)	dH(avg) =	1.665
Avg Stack Temperature (degF)	T(s avg)=	486.6
Average Meter Temperature (degF)	T(m avg)=	45.9
Avg SQRT(dP)	=	0.989

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	156.18
Stack Gas Water Vapor Proportion	B(wo) =	0.091
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.23
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	72.0
Isokineticity (%)	% I =	96.1
Stack Gas STD Vol Flow (dscfm)	Q(s) =	221513
Actual Stack Gas Vol Flow (acfm)	Q(a) =	414575
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0000
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0000
Particulate Emission Rate(lb/hr)	E(p) =	0.000

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
3-1	13	0.890	1.50	464	36	35	0.9434
2	13	1.100	1.85	478	44	37	1.0488
3	13	1.100	1.84	480	50	39	1.0488
4-1	13	0.600	1.01	482	54	41	0.7746
2	13	0.700	1.18	483	49	41	0.8367
3	13	1.200	2.01	484	49	41	1.0954
5-1	13	0.600	1.00	486	49	42	0.7746
2	13	0.700	1.17	486	49	41	0.8367
3	13	0.800	1.33	487	48	41	0.8944
7-1	13	0.800	1.33	488	46	41	0.8944
2	13	0.850	1.41	490	51	42	0.9220
3	13	0.900	1.50	491	52	42	0.9487
8-1	13	1.300	2.17	491	53	43	1.1402
2	13	1.450	2.43	492	55	44	1.2042
3	13	1.500	2.51	493	56	44	1.2247
1-1	13	1.100	1.80	494	57	44	1.0488
2	13	1.200	2.01	495	54	44	1.0954
3	13	1.150	1.92	495	54	44	1.0724
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	234	17.940	29.97	8759	906	746	17.8042

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-4-92

Performed by: B. Nichols
Sample Location: Unit #2 (Outlet)

Test No./Type: #4 MM5
Start/Stop Time: 1651

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.235
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	0.9900
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(234.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		709.50
Gas Meter Final Reading (cu ft)		899.50
Net Gas Sample Volume (cu ft)	V(m)	(190.00)
Vol of Liquid Collected (ml)	Vl(c)	419.0
Vol of Liq @ Std. Conds. (scf)	V(w std)	(19.722)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	1.229
Avg Orifice Meter Reading (in H2O)	dH(avg) =	2.008
Avg Stack Temperature (degF)	T(s avg)=	516.0
Average Meter Temperature (degF)	T(m avg)=	50.3
Avg SQRT(dP)	=	1.107

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	195.50
Stack Gas Water Vapor Proportion	B(wo) =	0.092
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.23
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	81.8
Isokineticity (%)	% I =	109.2
Stack Gas STD Vol Flow (dscfm)	Q(s) =	243983
Actual Stack Gas Vol Flow (acfm)	Q(a) =	471[illegible]
Particulate Loading, dry (gr/dscf)	C(s std)=	0.[illegible]
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0000
Particulate Emission Rate(lb/hr)	E(p) =	0.000

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter,dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
7-1	13	1.000	1.59	523	39	38	1.0000
2	13	1.100	1.75	519	40	38	1.0488
3	13	0.970	1.55	519	46	39	0.9849
8-1	13	1.400	2.25	519	50	40	1.1832
2	13	1.450	2.34	519	59	44	1.2042
3	13	1.350	2.21	519	59	44	1.1619
1-1	13	1.150	1.88	519	60	45	1.0724
2	13	1.250	2.05	520	59	46	1.1180
3	13	1.280	2.10	520	60	47	1.1314
3-1	13	1.240	2.04	521	61	47	1.1136
2	13	1.250	2.05	522	61	48	1.1180
3	13	1.260	2.07	510	43	40	1.1225
4-1	13	1.350	2.18	510	54	42	1.1619
2	13	1.400	2.30	510	59	44	1.1832
3	13	1.450	2.39	510	63	48	1.2042
5-1	13	1.130	1.88	510	66	50	1.0630
2	13	1.100	1.84	509	64	51	1.0488
3	13	1.000	1.67	509	65	52	1.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	234	22.130	36.14	9288	1008	803	19.9199

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-5-92

Performed by: B. Nichols
Sample Location: Unit #2 (Outlet)

Test No./Type: #5 MM5
Start/Stop Time: 0945

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.235
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	0.9900
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	22.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(360.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		900.20
Gas Meter Final Reading (cu ft)		1152.40
Net Gas Sample Volume (cu ft)	V(m)	(252.20)
Vol of Liquid Collected (ml)	Vl(c)	560.0
Vol of Liq @ Std. Conds. (scf)	V(w std)	(26.359)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg) =	1.172
Avg Orifice Meter Reading (in H2O)	dH(avg) =	1.979
Avg Stack Temperature (degF)	T(s avg)=	489.6
Average Meter Temperature (degF)	T(m avg)=	52.1
Avg SQRT(dP)	=	1.077

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	258.60
Stack Gas Water Vapor Proportion	B(wo) =	0.093
Mol. Wt., Stack Gas Dry	M(d) =	30.36
Mol. Wt., Stack Gas Wet	M(s) =	29.22
Abs Stack Pressure (in Hg)	P(s) =	31.54
Avg Stack Velocity (ft/sec)	V(s avg)=	78.5
Isokineticity (%)	% I =	95.3
Stack Gas STD Vol Flow (dscfm)	Q(s) =	240552
Actual Stack Gas Vol Flow (acfm)	Q(a) =	452279
Particulate Loading, dry (gr/dscf)	C(s std)=	0.0000
Particulate Loading, dry @7% O2 (gr/dscf)	=	0.0000
Particulate Emission Rate(lb/hr)	E(p) =	0.000

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter, dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
3-1	20	1.200	2.00	475	38	37	1.0954
2	20	1.400	2.35	483	52	40	1.1832
3	20	1.350	2.28	484	55	43	1.1619
4-1	20	0.900	1.52	486	57	46	0.9487
2	20	1.000	1.69	488	58	48	1.0000
3	20	1.100	1.86	489	58	49	1.0488
5-1	20	0.800	1.33	492	61	51	0.8944
2	20	1.200	2.04	491	58	50	1.0954
3	20	1.000	1.69	493	59	50	1.0000
7-1	20	0.850	1.44	490	47	45	0.9220
2	20	1.050	1.77	490	59	47	1.0247
3	20	1.000	1.69	490	61	47	1.0000
8-1	20	1.500	2.54	491	61	47	1.2247
2	20	1.700	2.90	491	63	48	1.3038
3	20	1.550	2.63	492	63	48	1.2450
1-1	20	1.100	1.86	494	64	49	1.0488
2	20	1.250	2.11	495	59	48	1.1180
3	20	1.150	1.93	499	60	48	1.0724
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	21.100	35.63	8813	1033	841	19.3874

ISOKINETIC PERFORMANCE WORKSHEET AND PARTICULATE CALCULATIONS

Plant: Nelson Dewey Station
Date: 11-6-92

Performed by: B. Nichols
Sample Location: Unit #2 (Outlet)

Test No./Type: #6 MM5
Start/Stop Time: 0843

PARAMETER	SYMBOL	VALUE (calc.)
Nozzle Diameter, Actual (in)	N(d)	0.235
Pitot Tube Correction Factor	C(p)	0.8400
Gas Meter Correction Factor	(gamma)	0.9900
Barometric Pressure (in Hg)	P(b)	29.92
Stack Pressure (in H2O)	P(stack)	21.000
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(360.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	64.00
Width (if rectangular)	W	216.00
Area of Stack (sq ft)	A(s)	(96.00)
Gas Meter Initial Reading (cu ft)		165.21
Gas Meter Final Reading (cu ft)		425.00
Net Gas Sample Volume (cu ft)	V(m)	(259.79)
Vol of Liquid Collected (ml)	Vl(c)	605.0
Vol of Liq @ Std. Conds. (scf)	V(w std)	(28.477)
Wt. of Front Half Particulate (gm)		0.0000
Wt. of Back Half Particulate (gm)		0.0000
Wt of Combined Particulate (gm)	M(p)	(0.0000)
O2 Concentration (by CEM)	% O2	3.00
CO2 Concentration (by CEM)	% CO2	14.00
CO Concentration (by CEM)	% CO	0.0
N2 Concentration (by diff.)	% N2	(83.00)

FIELD DATA AVERAGES

Avg Velocity Head (in H2O)	dP(avg)	= 1.037
Avg Orifice Meter Reading (in H2O)	dH(avg)	= 1.731
Avg Stack Temperature (degF)	T(s avg)	= 503.3
Average Meter Temperature (degF)	T(m avg)	= 53.1
Avg SQRT(dP)		= 1.013

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)	= 265.66
Stack Gas Water Vapor Proportion	B(wo)	= 0.097
Mol. Wt., Stack Gas Dry	M(d)	= 30.36
Mol. Wt., Stack Gas Wet	M(s)	= 29.16
Abs Stack Pressure (in Hg)	P(s)	= 31.46
Avg Stack Velocity (ft/sec)	V(s avg)	= 74.6
Isokineticity (%)	% I	= 105.3
Stack Gas STD Vol Flow (dscfm)	Q(s)	= 223590
Actual Stack Gas Vol Flow (acfm)	Q(a)	= 4294[illegible]
Particulate Loading, dry (gr/dscf)	C(s std)	= 0[illegible]
Particulate Loading, dry @7% O2 (gr/dscf)		= 0.0000
Particulate Emission Rate(lb/hr)	E(p)	= 0.000

Sample Point	dClock Time	Velocity Head, dP (in H2O)	Orifice Meter,dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out	SQRT(dP)
7-1	20	0.800	1.30	490	36	34	0.8944
2	20	0.900	1.47	495	48	37	0.9487
3	20	0.850	1.40	500	55	41	0.9220
8-1	20	1.000	1.66	503	58	44	1.0000
2	20	1.250	2.08	507	60	46	1.1180
3	20	1.100	1.83	510	64	48	1.0488
1-1	20	0.900	1.50	513	65	51	0.9487
2	20	1.050	1.75	517	66	53	1.0247
3	20	1.200	2.00	519	69	55	1.0954
3-1	20	0.950	1.59	496	57	54	0.9747
2	20	1.100	1.86	497	60	51	1.0488
3	20	1.050	1.77	496	60	51	1.0247
4-1	20	1.400	2.36	499	61	49	1.1832
2	20	1.500	2.53	500	63	50	1.2247
3	20	1.250	2.11	503	67	52	1.1180
5-1	20	0.750	1.26	503	60	50	0.8660
2	20	0.820	1.36	506	53	46	0.9055
3	20	0.800	1.32	505	53	46	0.8944
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
							0.0000
TOTALS	360	18.670	31.15	9059	1055	858	18.2409

APPENDIX H

SEMIVOLATILE ORGANIC GC/MS ANALYTICAL RESULTS

Internal Standards Compound	R.T.	Scan#	Area	Conc Units	ISTD
1) d4-Dichlorobenzene	10.67	634	43779	40.00 ng	ISTD001
3) d8-Naphthalene	13.77	930	93328	40.00 ng	ISTD002
7) d10-Acenaphthene	18.21	1353	54223	40.00 ng	ISTD003
10) d10-Phenanthrene	21.91	1706	95763	40.00 ng	ISTD004
17) d12-Chrysene	28.63	2347	37313	40.00 ng	ISTD005
23) d12-Perylene	32.54	2720	16002	40.00 ng	ISTD006
System Monitoring Compounds					
2) d5-Nitrobenzene	12.07	768	70179	103.35 ng	002
5) 2-Fluorobiphenyl	16.58	1198	92687	99.69 ng	003
15) d14-Terphenyl	26.06	2102	98530	102.25 ng	005
21) d12-Benzo(a)Pyrene	32.28	2695	40792	98.61 ng	006
Target Compounds					
4) naphthalene	13.82	935	241715	91.71 ng	002
6) Acenaphthylene	17.82	1316	243960	91.69 ng	003
8) Acenaphthene	18.30	1362	162416	90.79 ng	003
9) Fluorene	19.58	1484	176742	89.67 ng	003
11) Phenanthrene	21.98	1713	255574	94.23 ng	004
12) Anthracene	22.10	1724	257497	93.00 ng	004
13) Fluoranthene	25.00	2001	237119	94.93 ng	004
14) Pyrene	25.55	2053	223529	94.08 ng	004
16) Benzo(a)Anthracene	28.60	2344	113072	90.78 ng	005
18) Chrysene	28.70	2354	94938	88.39 ng	005
19) Benzo(b)Fluoranthene	31.39	2610	53682	94.69 ng	006
20) Benzo(k)Fluoranthene	31.46	2617	51292	93.41 ng	006
22) Benzo(a)Pyrene	32.36	2703	41803	89.02 ng	006
24) Indeno(1,2,3-cd)Pyrene	36.74	3121	29717	94.70 ng	006
25) Dibenz(a,h)Anthracene	36.88	3134	26676	89.45 ng	006
26) Benzo(ghi)Perylene	37.97	3238	28654	94.54 ng	006

Figure H-1. Semivolatile standards quantitation and target compound retention times

File: C:\CHEMPC\DATA\HPA1489.D
Operator: M HOWELL
Date Acquired: 15 Dec 92 5:52 pm
Method File: BNA.M
Sample Name: 8270,QA/QC,,SSTD100,L,,I-CAL @ 100NG,
Misc Info: QUANTS @ 40NG
ALS vial: 1

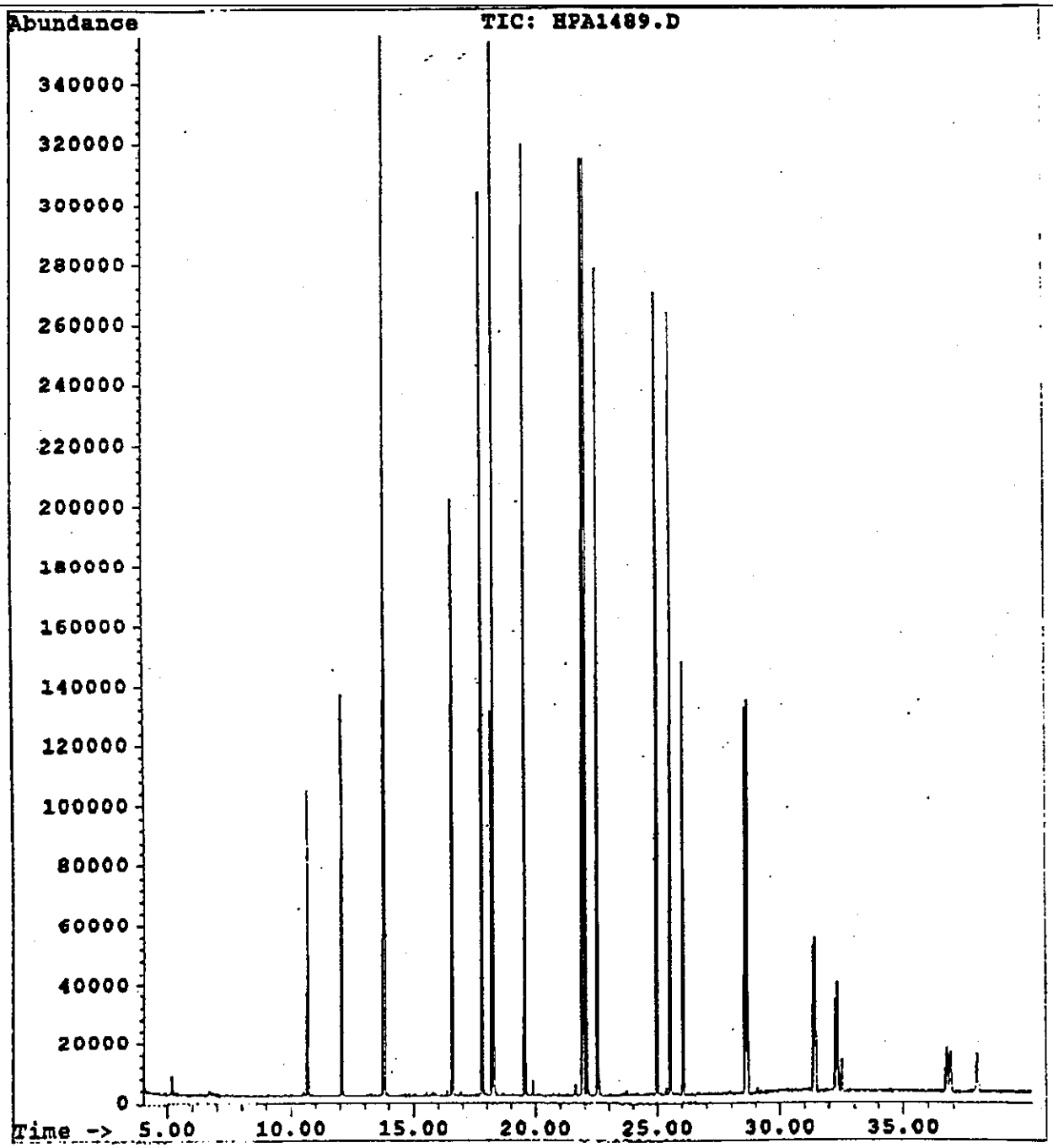


Figure H-2. Semivolatile chromatogram calibration

File: C:\CHEMPC\DATA\HPA1494.D
Operator: M HOWELL
Date Acquired: 15 Dec 92 8:48 pm
Method File: BNA.M
Sample Name: 8270,CASSVILLE,XAD-2 BLANK,L,AIR,LOT# T670
Misc Info: QUANTS @ 40NG
ALS Vial: 1

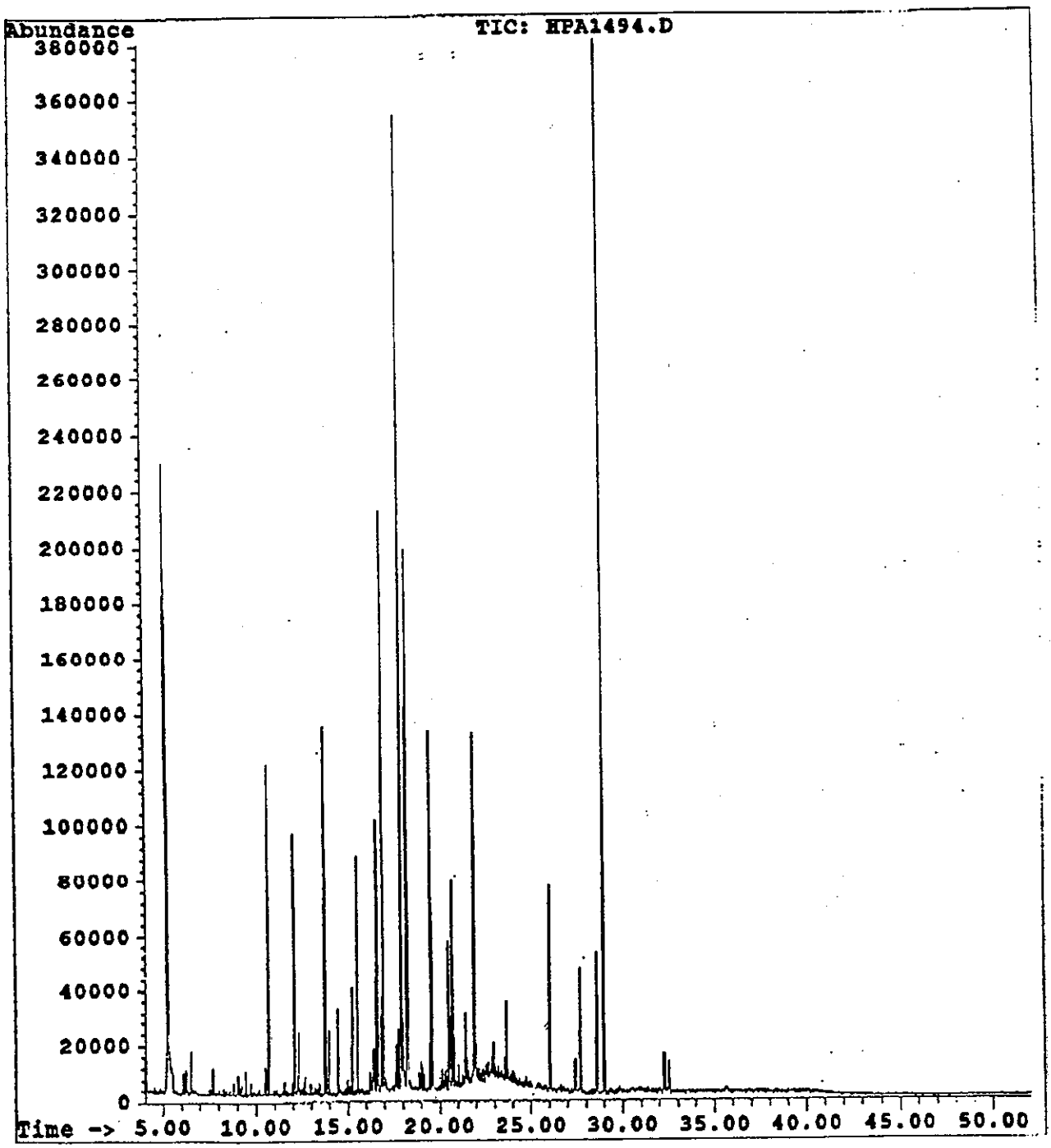


Figure H-3. Blank semivolatile chromatogram

File: C:\CHEMPC\DATA\HPA1498.D
Operator: M HOWELL
Date Acquired: 16 Dec 92 4:33 pm
Method File: BNA.M
Sample Name: 8270,CASSVILLE,BLANK 11/06/9,L,AIR,FIELD BLK
Misc Info: QUANTS @ 40NG
ALS vial: 1

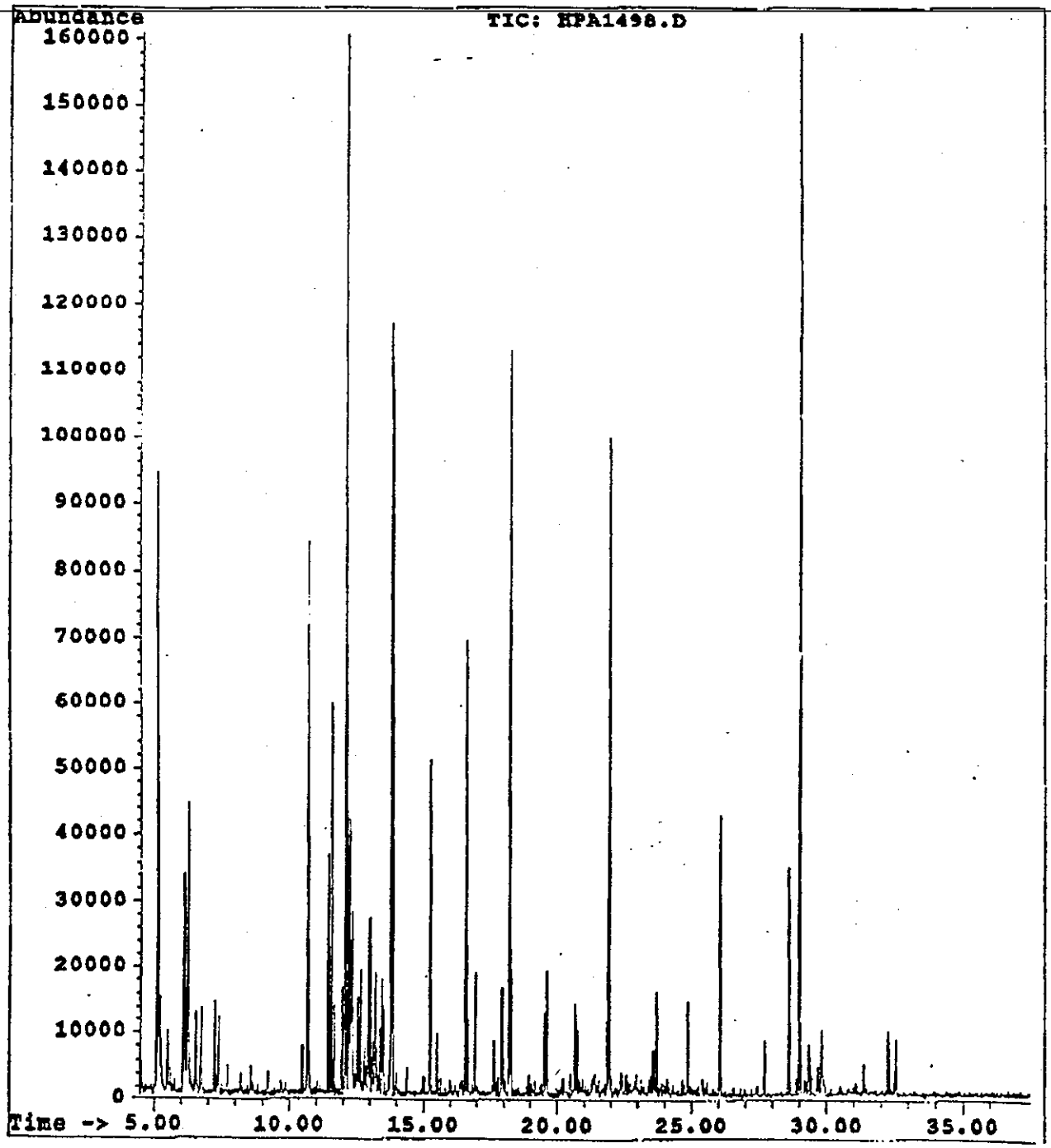


Figure H-4. Field blank semivolatile chromatogram

File: C:\CHEMPC\DATA\HPA1499.D
Operator: M HOWELL
Date Acquired: 16 Dec 92 5:18 pm
Method File: BNA.M
Sample Name: 8270,CASSVILLE,RUN # 1,L,AIR,XAD-2,
Misc Info: QUANTS @ 40NG
ALS vial: 1

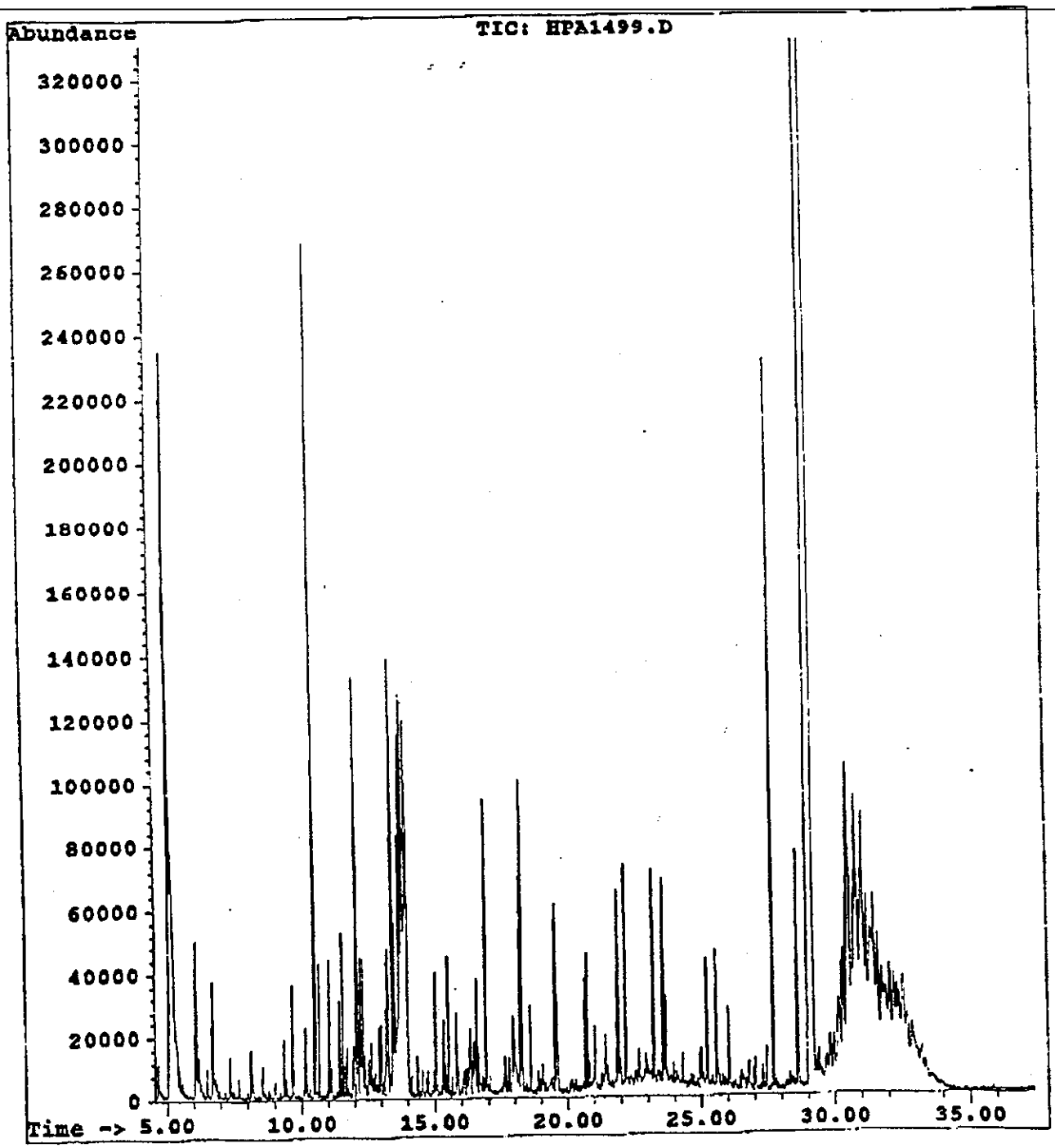


Figure H-5. Baseline Run 1 semivolatile chromatograph

File: C:\CHEMPC\DATA\HPA1500.D
Operator: M HOWELL
Date Acquired: 16 Dec 92 6:05 pm
Method File: BNA.M
Sample Name: 8270,CASSVILLE,RUN # 2,L,AIR,XAD-2,
Misc Info: QUANTS @ 40NG
ALS vial: 1

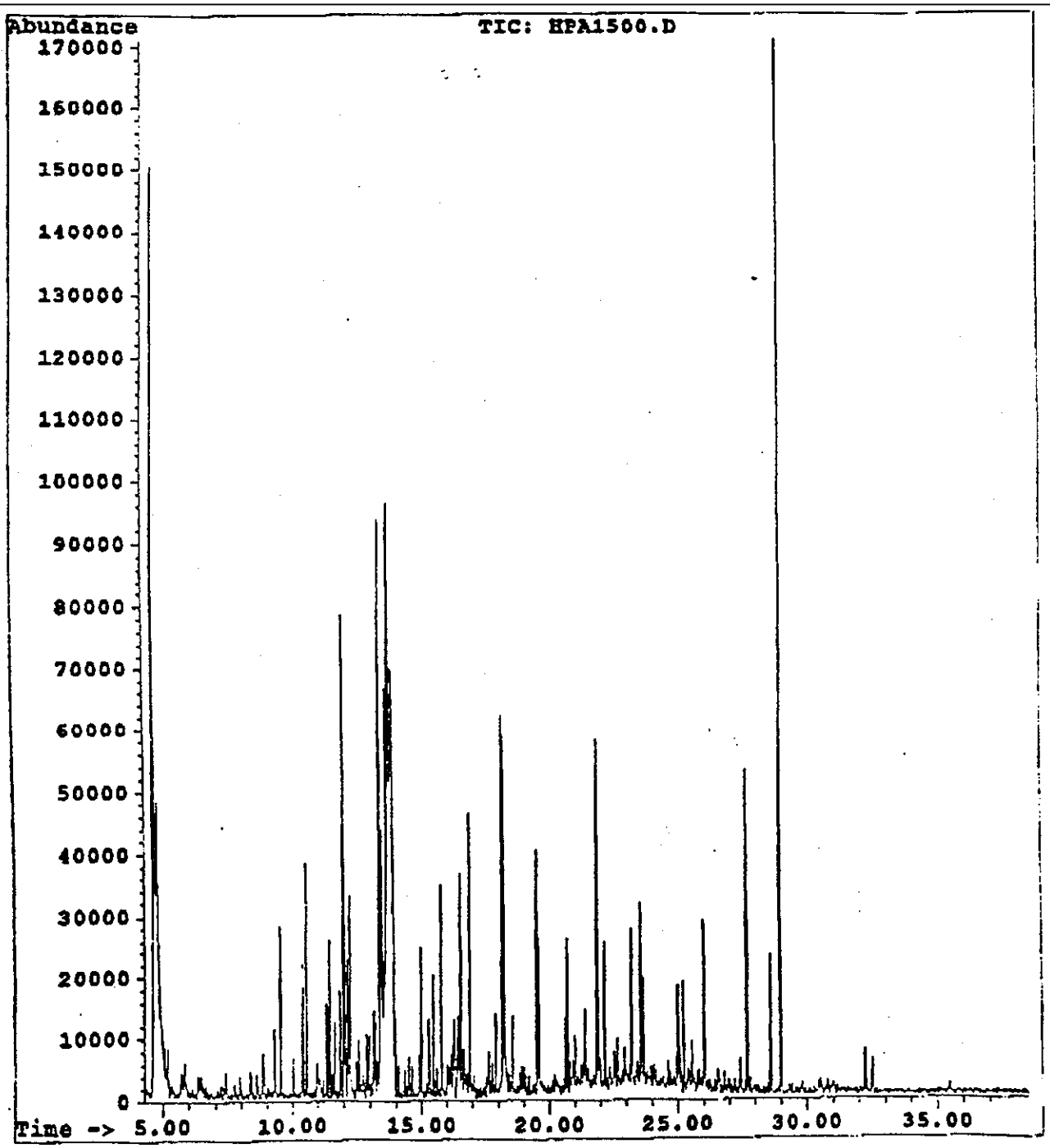


Figure H-6. Baseline Run 2 semivolatile chromatogram

File: C:\CHEMPC\DATA\HPA1501.D
Operator: M HOWELL
Date Acquired: 16 Dec 92 6:47 pm
Method File: BNA.M
Sample Name: 8270,CASSVILLE,RUN # 3,L,AIR,XAD-2,
Misc Info: QUANTS @ 40NG
ALS vial: 1

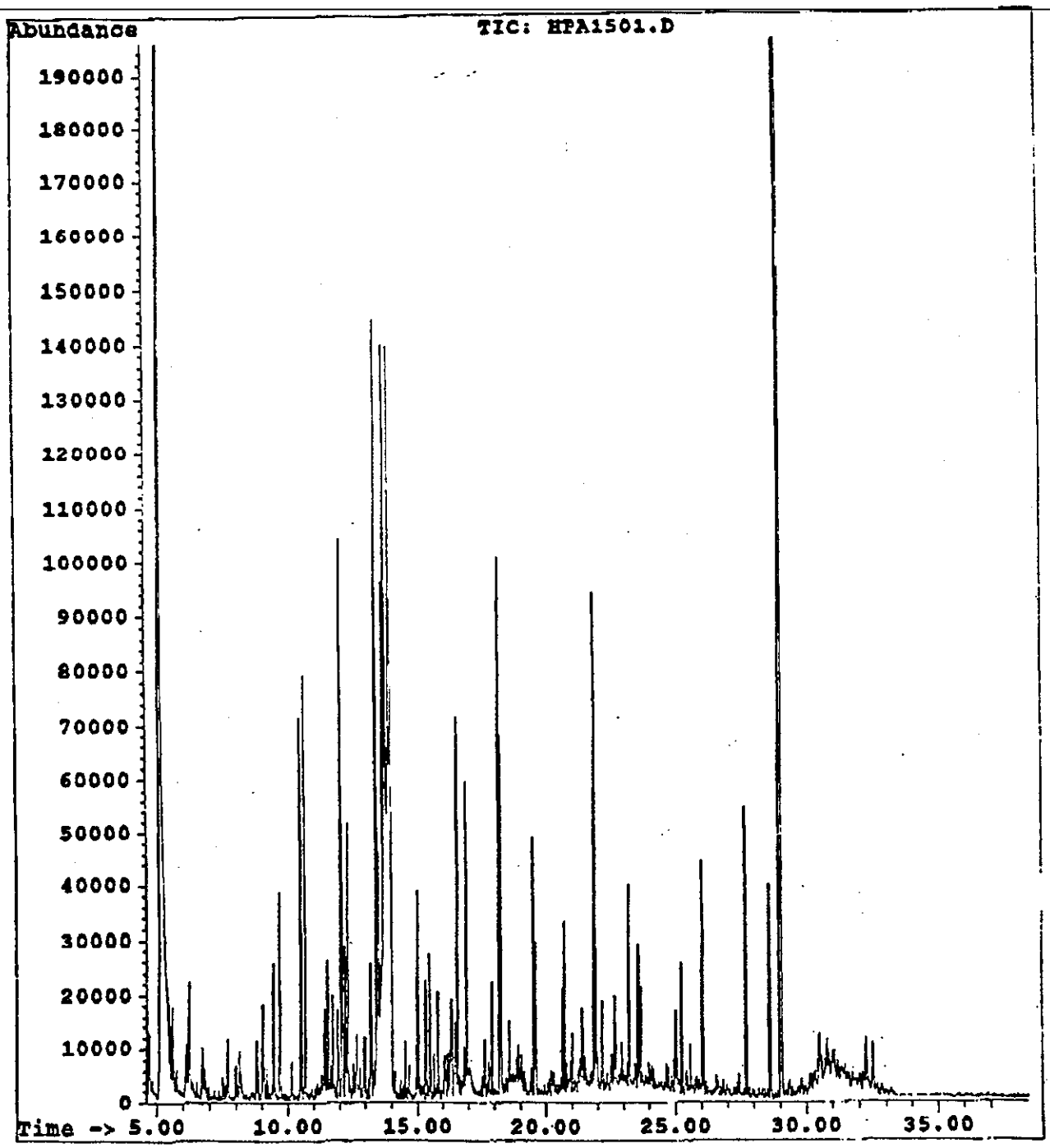


Figure H-7. Reburn Run 3 semivolatile chromatogram

File: C:\CHEMPC\DATA\HPA1502.D
Operator: M HOWELL
Date Acquired: 16 Dec 92 7:32 pm
Method File: BNA.M
Sample Name: 8270,CASSVILLE,RUN # 4,L,AIR,XAD-2,
Misc Info: QUANTS @ 40NG
ALS vial: 1

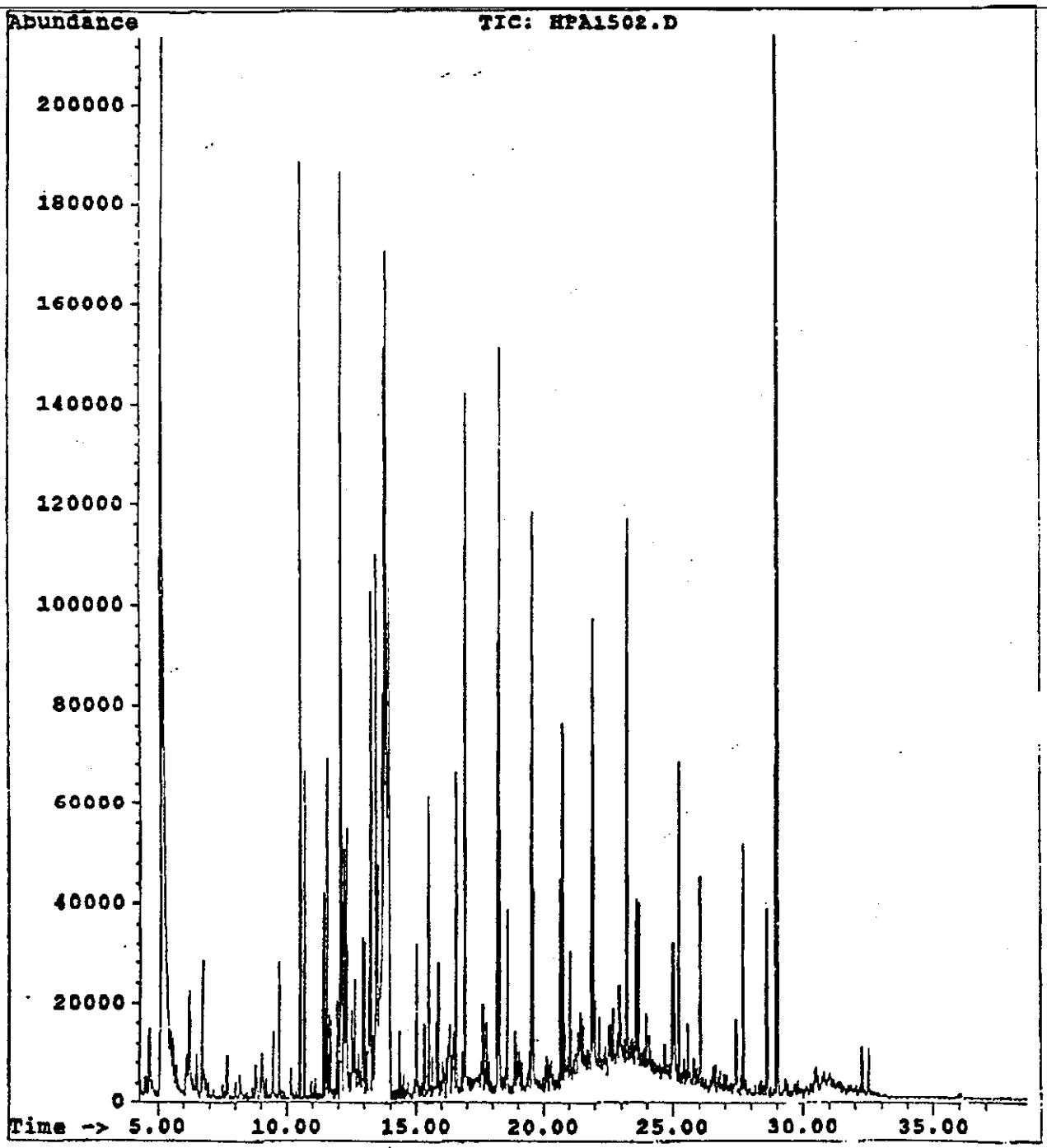


Figure H-8. Reburn Run 4 semivolatile chromatogram

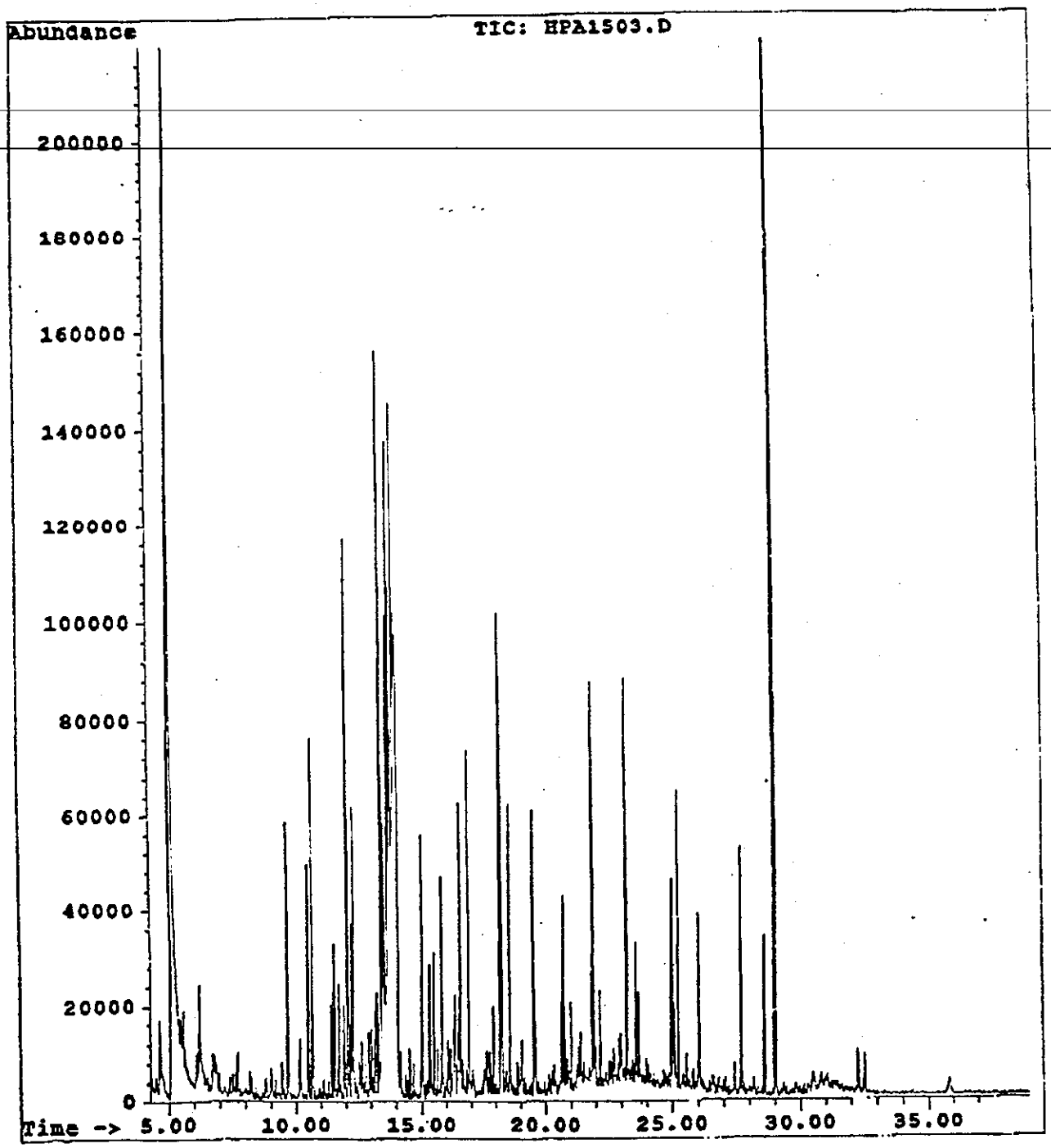


Figure H-9. Reburn Run 5 semivolatile chromatogram

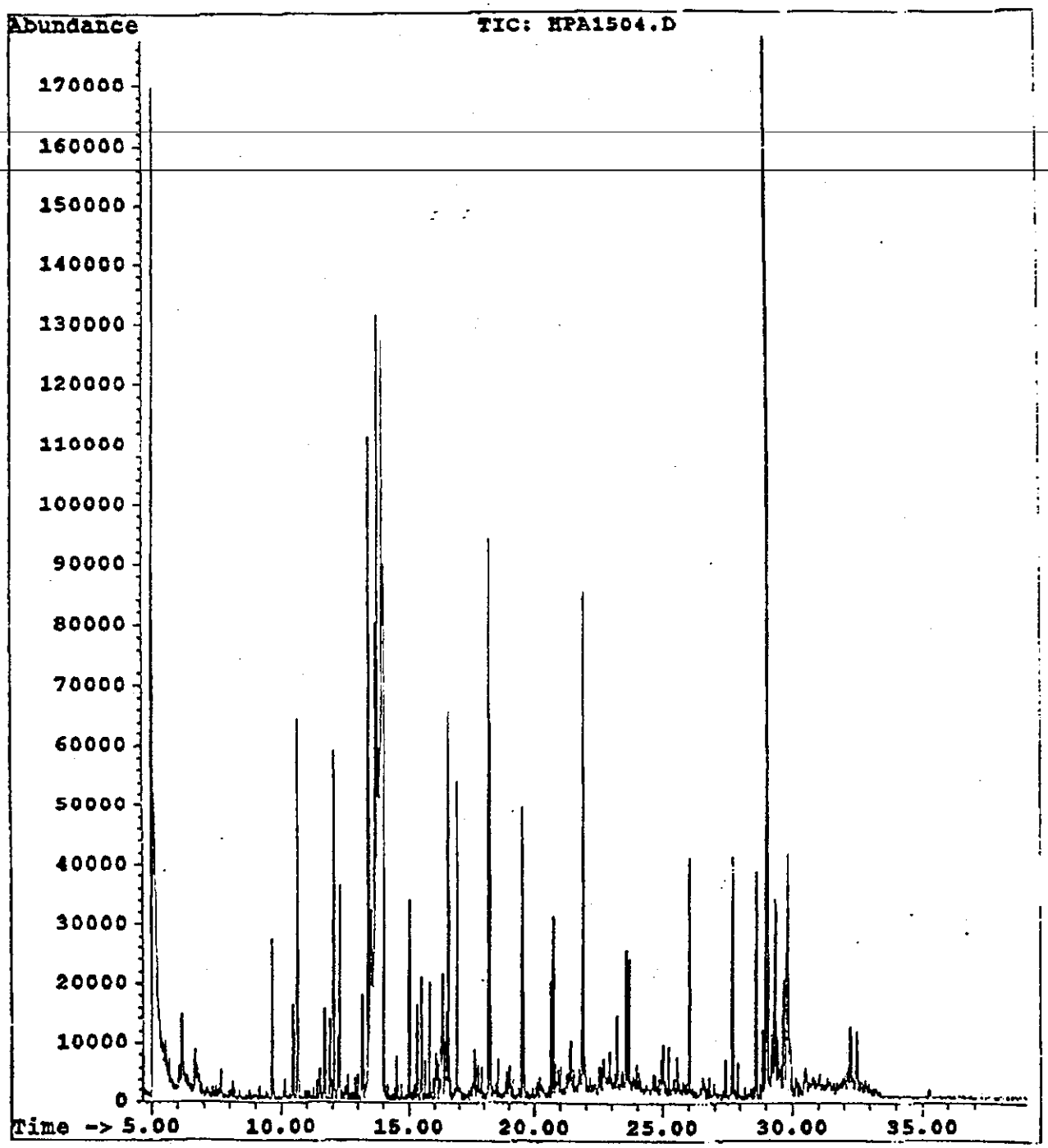


Figure H-10. Baseline Run 3 semivolatile chromatogram

Tentatively Identified Compound (LSC)

Operator ID: [BSB1]M HOWELL Date Acquired: 16 Dec 92 6:47 pm
Data File: C:\CHEMPC\DATA\BSB\HPA1501.D
Name: 8270,CASSVILLE,RUN # 3,L,AIR,XAD-2,
Misc: QUANTS @ 40NG
Method: BNA.M
Title: 8270
Last Calibration: Tue Dec 15 22:14:02 1992

Library Searched: NBS49K.L

R.T.	Conc	Area	Relative to ISTD	R.T.
16.92	18.30 ng	90059	d10-Acenaphthene	18.21

Hit# of 20	Tentative ID	Ref#	CAS#	Qual
1	Tetradecane	18383	000629-59-4	94
2	Decane, 2,3,5-trimethyl-	15638	062238-11-3	90
3	Tridecane	15584	000629-50-5	86
4	Nonadecane	29832	000629-92-5	80
5	Tetradecane, 1-iodo-	36442	019218-94-1	80

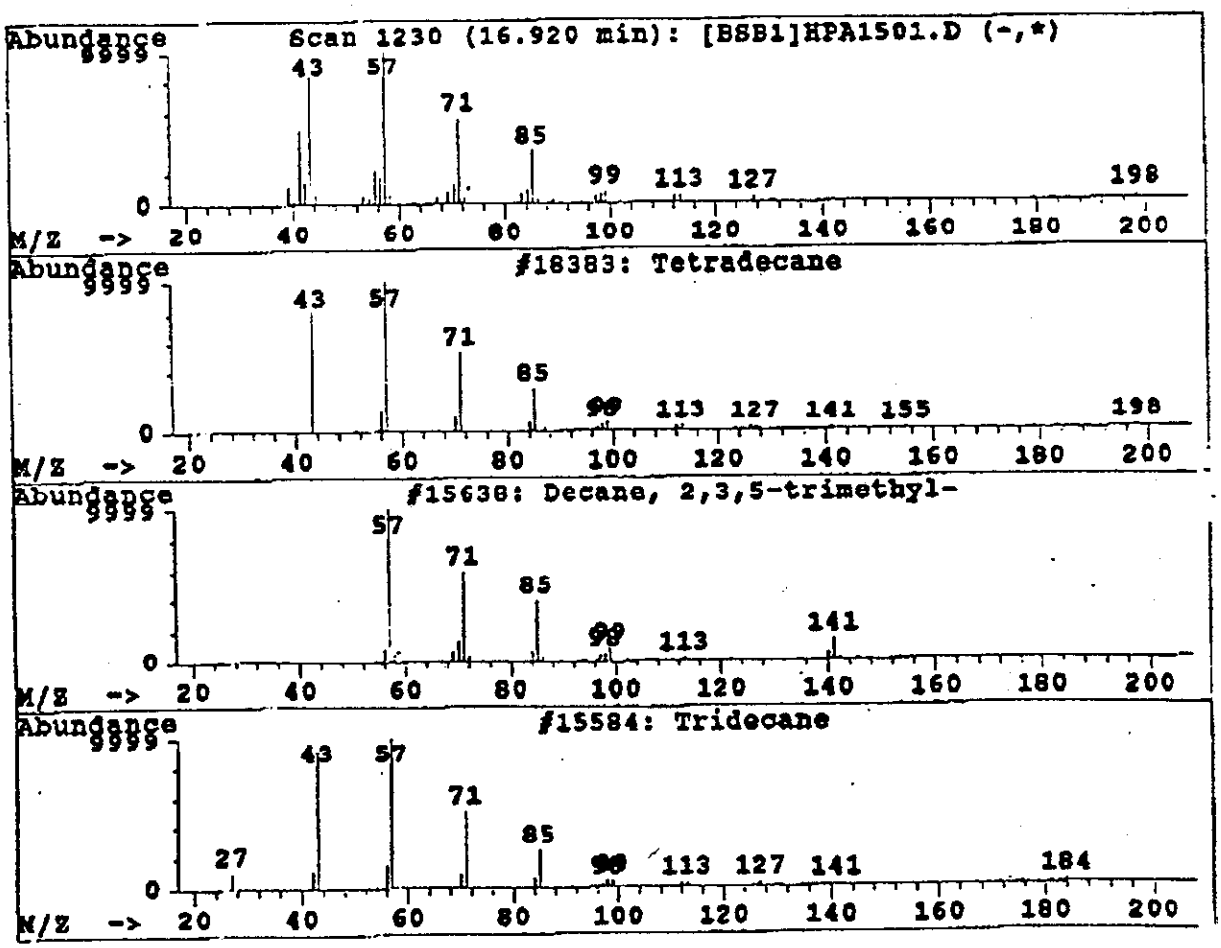


Figure H-11. Typical compound identifications, Run 3

Tentatively Identified Compound (LSC)

Operator ID: [BSB1]M HOWELL Date Acquired: 16 Dec 92 6:47 pm
Data File: C:\CHEMPC\DATA\BSB\HPA1501.D
Name: 8270,CASSVILLE,RUN # 3,L,AIR,XAD-2,
Misc: QUANTS @ 40NG
Method: BNA.M
Title: 8270
Last Calibration: Tue Dec 15 22:14:02 1992

Library Searched: NBS49K.L

R.T.	Conc	Area	Relative to ISTD	R.T.
23.23	11.74 ng	67576	d10-Phenanthrene	21.90

Hit# of 20	Tentative ID	Ref#	CAS#	Qual
1	Pentadecanoic acid, methyl ester	28101	007132-64-1	86
2	Undecanoic acid, 11-bromo-, methyl	31025	006287-90-7	72
3	Decanoic acid, methyl ester	15959	000110-42-9	64
4	Decanoyl chloride	16608	000112-13-0	64
5	2-Naphthalenol, 8-amino-	10246	000118-46-7	64

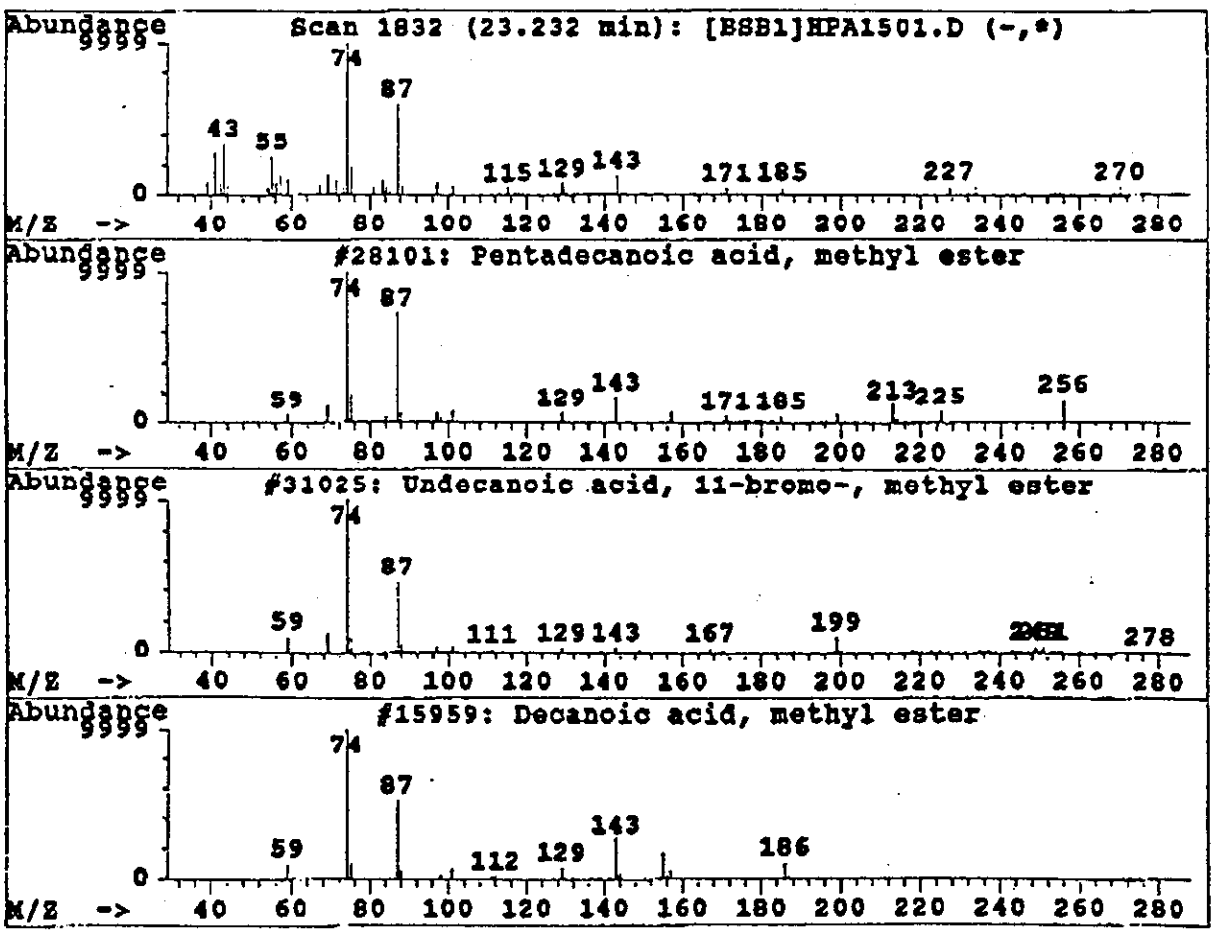


Figure H-12. Typical compound identifications, Run 3

Tentatively Identified Compound (LSC)

Operator ID: [BSB1]M HOWELL Date Acquired: 16 Dec 92 6:47 pm
Data File: C:\CHEMPC\DATA\BSB\HPA1501.D
Name: 8270,CASSVILLE,RUN # 3,L,AIR,XAD-2,
Misc: QUANTS @ 40NG
Method: BNA.M
Title: 8270
Last Calibration: Tue Dec 15 22:14:02 1992

Library Searched: NBS49K.L

R.T.	Conc	Area	Relative to ISTD	R.T.
23.59	9.21 ng	53008	d10-Phenanthrene	21.90

Hit# of 20	Tentative ID	Ref#	CAS#	Qual
1	Undecanoic acid	15978	000112-37-8	45
2	Decanoic acid, silver(1+) salt	31189	013126-67-5	45
3	Dodecanoic acid, silver(1+) salt	34678	018268-45-6	42
4	Dodecanoic acid	18687	000143-07-7	42
5	Glycine, N-methyl-N-(1-oxododecyl)-	30178	000097-78-9	42

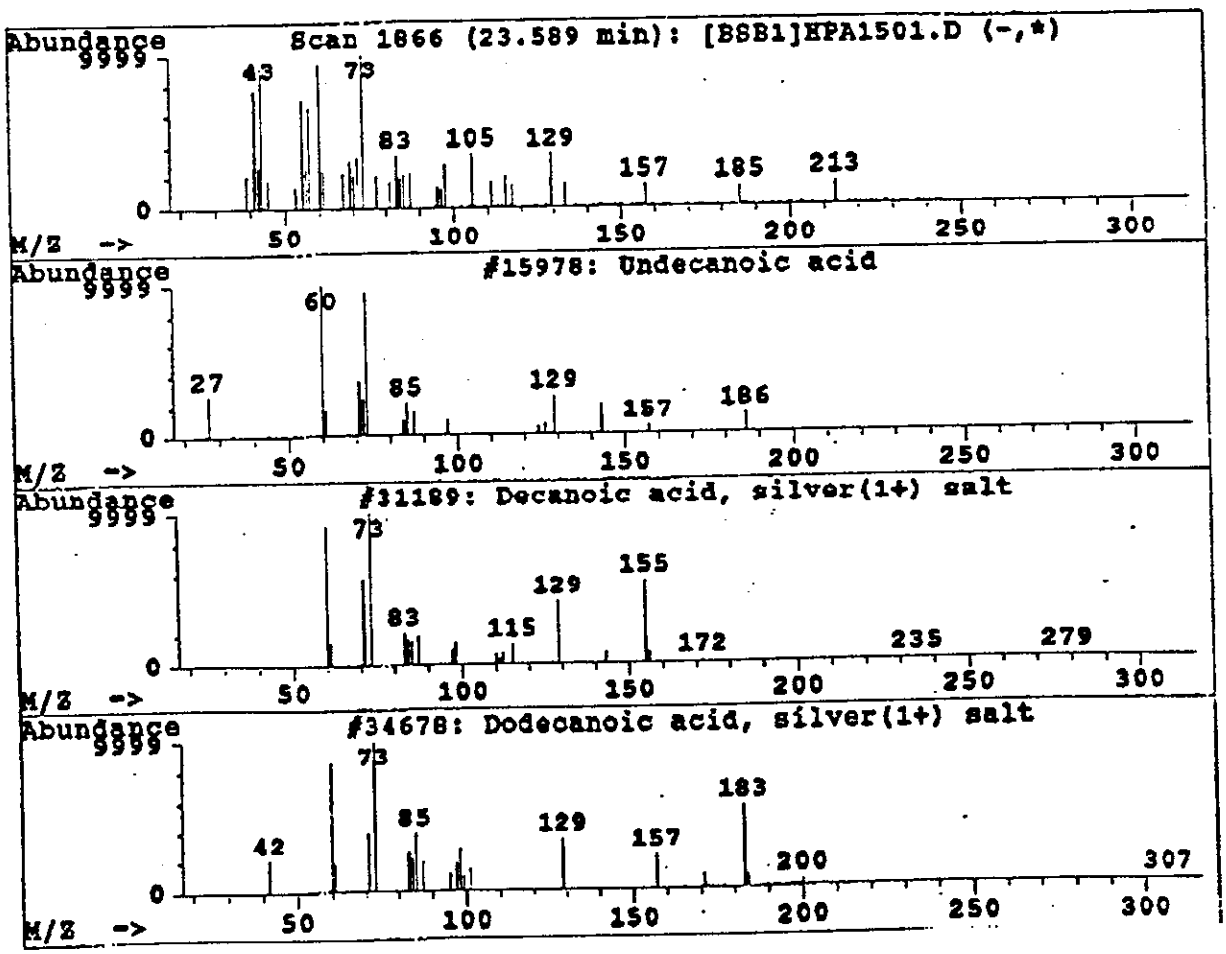


Figure H-13. Typical compound identifications, Run 3

Tentatively Identified Compound (LSC)

Operator ID: [BSB1]M HOWELL Date Acquired: 16 Dec 92 6:47 pm
Data File: C:\CHEMPC\DATA\BSB\HPA1501.D
Name: 8270,CASSVILLE,RUN # 3,L,AIR,XAD-2,
Misc: QUANTS @ 40NG
Method: BNA.M
Title: 8270
Last Calibration: Tue Dec 15 22:14:02 1992

Library Searched: NBS49K.L

R.T.	Conc	Area	Relative to ISTD	R.T.
27.71	43.98 ng	88962	d12-Chrysene	28.62

Hit# of 20	Tentative ID	Ref#	CAS#	Qual
1	3-MERCAPTO-5-ETHYL-1,2,4-TRIAZOLE	4478	007271-45-6	38
2	Hexanedioic acid, dicyclohexyl este	34998	000849-99-0	25
3	Nonanedioic acid, bis(2-ethylhexyl)	43195	000103-24-2	23
4	Hexanedioic acid, bis(1,3-dimethylb	35449	055125-22-9	23
5	Quinoline	4555	000091-22-5	22

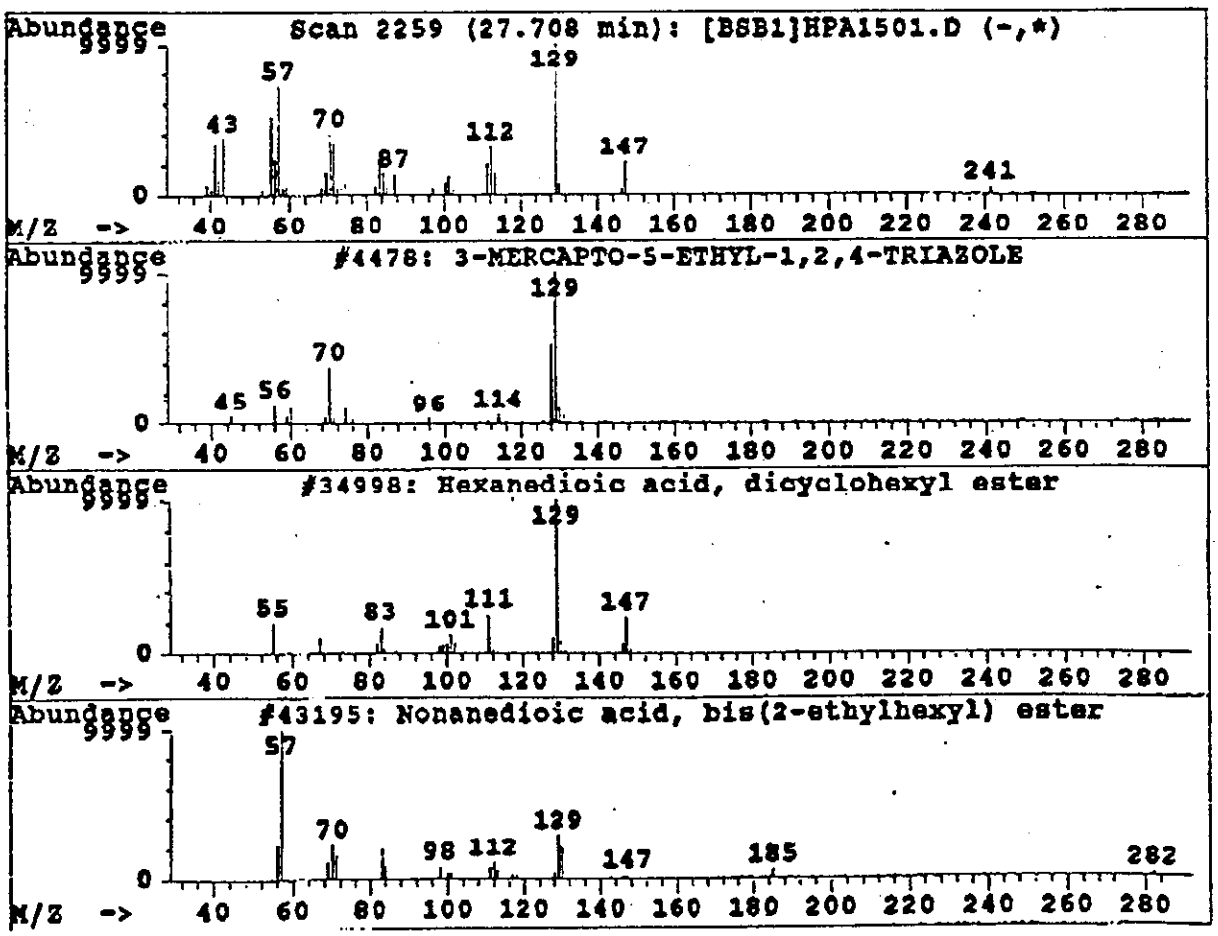


Figure H-14. Typical compound identifications, Run 3

APPENDIX I

TO2 TRAIN FOR VOLATILE ORGANICS AT ESP OUTLET: RUN SUMMARY

TO2 CALCULATIONS

Plant: Nelson Dewey Station
Sample Location: Unit #2 (Outlet)
Performed by: B. Johnston

Test No./Type: TO2-1 (Baseline)
Date : 11/2/92
Start/Stop Time: 1033

Barometric Pressure (in Hg): 29.92

Trap I.D.	Time Sampled (min.)	Volume Sampled (liters)	Volume Sampled (cu. ft.)	Gas Meter Temperature (F)	Correction Factor (Gamma)	Volume Sampled (liters, STD)	Volume Sampled (cu.ft., STD)
219	30.0	15.000	0.530	53.6	0.996	15.390	0.544
225	30.0	15.000	0.530	57.2	0.996	15.283	0.540
216	30.0	15.000	0.530	57.2	0.996	15.283	0.540
226	30.0	15.000	0.530	61.0	1.004	15.294	0.540
224	30.0	15.000	0.530	60.0	1.004	15.323	0.541
228	30.0	15.000	0.530	62.0	1.004	15.264	0.539

Test No./Type: TO2-2 (Baseline)
Date : 11/3/92
Start/Stop Time: 1142

Barometric Pressure (in Hg): 29.92

Trap I.D.	Time Sampled (min.)	Volume Sampled (liters)	Volume Sampled (cu. ft.)	Gas Meter Temperature (F)	Correction Factor (Gamma)	Volume Sampled (liters, STD)	Volume Sampled (cu.ft., STD)
217	33.0	15.000	0.530	46.4	0.996	15.609	0.551
205	27.0	15.000	0.530	55.4	0.996	15.337	0.542
204	30.0	17.000	0.600	59.0	0.996	17.261	0.610
201	27.0	15.000	0.530	44.6	1.002	15.759	0.557
200	31.0	15.000	0.530	44.6	1.002	15.759	0.557
222	34.0	15.000	0.530	46.4	1.002	15.703	0.555

Test No./Type: TO2-3 (Reburn)
Date : 11/4/92
Start/Stop Time: 0957

Barometric Pressure (in Hg): 29.92

Trap I.D.	Time Sampled (min.)	Volume Sampled (liters)	Volume Sampled (cu. ft.)	Gas Meter Temperature (F)	Correction Factor (Gamma)	Volume Sampled (liters, STD)	Volume Sampled (cu.ft., STD)
214	31.0	15.000	0.530	42.8	0.996	15.721	0.555
202	27.0	15.000	0.530	50.0	0.996	15.499	0.547
229	30.0	15.000	0.530	51.8	0.996	15.445	0.545
206	28.0	15.000	0.530	50.0	0.996	15.499	0.547
230	28.0	15.000	0.530	48.2	0.996	15.554	0.549
220	28.0	15.000	0.530	48.2	0.996	15.554	0.549

TO2 CALCULATIONS

Plant: Nelson Dewey Station
Sample Location: Unit #2 (Outlet)
Performed by: B. Johnston

Test No./Type: TO2-4 (Reburn)
Date : 11/4/92
Start/Stop Time: 1626

Barometric Pressure (in Hg): 29.92

Trap I.D.	Time Sampled (min.)	Volume Sampled (liters)	Volume Sampled (cu. ft.)	Gas Meter Temperature (F)	Correction Factor (Gamma)	Volume Sampled (liters, STD)	Volume Sampled (cu.ft., STD)
227	30.0	15.000	0.530	41.0	0.996	15.778	0.557
221	29.0	15.000	0.530	44.6	0.996	15.665	0.553
210	28.0	15.000	0.530	46.4	0.996	15.609	0.551
213	30.0	15.000	0.530	48.2	0.996	15.554	0.549
203	30.0	15.000	0.530	50.0	0.996	15.499	0.547
212	33.0	15.000	0.530	44.6	0.996	15.665	0.553

Test No./Type: TO2-5 (Baseline)
Date : 11/5/92
Start/Stop Time: 1020

Barometric Pressure (in Hg): 29.92

Trap I.D.	Time Sampled (min.)	Volume Sampled (liters)	Volume Sampled (cu. ft.)	Gas Meter Temperature (F)	Correction Factor (Gamma)	Volume Sampled (liters, STD)	Volume Sampled (cu.ft., STD)
234	29.0	15.000	0.530	51.8	0.996	15.445	0.545
236	29.0	15.000	0.530	51.8	0.996	15.445	0.545
243	30.0	15.000	0.530	53.6	0.996	15.390	0.544
215	32.0	15.000	0.530	48.2	0.996	15.554	0.549
211	28.0	15.000	0.530	48.2	0.996	15.554	0.549
233	28.0	15.000	0.530	48.2	0.996	15.554	0.549

Test No./Type: TO2-6 (Reburn)
Date : 11/6/92
Start/Stop Time: 1057

Barometric Pressure (in Hg): 29.92

Trap I.D.	Time Sampled (min.)	Volume Sampled (liters)	Volume Sampled (cu. ft.)	Gas Meter Temperature (F)	Correction Factor (Gamma)	Volume Sampled (liters, STD)	Volume Sampled (cu.ft., STD)
240	31.0	15.000	0.530	46.4	0.996	15.609	0.551
238	30.0	15.000	0.530	48.2	0.996	15.554	0.549
235	29.0	15.000	0.530	48.2	0.996	15.554	0.549
239	30.0	15.000	0.530	37.4	0.996	15.892	0.561
241	32.0	15.000	0.530	42.8	0.996	15.721	0.555
237	30.0	15.000	0.530	46.4	0.996	15.609	0.551

APPENDIX J

VOLATILE ORGANIC GC/MS RESULTS

QUANT REPORT

Operator ID: M HOWELL Date Acquired: 1 Dec 92 2:53 pm
Data File: A:\HPA1413.D
Name: TO-2,0406,#226,BASELINE,L,AIR,TEST # 1,
Misc: QUANTS & SURRS @ 250NG
Method: VOST.M
Title: 8240
Last Calibration: Thu Nov 19 10:43:19 1992

Compound	R.T.	Scan#	Area	Conc Units	ISTD
Internal Standards					
19) 1,4-difluorobenzene (is)	17.35	892	378853	250.00 ng	ISTD001
30) d5-chlorobenzene (is)	21.53	1172	844473	250.00 ng	ISTD002
System Monitoring Compounds					
11) bromochloromethane (surr)	15.82	790	146488	272.27 ng	001
15) d5-1,2-dichloroethane (sur	16.64	845	239923	250.69 ng	001#
16) d6-Benzene	16.66	846	164301	95.55 ng	002
24) d8-toluene (surr)	19.41	1030	847912	219.38 ng	002
38) 4-bromofluorobenzene (surr	23.39	1296	579480	228.19 ng	002
Target Compounds					
1) chloromethane(spcc)	6.68	178	79674	38.09 ng	001#
2) vinyl chloride(ccc)	0.00			**Not Found**	001
3) bromomethane	9.41	361	154284	73.58 ng	001
4) chloroethane	9.94	396	1474	1.30 ng	001
5) trichlorofluoromethane	10.94	463	43295	35.59 ng	001
6) 1,1-dichloroethene(ccc)	12.25	551	851	0.60 ng	001#
7) Acetone	12.63	576	56801	41.97 ng	001
8) methylene chloride	13.37	626	91116	61.06 ng	001
9) trans-1,2-dichloroethene	0.00			**Not Found**	001
10) 1,1-dichloroethane(spcc)	0.00			**Not Found**	001
12) chloroform(ccc)	16.00	802	189890	102.27 ng	001
13) 1,1,1-trichloroethane	16.20	815	3679	2.39 ng	002
14) carbon tetrachloride	16.43	831	2862	2.20 ng	002#
17) benzene	16.72	850	171243	102.65 ng	002#
18) 1,2-dichloroethane	16.70	849	4922	4.47 ng	001#
20) trichloroethene	0.00			**Not Found**	002
21) 1,2-dichloropropane(ccc)	0.00			**Not Found**	002
22) bromodichloromethane	18.41	963	13487	4.22 ng	002
23) cis-1,3-dichloropropene	0.00			**Not Found**	002
25) toluene(ccc)	19.50	1036	101699	22.16 ng	002
26) trans-1,3-dichloropropene	0.00			**Not Found**	002
27) 1,1,2-trichloroethane	19.92	1064	1404	0.79 ng	002#
28) tetrachloroethene	0.00			**Not Found**	002
29) dibromochloromethane	20.66	1114	1364	0.46 ng	002#
31) chlorobenzene(spcc)	21.58	1175	1052	0.33 ng	002
32) 1,1,1,2-Tetrachloroethane	21.92	1198	6173	3.49 ng	002
33) ethyl benzene(ccc)	21.79	1189	2993	2.01 ng	002
34) m,p-xylene	21.97	1201	9596	5.58 ng	002
35) o-xylene	22.58	1242	4199	2.40 ng	002
36) Styrene	22.59	1243	8207	2.67 ng	002
37) bromoform(spcc)	0.00			**Not Found**	002
39) 1,1,2,2-tetrachloroethane(	23.86	1328	4231	20.27 ng	002#
40) 1,3-Dichlorobenzene	0.00			**Not Found**	002
41) 1,4-Dichlorobenzene	25.30	1424	945	0.34 ng	002#
42) 1,2-Dichlorobenzene	0.00			**Not Found**	002

Figure J-1. Volatile standards quantitation and target compound retention times

File: A:\HPA1410.D
Operator: M HOWELL
Date Acquired: 1 Dec 92 12:29 pm
Method File: VOST.M
Sample Name: TO-2,1180,#223,FIELD BLANK,L,AIR,TEST # 1,
Misc Info: QUANTS & SURRS @ 250NG
ALS vial: 1

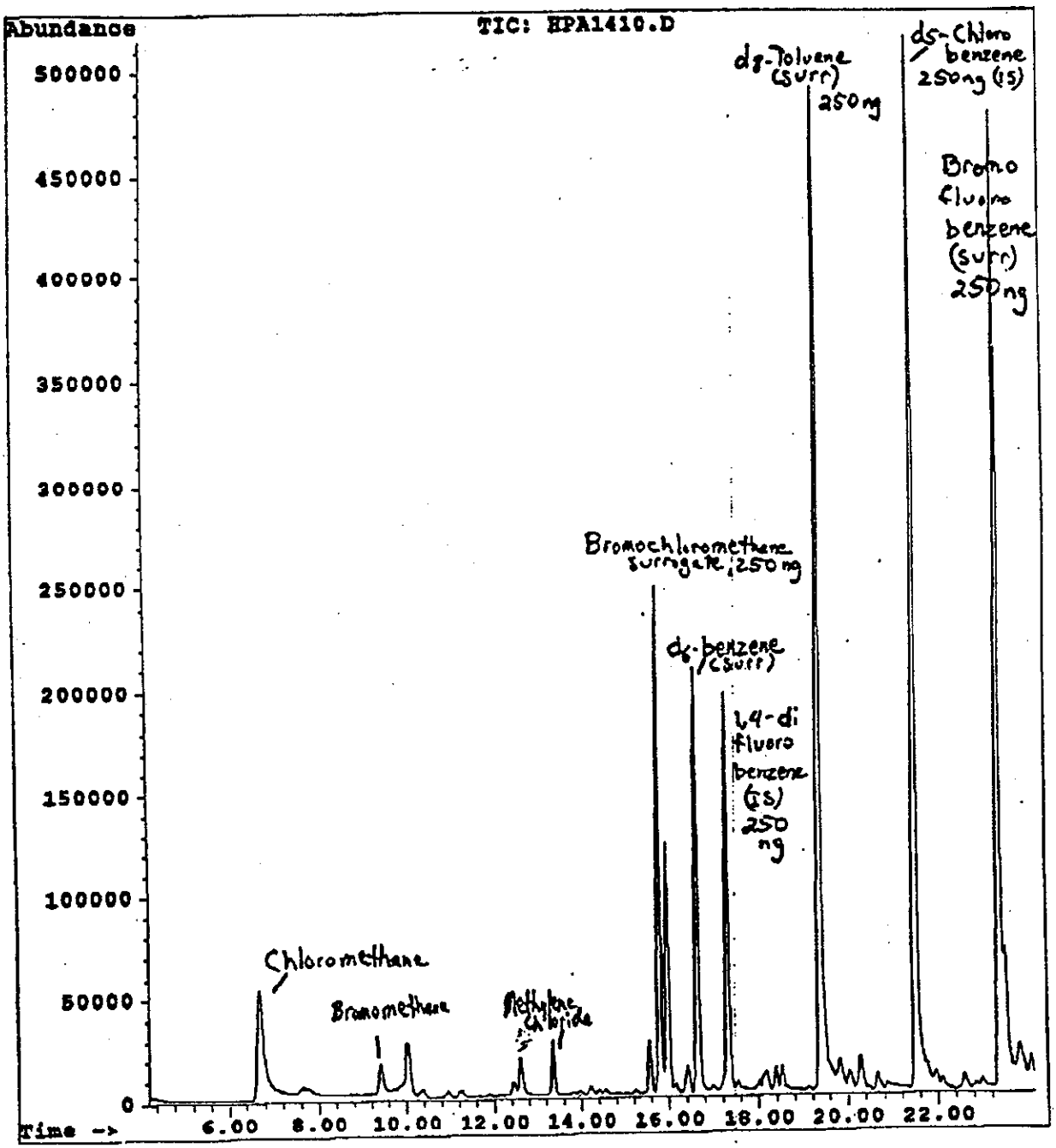


Figure J-2. Volatile organic chromatograms — field blank

File: A:\HPA1413.D
Operator: M HOWELL
Date Acquired: 1 Dec 92 2:52 pm
Method File: VOST.M
Sample Name: TO-2,0406,#226,BASELINE,L,AIR,TEST # 1,
Misc Info: QUANTS & SURRS @ 250NG
ALS vial: 1

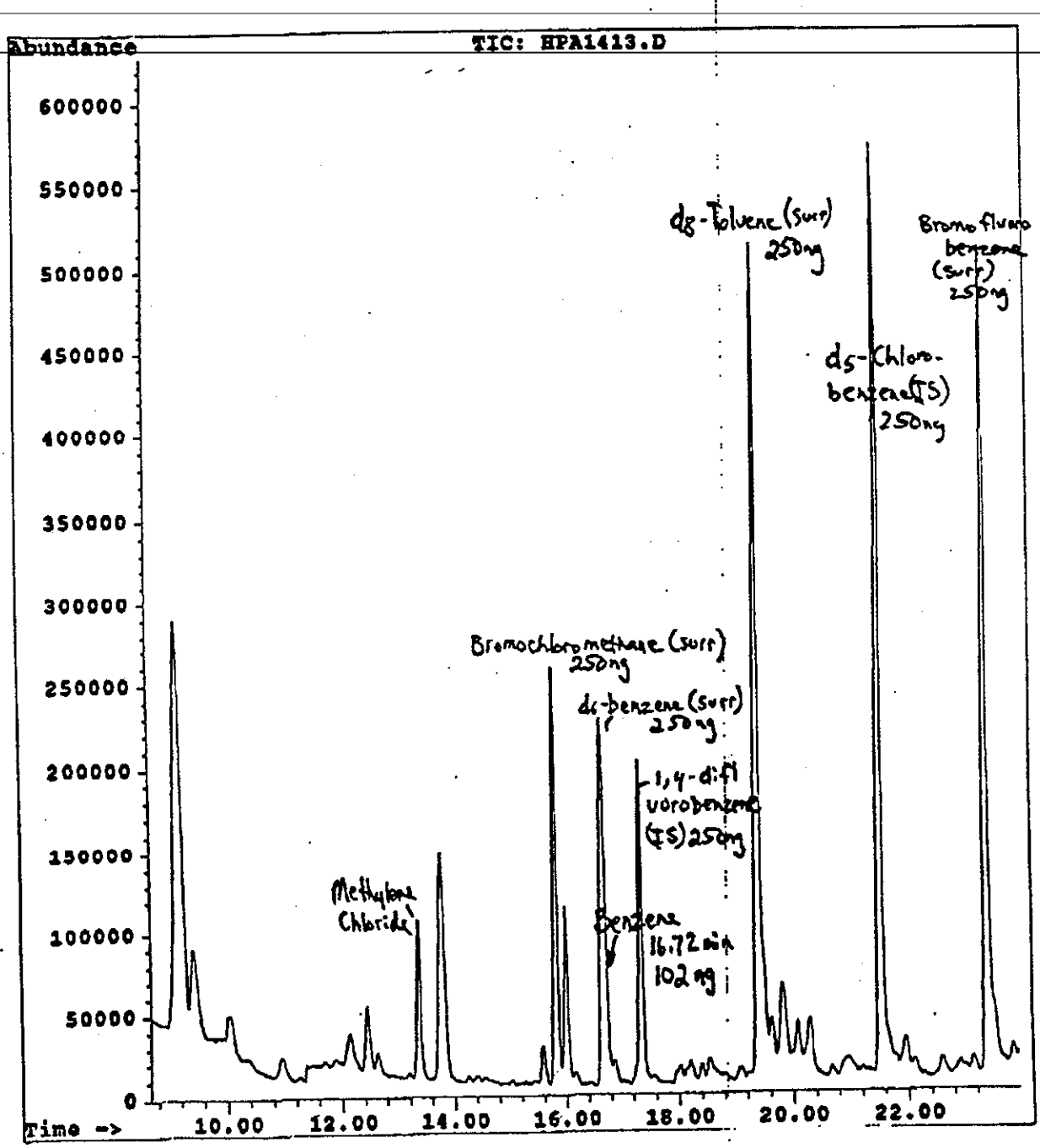


Figure J-3. Volatile organic chromatograms — Test 1

File: C:\CHEMPC\DATA\BSB\HPA1441.D
Operator: [BSB1]M HOWELL
Date Acquired: 4 Dec 92 2:07 pm
Method File: VDAILY.M
Sample Name: TO2,0414,#222,BASELINE,L,AIR,TEST # 2,
Misc Info: QUANTS & SURRS @ 250NG
ALS vial: 1

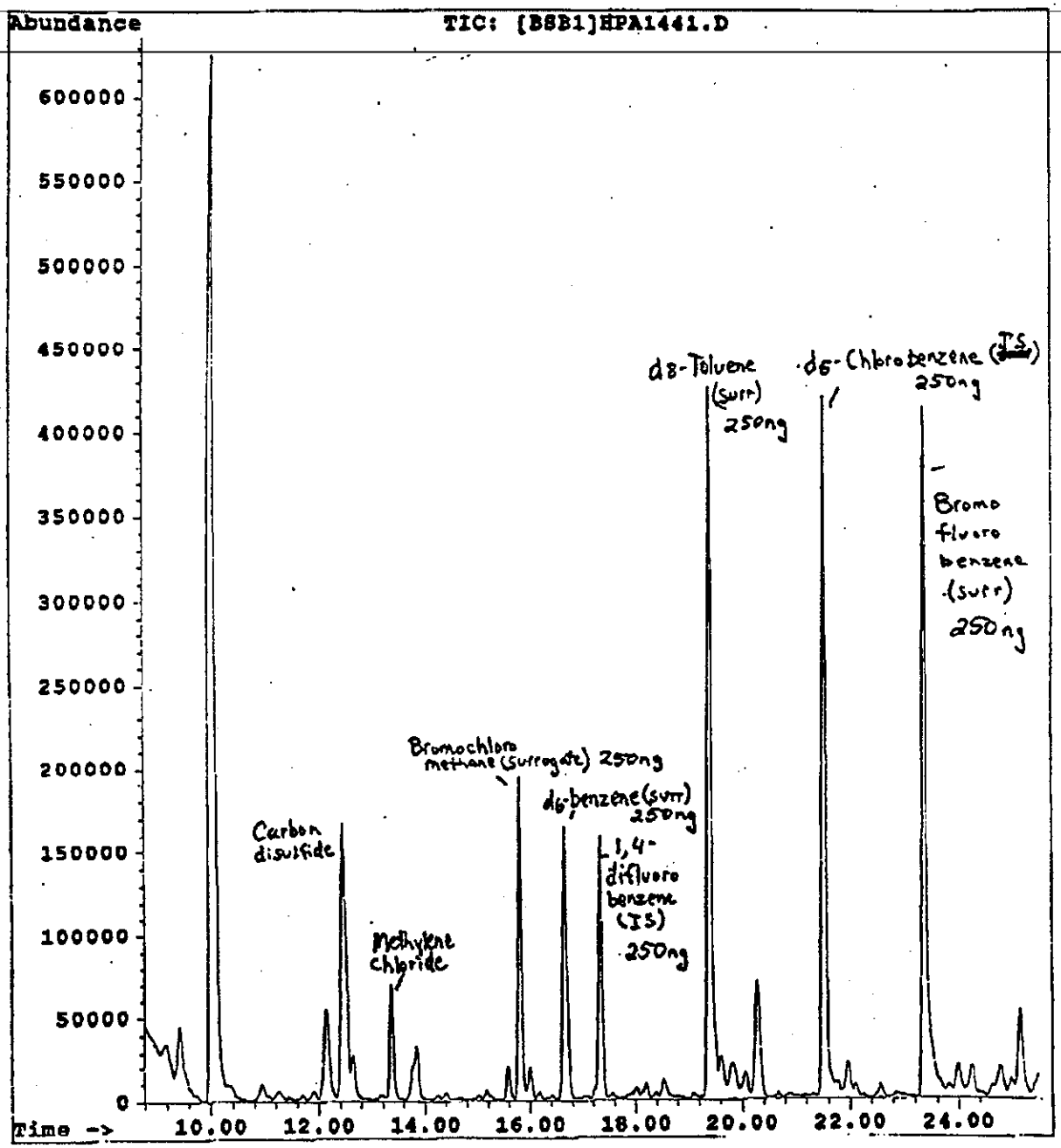


Figure J-4. Volatile organic baseline chromatogram, Run 2

File: C:\CHEMPC\DATA\HPA1448.D
Operator: M HOWELL
Date Acquired: 8 Dec 92 4:07 pm
Method File: VOST.M
Sample Name: TO2,0418,#206,REBURN,L,AIR,TEST #3,
Misc Info: QUANT & SURRS @ 250NG
ALS Vial: 1

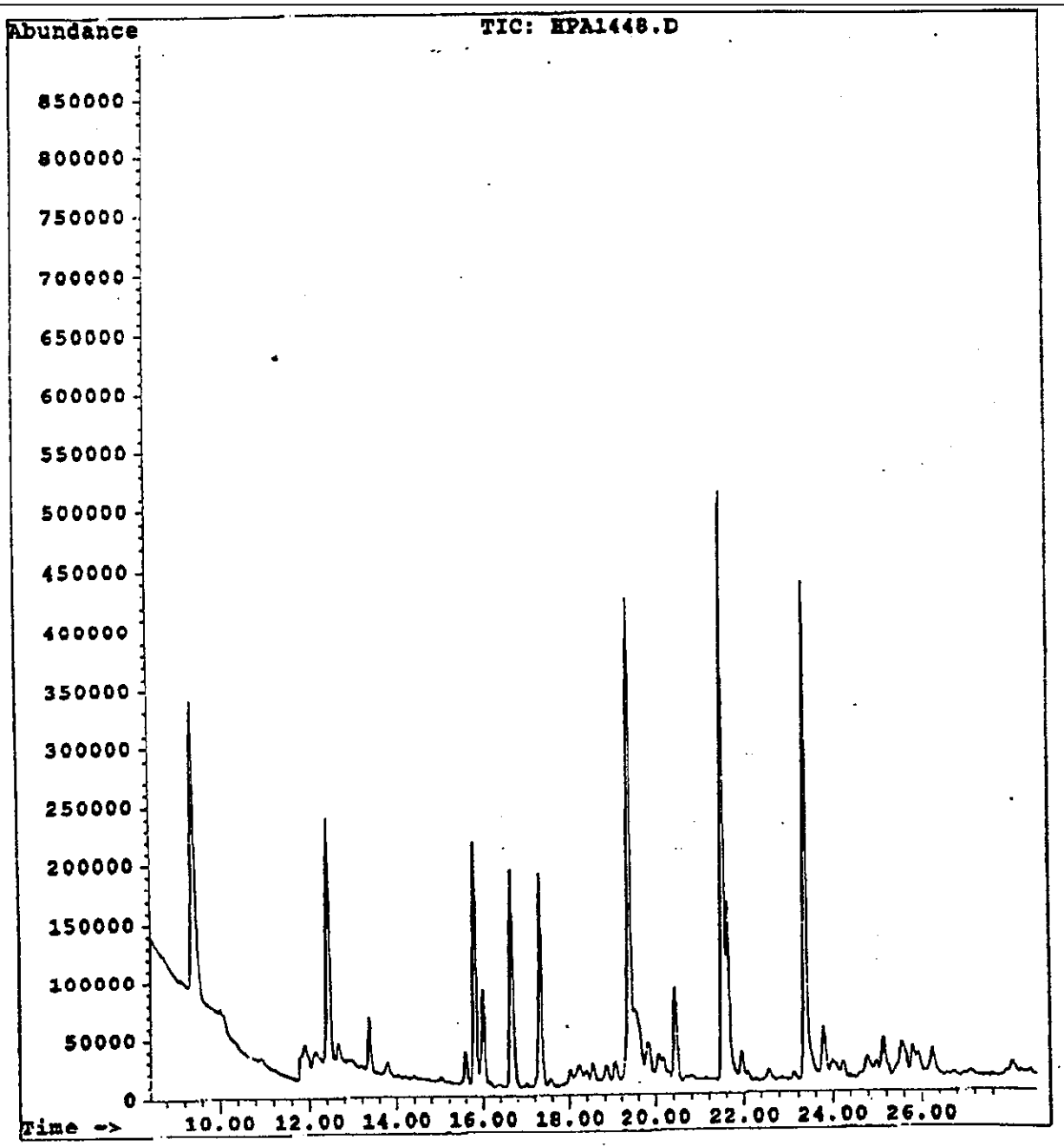


Figure J-5. Volatile organic reburn chromatogram, Run 3

File: C:\CHEMPC\DATA\HPA1455.D
Operator: M HOWELL
Date Acquired: 9 Dec 92 1:22 pm
Method File: VOST.M
Sample Name: TO2,0425,#221,REBURN,L,AIR,TEST # 4,
Misc Info: QUANTS & SURRS @ 250NG
ALS vial: 1

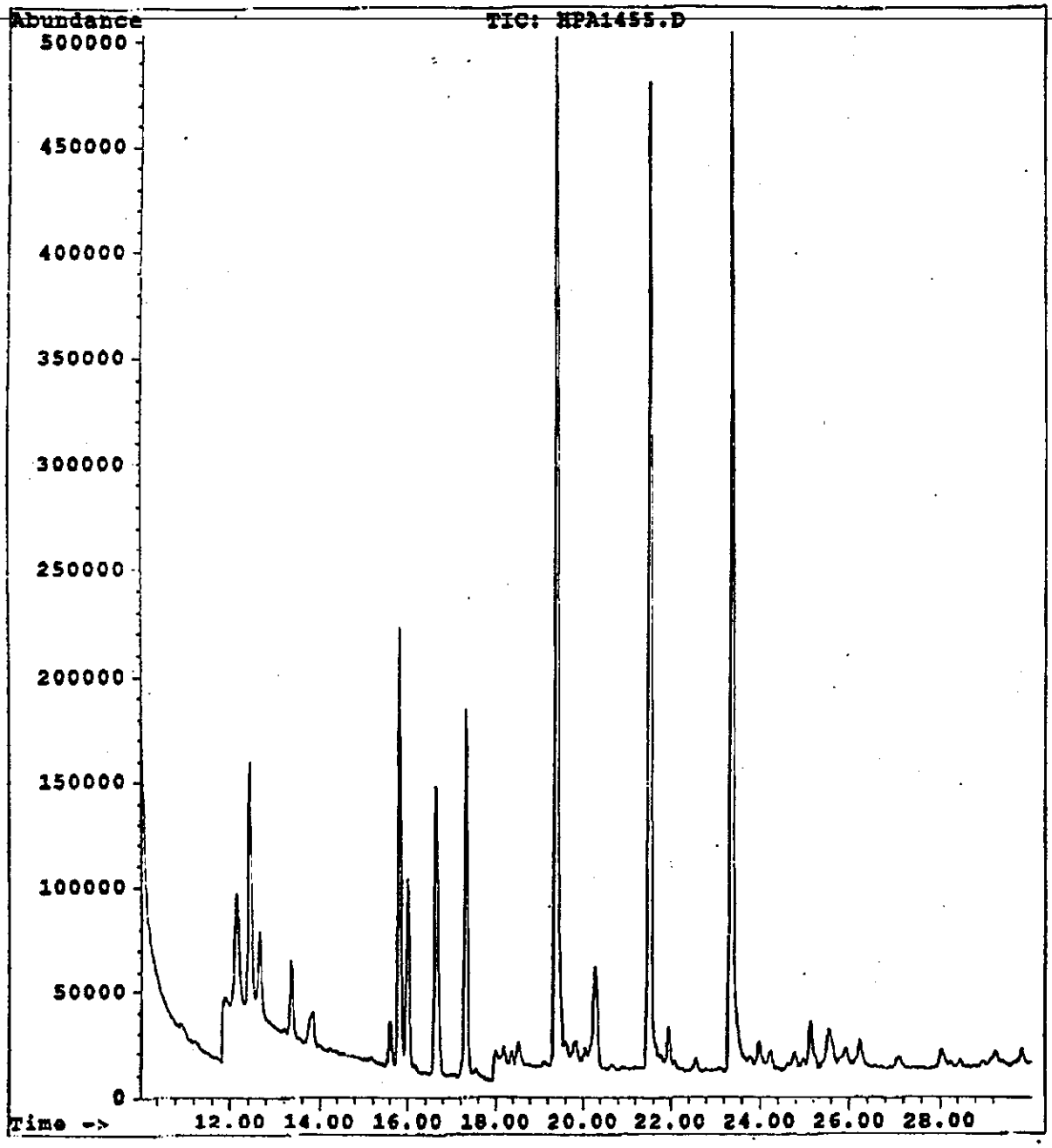


Figure J-6. Volatile organic reburn chromatogram, Run 4

File: C:\CHEMPC\DATA\HPA1461.D
Operator: M HOWELL
Date Acquired: 9 Dec 92 5:10 pm
Method File: VOST.M
Sample Name: TO2,0428,#236,BASELINE,L,AIR,TEST # 5,
Misc Info: QUANTS & SURRS @ 250NG
ALS vial: 1

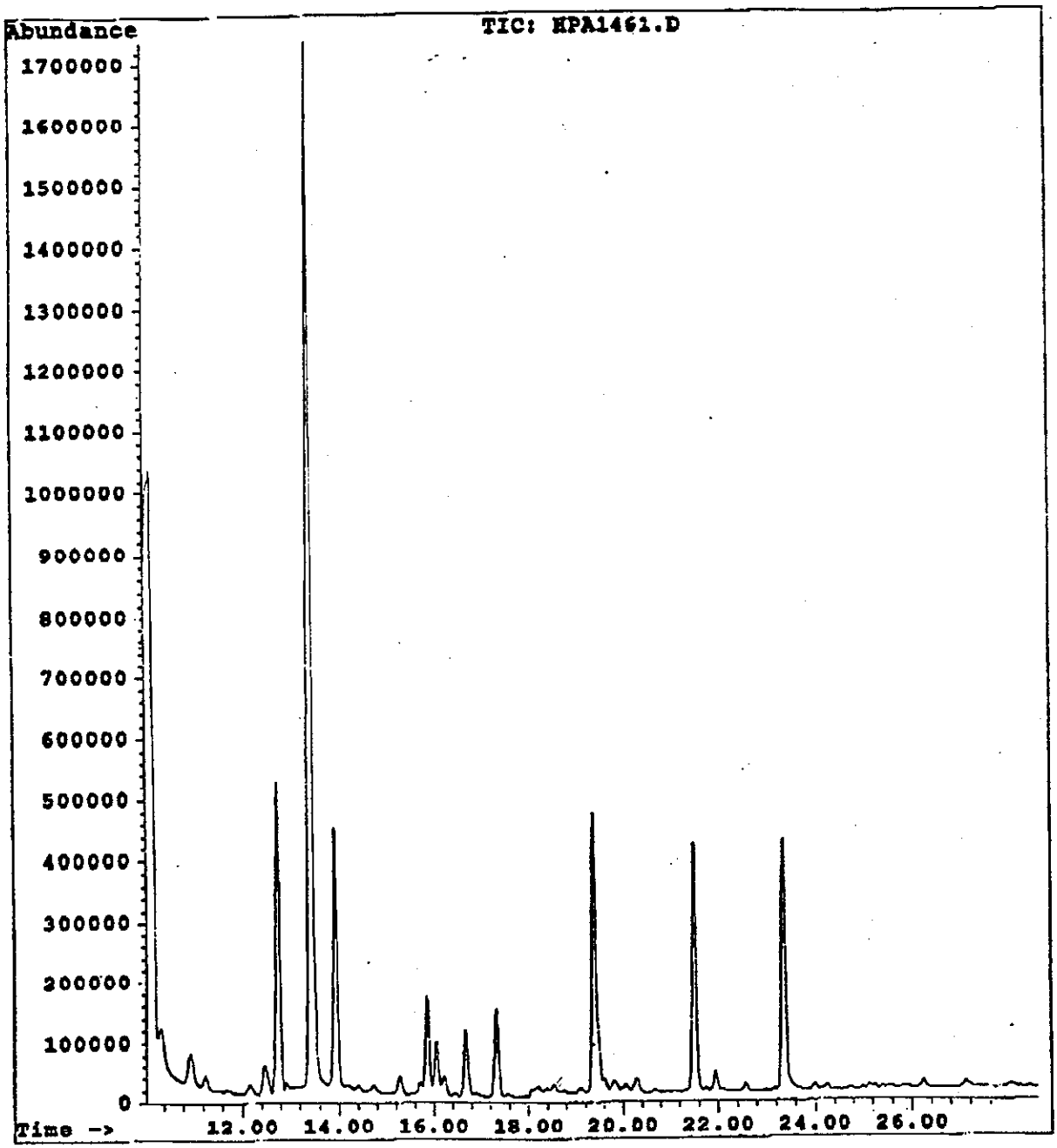


Figure J-7. Volatile organic baseline chromatogram, run 5

File: C:\CHEMPC\DATA\HPA1469.D
Operator: M HOWELL
Date Acquired: 10 Dec 92 1:25 pm
Method File: VOST.M
Sample Name: TO2,0433,#240,REBURN,L,AIR,TEST #6,
Misc Info: QUANTS & SURRS @ 250NG
ALS vial: 1

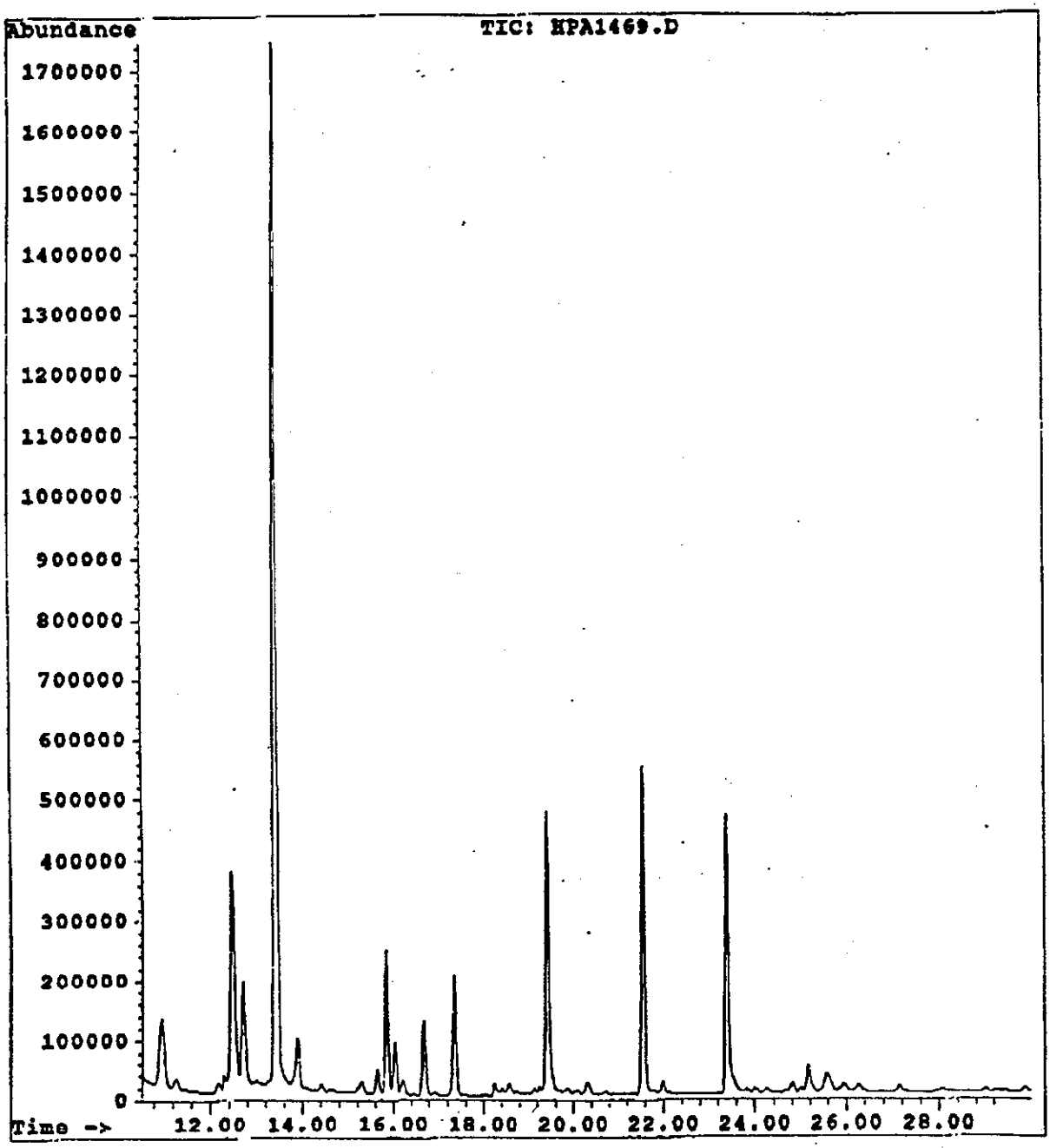


Figure J-8. Volatile organic reburn chromatogram, Run 6

APPENDIX K

METHOD 430 TRAIN FOR ALDEHYDES AT ESP OUTLET: DATA RUN SUMMARY

METHOD 430 ALDEHYDES TRAIN

Plant: Nelson Dewey Station
Date : 11/2/92
Performed by: R. McKenzie

Sample Location: Unit #2 (Outlet)
Test No./Type: 430-1
Start/Stop Time: 11:55

PARAMETER	SYMBOL	VALUE (calc.)
Gas Meter Correction Factor	(gamma)	0.9960
Barometric Pressure (in Hg)	P(b)	29.92
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(120.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	216.00
Width (if rectangular)	W	64.00
Area of Stack (sq ft)	A(s)	(96.00)
		cubic ft LITERS
Gas Meter Initial Reading (cu ft)		2.16 61.28
Gas Meter Final Reading (cu ft)		6.71 190.05
Net Gas Sample Volume (cu ft)	V(m)	(4.55)
Vol of Liquid Collected (ml)	Vl(c)	9.6
Vol of Liq @ Std. Conds. (scf)	V(w std)	(0.452)

FIELD DATA AVERAGES

Avg Orifice Meter Reading (in H20)	dH(avg) =	1.000
Avg Stack Temperature (degF)	T(s avg)=	514.0
Average Meter Temperature (degF)	T(m avg)=	55.0

CALCULATED VALUES

Meter Volume (std. cu. ft.)	V(m std)=	4.65
Liters, std.		131.8
Stack Gas Water Vapor Proportion	B(wo) =	0.089

Sample Point	dClock Time	Orifice Meter,dH (in H20)	Stack Temp (degF)	Gas Meter Temp (degF) in	Gas Meter Temp (degF) out
S-1	15.0	1.000	514.0	55	55
2	15.0	1.000	514.0	55	55
3	15.0	1.000	514.0	55	55
4	15.0	1.000	514.0	55	55
5	15.0	1.000	514.0	55	55
6	15.0	1.000	514.0	55	55
7	15.0	1.000	514.0	55	55
8	15.0	1.000	514.0	55	55
9	15.0	1.000	514.0	55	55
N-1	15.0	1.000	514.0	55	55
2	15.0	1.000	514.0	55	55
3	15.0	1.000	514.0	55	55
4	15.0	1.000	514.0	55	55
5	15.0	1.000	514.0	55	55
6	15.0	1.000	514.0	55	55
7	15.0	1.000	514.0	55	55
8	15.0	1.000	514.0	55	55
9	15.0	1.000	514.0	55	55
TOTALS	270.0	18.0000	9252.0	990.0	990.0

METHOD 430 ALDEHYDES TRAIN

Plant: Nelson Dewey Station
Date : 11/3/92
Performed by: R. McKenzie

Sample Location: Unit #2 (Outlet)
Test No./Type: 430-2
Start/Stop Time: 11:54

PARAMETER	SYMBOL	VALUE (calc.)
Gas Meter Correction Factor	(gamma)	0.9960
Barometric Pressure (in Hg)	P(b)	29.92
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(120.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	216.00
Width (if rectangular)	W	64.00
Area of Stack (sq ft)	A(s)	(96.00)
		cubic ft LITERS
Gas Meter Initial Reading (cu ft)		10.25 290.36
Gas Meter Final Reading (cu ft)		14.77 418.19
Net Gas Sample Volume (cu ft)	V(m)	(4.51)
Vol of Liquid Collected (ml)	Vl(c)	9.1
Vol of Liq @ Std. Conds. (scf)	V(w std)	(0.428)

FIELD DATA AVERAGES

Avg Orifice Meter Reading (in H20)	dH(avg) =	1.000
Avg Stack Temperature (degF)	T(s avg)=	488.0
Average Meter Temperature (degF)	T(m avg)=	55.0

CALCULATED VALUES

Meter Volume (std. cu. ft.)	V(m std)=	4.62
Liters, std.		130.8
Stack Gas Water Vapor Proportion	B(wo) =	0.085

Sample Point	dClock Time	Orifice Meter,dH (in H20)	Stack Temp (degF)	Gas Temp in	Meter (degF) out
S-1	15.0	1.000	488.0	55	55
2	15.0	1.000	488.0	55	55
3	15.0	1.000	488.0	55	55
4	15.0	1.000	488.0	55	55
5	15.0	1.000	488.0	55	55
6	15.0	1.000	488.0	55	55
7	15.0	1.000	488.0	55	55
8	15.0	1.000	488.0	55	55
9	15.0	1.000	488.0	55	55
N-1	15.0	1.000	488.0	55	55
2	15.0	1.000	488.0	55	55
3	15.0	1.000	488.0	55	55
4	15.0	1.000	488.0	55	55
5	15.0	1.000	488.0	55	55
6	15.0	1.000	488.0	55	55
7	15.0	1.000	488.0	55	55
8	15.0	1.000	488.0	55	55
9	15.0	1.000	488.0	55	55
TOTALS	270.0	18.0000	8784.0	990.0	990.0

METHOD 430 ALDEHYDES TRAIN

Plant: Nelson Dewey Station
Date : 11/4/92
Performed by: R. McKenzie

Sample Location: Unit #2 (Outlet)
Test No./Type: 430-3
Start/Stop Time: 9:56

PARAMETER	SYMBOL	VALUE (calc.)
Gas Meter Correction Factor	(gamma)	0.9960
Barometric Pressure (in Hg)	P(b)	29.92
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(120.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	216.00
Width (if rectangular)	W	64.00
Area of Stack (sq ft)	A(s)	(96.00)
		cubic ft LITERS
Gas Meter Initial Reading (cu ft)		15.95 451.74
Gas Meter Final Reading (cu ft)		20.55 581.84
Net Gas Sample Volume (cu ft)	V(m)	(4.59)
Vol of Liquid Collected (ml)	Vl(c)	10.0
Vol of Liq @ Std. Conds. (scf)	V(w std)	(0.471)

FIELD DATA AVERAGES

Avg Orifice Meter Reading (in H2O)	dH(avg) =	1.000
Avg Stack Temperature (degF)	T(s avg)=	491.0
Average Meter Temperature (degF)	T(m avg)=	52.0

CALCULATED VALUES

Meter Volume (std. cu. ft.)	V(m std)=	4.73
Liters, std.		133.9
Stack Gas Water Vapor Proportion	B(wo) =	0.091

Sample Point	dClock Time	Orifice Meter,dH (in H2O)	Stack Temp (degF)	Gas Temp in	Meter (degF) out
S-1	15.0	1.000	491.0	52	52
2	15.0	1.000	491.0	52	52
3	15.0	1.000	491.0	52	52
4	15.0	1.000	491.0	52	52
5	15.0	1.000	491.0	52	52
6	15.0	1.000	491.0	52	52
7	15.0	1.000	491.0	52	52
8	15.0	1.000	491.0	52	52
9	15.0	1.000	491.0	52	52
N-1	15.0	1.000	491.0	52	52
2	15.0	1.000	491.0	52	52
3	15.0	1.000	491.0	52	52
4	15.0	1.000	491.0	52	52
5	15.0	1.000	491.0	52	52
6	15.0	1.000	491.0	52	52
7	15.0	1.000	491.0	52	52
8	15.0	1.000	491.0	52	52
9	15.0	1.000	491.0	52	52
TOTALS	270.0	18.0000	8838.0	936.0	936.0

METHOD 430 ALDEHYDES TRAIN

Plant: Nelson Dewey Station
Date : 11/4/92
Performed by: R. McKenzie

Sample Location: Unit #2 (Outlet)
Test No./Type: 430-4
Start/Stop Time: 16:21

PARAMETER	SYMBOL	VALUE (calc.)
Gas Meter Correction Factor	(gamma)	0.9960
Barometric Pressure (in Hg)	P(b)	29.92
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(120.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	216.00
Width (if rectangular)	W	64.00
Area of Stack (sq ft)	A(s)	(96.00)
		cubic ft LITERS
Gas Meter Initial Reading (cu ft)		22.72 643.44
Gas Meter Final Reading (cu ft)		27.31 773.33
Net Gas Sample Volume (cu ft)	V(m)	(4.59)
Vol of Liquid Collected (ml)	Vl(c)	10.2
Vol of Liq @ Std. Conds. (scf)	V(w std)	(0.480)

FIELD DATA AVERAGES

Avg Orifice Meter Reading (in H20)	dH(avg) =	1.000
Avg Stack Temperature (degF)	T(s avg)=	505.0
Average Meter Temperature (degF)	T(m avg)=	50.0

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	4.74
Liters, std.		134.2
Stack Gas Water Vapor Proportion	B(wo) =	0.092

Sample Point	dClock Time	Orifice Meter,dH (in H20)	Stack Temp (degF)	Gas Meter Temp (degF) in	Gas Meter Temp (degF) out
N-1	15.0	1.000	505.0	50	50
2	15.0	1.000	505.0	50	50
3	15.0	1.000	505.0	50	50
4	15.0	1.000	505.0	50	50
5	15.0	1.000	505.0	50	50
6	15.0	1.000	505.0	50	50
7	15.0	1.000	505.0	50	50
8	15.0	1.000	505.0	50	50
9	15.0	1.000	505.0	50	50
S-1	15.0	1.000	505.0	50	50
2	15.0	1.000	505.0	50	50
3	15.0	1.000	505.0	50	50
4	15.0	1.000	505.0	50	50
5	15.0	1.000	505.0	50	50
6	15.0	1.000	505.0	50	50
7	15.0	1.000	505.0	50	50
8	15.0	1.000	505.0	50	50
9	15.0	1.000	505.0	50	50
TOTALS	270.0	18.0000	9090.0	900.0	900.0

METHOD 430 ALDEHYDES TRAIN

Plant: Nelson Dewey Station
Date : 11/5/92
Performed by: R. McKenzie

Sample Location: Unit #2 (Outlet)
Test No./Type: 430-5
Start/Stop Time: 10:04

PARAMETER	SYMBOL	VALUE (calc.)
Gas Meter Correction Factor	(gamma)	0.9960
Barometric Pressure (in Hg)	P(b)	29.92
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(120.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	216.00
Width (if rectangular)	W	64.00
Area of Stack (sq ft)	A(s)	(96.00)
		cubic ft LITERS
Gas Meter Initial Reading (cu ft)		29.62 838.70
Gas Meter Final Reading (cu ft)		34.18 967.96
Net Gas Sample Volume (cu ft)	V(m)	(4.56)
Vol of Liquid Collected (ml)	Vl(c)	10.2
Vol of Liq @ Std. Conds. (scf)	V(w std)	(0.480)

FIELD DATA AVERAGES

Avg Orifice Meter Reading (in H20)	dH(avg) =	1.000
Avg Stack Temperature (degF)	T(s avg)=	488.0
Average Meter Temperature (degF)	T(m avg)=	52.0

CALCULATED VALUES

Meter Volume (std, cu. ft.)	V(m std)=	4.70
Liters, std.		133.0
Stack Gas Water Vapor Proportion	B(wo) =	0.093

Sample Point	dClock Time	Orifice Meter,dH (in H20)	Stack Temp (degF)	Gas Temp in	Meter (degF) out
S-1	15.0	1.000	488.0	52	52
2	15.0	1.000	488.0	52	52
3	15.0	1.000	488.0	52	52
4	15.0	1.000	488.0	52	52
5	15.0	1.000	488.0	52	52
6	15.0	1.000	488.0	52	52
7	15.0	1.000	488.0	52	52
8	15.0	1.000	488.0	52	52
9	15.0	1.000	488.0	52	52
N-1	15.0	1.000	488.0	52	52
2	15.0	1.000	488.0	52	52
3	15.0	1.000	488.0	52	52
4	15.0	1.000	488.0	52	52
5	15.0	1.000	488.0	52	52
6	15.0	1.000	488.0	52	52
7	15.0	1.000	488.0	52	52
8	15.0	1.000	488.0	52	52
9	15.0	1.000	488.0	52	52
TOTALS	270.0	18.0000	8784.0	936.0	936.0

METHOD 430 ALDEHYDES TRAIN

Plant: Nelson Dewey Station
Date : 11/6/92
Performed by: R. McKenzie

Sample Location: Unit #2 (Outlet)
Test No./Type: 430-6
Start/Stop Time: 8:44

PARAMETER	SYMBOL	VALUE (calc.)
Gas Meter Correction Factor	(gamma)	0.9960
Barometric Pressure (in Hg)	P(b)	29.92
# of Sample Points	#	18
Total Sampling Time (min)	(theta)	(120.00)
Stack (Duct) Dimensions (in):		
Radius (if round)	R	0.00
Length (if rectangular)	L	216.00
Width (if rectangular)	W	64.00
Area of Stack (sq ft)	A(s)	(96.00)
		cubic ft LITERS
Gas Meter Initial Reading (cu ft)		34.80 985.30
Gas Meter Final Reading (cu ft)		39.39 1115.46
Net Gas Sample Volume (cu ft)	V(m)	(4.60)
Vol of Liquid Collected (ml)	Vl(c)	10.8
Vol of Liq @ Std. Conds. (scf)	V(w std)	(0.508)

FIELD DATA AVERAGES

Avg Orifice Meter Reading (in H20)	dH(avg) =	1.000
Avg Stack Temperature (degF)	T(s avg)=	497.0
Average Meter Temperature (degF)	T(m avg)=	52.0

CALCULATED VALUES

Meter Volume (std. cu. ft.)	V(m std)=	4.73
Liters, std.		134.0
Stack Gas Water Vapor Proportion	B(wo) =	0.097

Sample Point	dClock Time	Orifice Meter,dH (in H20)	Stack Temp (degF)	Gas Temp in	Meter (degF) out
N-1	15.0	1.000	497.0	52	52
2	15.0	1.000	497.0	52	52
3	15.0	1.000	497.0	52	52
4	15.0	1.000	497.0	52	52
5	15.0	1.000	497.0	52	52
6	15.0	1.000	497.0	52	52
7	15.0	1.000	497.0	52	52
8	15.0	1.000	497.0	52	52
9	15.0	1.000	497.0	52	52
S-1	15.0	1.000	497.0	52	52
2	15.0	1.000	497.0	52	52
3	15.0	1.000	497.0	52	52
4	15.0	1.000	497.0	52	52
5	15.0	1.000	497.0	52	52
6	15.0	1.000	497.0	52	52
7	15.0	1.000	497.0	52	52
8	15.0	1.000	497.0	52	52
9	15.0	1.000	497.0	52	52
TOTALS	270.0	18.0000	8946.0	936.0	936.0

APPENDIX NO. 21

Material Condition Assessment of Furnace Tube Test Samples for Wisconsin Power & Light Company RB-369

Babcock & Wilcox
a McDermott company

Alliance Research Center

Material Condition Assessment of Furnace Tube Test Samples From WISCONSIN POWER & LIGHT COMPANY RB-369

PREPARED FOR
WISCONSIN POWER & LIGHT COMPANY
NELSON DEWEY STATION UNIT No.2
CASSVILLE, WISCONSIN
RB-369

PREPARED BY
THE BABCOCK & WILCOX COMPANY
RESEARCH AND DEVELOPMENT DIVISION
1562 BEESON STREET
ALLIANCE,OHIO 44601
(216) 821-9110

PRINCIPAL INVESTIGATOR
A.S. MILLER

RDD:93:45760-29-01:02

MARCH 1993

SUMMARY

The metallurgical examination of two furnace tube test samples from Wisconsin Power & Light Company's Nelson Dewey Station, Unit #2 (B&W Contract Number RB-369) was completed. The objective was to assess the material condition of the two furnace tube test samples. Highlights of the metallurgical findings are as follows:

Description of Tube Samples

Sample Number	Type of Tube	Specified Tube Material	Specified Tube Size (O.D. x MW)
1	Furnace	SA213-TP304L/ SA210Al	3.0" x 0.420"
2	Furnace	SA210Al	3.0" x 0.420"

Sample #1 is a bimetallic tube consisting of an outer layer of SA213-TP304L stainless steel and inner core layer of SA210Al carbon steel.

Location of Tube Samples in Boiler

Sample #1: Furnace Tube #68 when facing rear wall and counting left to right, tube located at centerline of rear wall and at elevation 670 feet.

Sample #2: Furnace Tube #67 when facing rear wall and counting left to right, tube location at centerline of rear wall and at elevation 670 feet.

Examination Results

- Samples #1 and #2 met the chemical composition requirements of their tube material specifications.

- No wall thinning was noted of tube samples examined. Samples #1 and #2 showed wall thickness greater than the specified minimum wall thickness of 0.420 inches.

- No pitting was noted at the internal surface of Samples #1 and #2. No general corrosion was noted on the external surface of Sample #1. Minor oxide penetrations (3 mils deep) were observed on the external surface of Sample #2. Oxide penetrations are associated with thermal fatigue.

- No evidence of microstructure degradation (overheating) was observed of Samples #1 and #2.

- Internal deposit analysis.

	Sample #1	**Sample #2**
X-ray Diffraction (Major/Others)	Fe_3O_4,Cu,Fe_2O_3/CuO	Fe_3O_4,Cu/Fe_2O_3,CuO
Spectrographic (Contaminants $\geq$1.0%)	Copper, Zinc	Copper, Zinc, Calcium
Deposit Weight g/ft^2 Furnace Side/Opposite Furnace Side	38.1/25.4	24.9/12.6

INTRODUCTION

Two furnace tube test samples from Wisconsin Power & Light Company's Nelson Dewey Station, Unit #2 were examined by the Metallurgy Department of the Babcock & Wilcox Alliance (Ohio) Research Center. The objective was to assess the material condition of the two service-exposed tube samples. A section side view of Unit #2 is presented in Sketch A.

UNIT INFORMATION

CUSTOMER:	Wisconsin Power & Light Company
B&W CONTRACT NUMBER:	RB-369
STATION AND UNIT NUMBER:	Nelson Dewey Station, Unit #2
LOCATION:	Cassville, Wisconsin

DESIGN CONDITIONS:

- Fuel ..... Cyclone Coal
- Main Steam Flow ..... 770M lb/hr
- Design Pressure ..... 1700 psig
- SH Outlet Pressure ..... 1500 psig
- Steam Temperature (SH/RH) ..... 1005°F/1005°F

Nominal Capability: 100 MWe

Start-up Date: 1962

DESCRIPTION AND LOCATION OF TUBE SAMPLES

- Description of Tube Samples

Sample Number	Type of Tube	Specified Tube Material	Specified Tube Size (O.D. x MW)
1	Furnace	SA213-TP304L/SA210Al	3.0" x 0.420"
2	Furnace	SA210Al	3.0" x 0.420"

Sample #1 is a bimetallic tube consisting of an outer layer of SA213-TP304L stainless steel and inner core layer of SA210Al carbon steel.

- Location of Tube Samples in Boiler

Sample #1: Furnace Tube #68 when facing rear wall and counting left to right, tube located at centerline of rear wall and at elevation 670 feet.

Sample #2: Furnace Tube #67 when facing rear wall and counting left to right, tube location at centerline of rear wall and at elevation 670 feet.

- Other Information

Samples #1 and #2 were made with a heavier tube wall for the purpose of increasing the tube temperature by 100°F above Unit #2 operating temperature (1500 psig boiler). This is to simulate a high temperature tube boiler (3000 psig boiler).

DESCRIPTION OF WORK

Tube samples were subjected to the following examination:

1. Photographs were taken of the as-received tube samples.

2. Visual examination.

3. Dimensional measurements (O.D. and wall thickness) of a grit blasted full ring section.

4. Chemistry of tube material by Direct Reading Emission Spectrographic Analysis.

5. Optical Emission Spectrographic Analysis, X-ray Diffraction Analysis and weight determination of internal deposits.

6. Optical metallography.

7. Hardness measurements at the mid-wall of the tube thickness.

PROCEDURES

Before the tubes were sectioned for the analysis, a line was drawn the length of each tube for reference purposes. The line was referred to as the 12 o'clock position. In this manner, one could go to a desired part of the tube circumference merely by knowing its "clock" position. The 12 o'clock position was the furnace side of the tube (hence, the 6 o'clock position was located opposite the furnace side of the tube).

Tube samples were prepared and dry saw cut into sections for analysis:

1. A section of each tube sample was split longitudinally into two halves. Samples of deposits were scraped from the internal surface (at the 12 and 6 o'clock positions) for the determination of deposit weight. Weight is expressed in grams per square foot (g/ft^2). Spectrographic and X-ray diffraction analyses were also performed on the internal deposits taken from the 12 o'clock position.

2. A full ring section was cut from each tube sample and grit blasted for outer diameter and wall thickness measurements. The transverse section of the full ring taken from Sample #1 (the bimetallic tube) was polished and etched for the purpose of measuring the outer layer and inner core layer thickness.

3. A full ring section was cut adjacent to the section described in Item 2, above. A ring segment was cut at the 12 and 6 o'clock position and prepared for metallographic examination. Segments were used to examine the tube microstructure and record hardness measurements (using Rockwell B scale) at the mid-wall of the tube wall thickness.

4. A small piece of each tube sample was used for chemical analysis to determine the tube material composition. A chemical analysis was performed on both the outer and inner layer of Sample #1.

RESULTS

Visual Examination

Photographs showing an overall view and close-up view of the external surface of the as-received tube samples are presented in Figures 1 and 2. Photographs illustrating the external and internal surfaces (in the as-received and grit blasted condition) of longitudinal split sections of tube samples are shown in Figures 3 through 6. Internal deposit weights are also shown on Figures 4 and 6. No pitting was observed at the internal surface of tube samples examined.

Chemical Composition of Tube Samples

Results of the spectrographic analysis of the outer and inner layer of bimetallic tube Sample #1 and tube Sample #2 are given in the following in percent by weight. Tube samples conformed to the chemical composition requirements of their material specifications.

Sample	Material	C	Mn	P	S	Si	Cr	Mo	Ni
#1 (Inner Layer)	SA210A1	.19	.61	.021	.003	.25	<.10	<.05	<.10
#1 (Outer Layer)	SA213-TP304L	.023	1.46	.023	.002	.37	18.30	0.10	10.68
#2	SA210A1	.21	.72	.008	.002	.23	<.10	<.05	<.10
Spec. for SA210A1		.27 max.	.93 max.	.048 max.	.058 max.	.10 min.	--	--	--
Spec. for SA213-TP304L		.035 max.	2.0 max.	.040 max.	.030 max.	.75 max.	18.0-20.0	--	8.0-13.0

Internal Deposit Analysis of Tube Samples

Results of the internal deposit analysis are presented in Tables 1 and 2 and summarized as follows:

Sample #1 (Table 1)

- Internal Deposit Weight
  - Furnace Side ..... 38.1 g/ft^2
  - Opposite Furnace Side ..... 25.4 g/ft^2

- X-ray Diffraction (Crystalline Constituents)
  - Major ..... Fe_3O_4, Cu, Fe_2O_3
  - Trace ..... CuO

- Contaminants ($\geq$ 1.0%): Copper and Zinc

Sample #2 (Table 2)

- Internal Deposit Weight
  - Furnace Side ..... 24.9 g/ft^2
  - Opposite Furnace Side ..... 12.6 g/ft^2

- X-ray Diffraction (Crystalline Constituents)
  - Major ..... Fe_3O_4, Cu
  - Medium ..... Fe_2O_3
  - Minor ..... CuO

- Contaminants ($\geq$ 1.0%): Copper, Zinc and Calcium

Dimensional Measurements

Measurements of the outer diameter and tube wall thickness around the circumference of grit blasted full rings were recorded of Samples #1 and #2. The thickness of the outer layer and inner core layer of bimetallic tube Sample #1 were also recorded. Measurements recorded of Samples #1 and #2 are presented in Figures 7 and 8, respectively. No wall thinning was noted of Samples #1 and #2, based on the specified minimum wall thickness of 0.420 inches.

Optical Metallography

Mid-wall microstructures and internal deposits of Samples #1 and #2 are shown in Figures 9 and 10, respectively. Descriptions of mid-wall microstructures are as follows:

Sample	Material	Microstructural Constituents
#1	SA210Al	Ferrite and Pearlite
#2	SA210Al	Ferrite and Pearlite

No evidence of degradation of the pearlite that would indicate overheating was observed in the microstructure of Samples #1 and #2.

Examples of deposit-scale morphology formed on the external surface of tube samples examined are presented in Figure 11. Minor scale/deposits were observed on the external surface of Samples #1 and #2. The external surface of Sample #2 exhibited minor oxide penetrations. Maximum depth of penetrations was 3 mils (0.003 inches).

Mid-Wall Hardness Measurements

Results of the mid-wall hardness measurements are given in the following Rockwell hardness numbers using B scale. Hardness numbers are also given on Figures 9 and 10. Hardness measurements were also recorded of the outer layer (SA213-TP304L stainless steel) of the bimetallic tube Sample #1. Results are presented below:

		Rockwell Hardness - HRB (Average 3 Readings)	
Sample	**Material**	**Furnace Side**	**Opposite Furnace Side**
#1	SA210Al	73	74
#2	SA210Al	75	76
#1	SA213-TP304L	88	86

Specification for SA210Al . . . . . Hardness not to Exceed HRB-79
Specification for SA213-TP304L . . . . . Hardness not to Exceed HRB-90

Tube samples exhibited hardness numbers within specification limits with no significant differences between the furnace side and opposite furnace side. Hardness numbers should not be accepted or rejected based on specification limits. The specification limits apply only to as-produced tubes.

CONCLUSIONS

The metallurgical examination has led to the following conclusions regarding the two furnace tube test samples:

1. Through chemistry comparison, tube Samples #1 and #2 met the chemical composition requirements of their tube material specifications.

2. Based on specified minimum wall thickness, no wall thinning was noted of Samples #1 and #2.

3. Heavy deposits were observed at the internal surface of Samples #1 and #2. High levels of copper and nickel were detected in the internal deposits of both tube samples. The presence of copper and nickel in the deposits are most likely the result of corrosion of pre-boiler/condenser materials.

4. No pitting damage was noted at the internal surface of Samples #1 and #2. No evidence of corrosion damage was noted on the external surface of Sample #1 while minor oxide penetrations were observed on the external surface of Sample #2. Oxide penetrations observed are usually associated with thermal fatigue.

5. No evidence of overheating was observed in the microstructure of Samples #1 and #2.

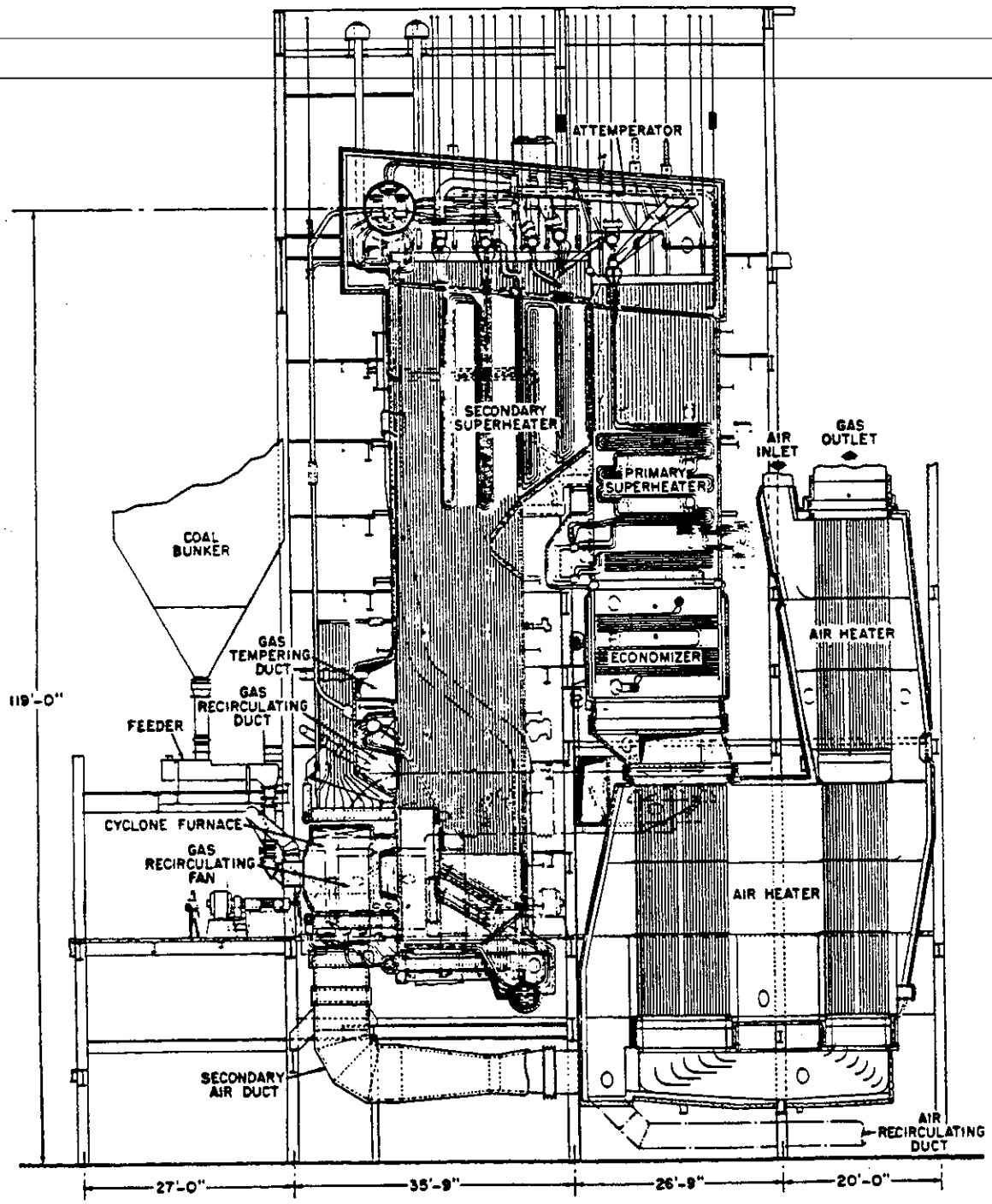
Submitted by: A. S. Miller
Senior Research Engineer

Approved by: L. W. Sarver
Group Supervisor

bg
Attach.

WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2 RB-369



K RB-369

CY-RB-369-500

SKETCH A SECTION SIDE VIEW OF UNIT No.2

WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2

RB-369

TABLE 1 INTERNAL DEPOSIT ANALYSIS

SAMPLE #1
FURNACE TUBE (Bimetallic Tube)

	Sample #1, Hot Side	Sample #1, Cold Side
Deposit Weight, g/ft^2	38.1	25.4
Spectrographic Semi-Quantitative Analysis (%)*		
Silicon as SiO_2	<0.06	N
Aluminum as Al_2O_3	0.4	O
Iron as Fe_2O_3	>25.0	T
Titanium as TiO_2	0.2	
Calcium as CaO	0.8	A
Magnesium as MgO	0.2	N
Sodium as Na_2O	Zinc Interference	A
Nickel as NiO	0.6	L
Chromium as Cr_2O_3	0.4	Y
Molybdenum as MoO_3	<0.06	Z
Vanadium as V_2O_5	<0.1	E
Cobalt as CoO	0.06	D
Manganese as MnO_2	0.5	
Copper as CuO	>25.0	
Zinc as ZnO	6.4	
Lead as PbO	0.2	
Tin as SnO_2	0.2	
Zirconium as ZrO_2	<0.06	
X-ray Diffraction (Crystalline Constituents)		
Major	Fe_3O_4, Cu, Fe_2O_3	
Trace	CuO	

* The results of spectrographic analysis are reported by the Research Center as the oxides. This does not necessarily mean that the elements are present as such in the sample.

WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2

RB-369

TABLE 2 INTERNAL DEPOSIT ANALYSIS

Description:	SAMPLE #2 Furnace Tube, Sample #2, Hot Side	Furnace Tube, Sample #2, Cold Side
Deposit Weight, g/ft^2	24.9	12.6
Spectrographic Semi-Quantitative Analysis (%)*		
Silicon as SiO_2	<0.06	N
Aluminum as Al_2O_3	0.8	O
Iron as Fe_2O_3	>25.0	T
Titanium as TiO_2	0.2	
Calcium as CaO	1.0	A
Magnesium as MgO	0.7	N
Sodium as Na_2O	Zinc Interference	A
Nickel as NiO	0.5	L
Chromium as Cr_2O_3	0.5	Y
Molybdenum as MoO_3	<0.06	Z
Vanadium as V_2O_5	<0.1	E
Cobalt as CoO	0.06	D
Manganese as MnO_2	0.7	
Copper as CuO	>25.0	
Zinc as ZnO	>25.0	
Lead as PbO	0.2	
Tin as SnO_2	0.2	
Zirconium as ZrO_2	<0.06	
X-ray Diffraction (Crystalline Constituents)		
Major	Fe_3O_4**, Cu	
Medium	Fe_2O_3	
Minor	CuO	

* The results of spectrographic analysis are reported by the Research Center as the oxides. This does not necessarily mean that the elements are present as such in the sample.

** An Fe_3O_4 spinel structure containing zinc oxide.

WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2 RB-369

SAMPLE #1
FURNACE TUBE
(BIMETALLIC TUBE)

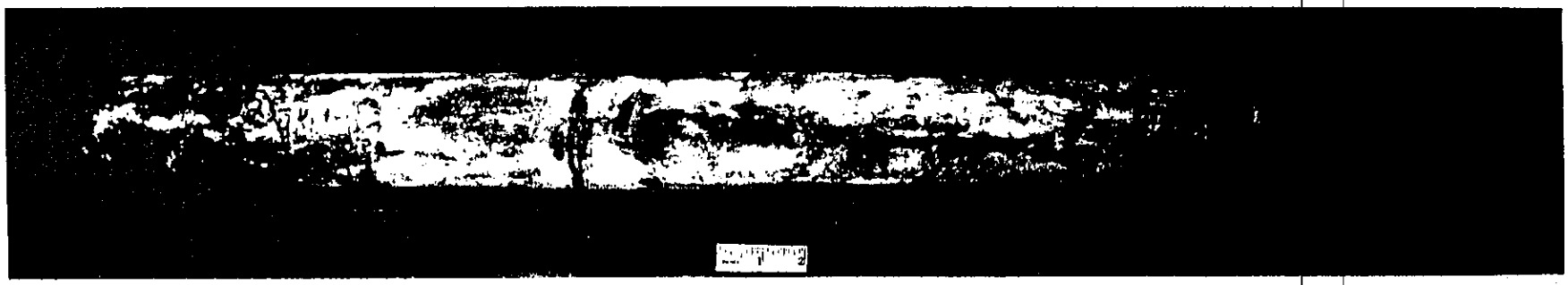
LOCATION OF TUBE SAMPLE IN BOILER: Tube #68 When Facing Rear Wall and Counting Left to Right, Tube Located at Centerline of Rear Wall and at Elevation 670 feet

FIGURE 1 AS RECEIVED FURNACE TUBE SAMPLE

RDD:93:45760-29-01:02

WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2 RB-369



SAMPLE #2
FURNACE TUBE

LOCATION OF TUBE SAMPLE IN BOILER: Tube #67 When Facing Rear Wall and Counting Left to Right, Tube Located at Centerline of Rear Wall and at Elevation 670 feet

FIGURE 2 AS RECEIVED FURNACE TUBE SAMPLE

RDD:93:45760-29-01:02

WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2 RB-369

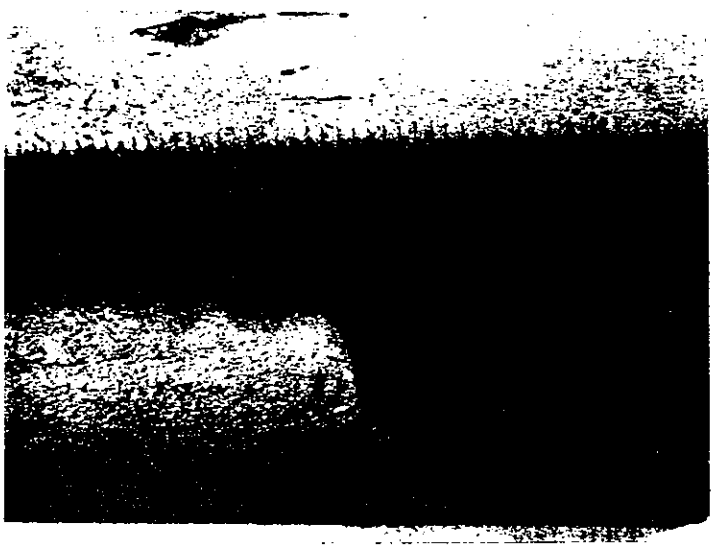
SAMPLE #1

FURNACE TUBE (BIMETALLIC TUBE)

EXTERNAL SURFACE OF TUBE SAMPLE

FURNACE SIDE

AS-RECEIVED CONDITION



GRIT BLASTED CONDITION

OPPOSITE FURNACE SIDE

AS-RECEIVED CONDITION

GRIT BLASTED CONDITION

FIGURE 3 LONGITUDINAL HALF-SECTION ILLUSTRATING EXTERNAL SURFACE OF TUBE SAMPLE

WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2 RB-369

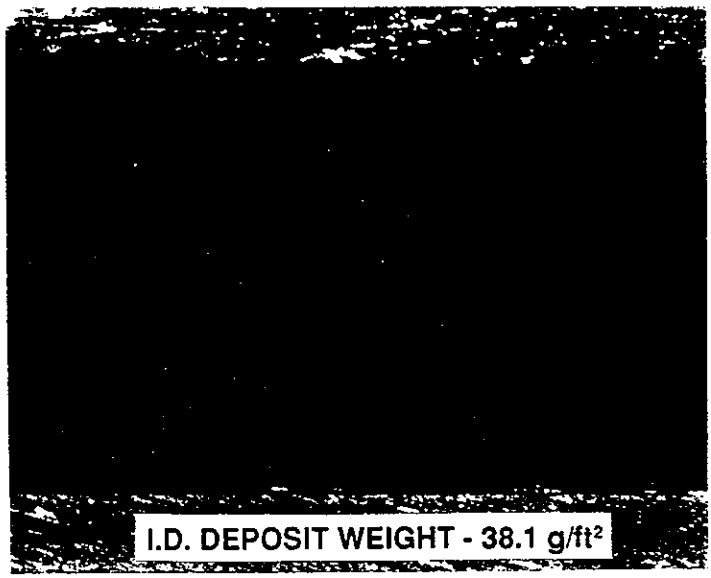
SAMPLE #1

FURNACE TUBE (BIMETALLIC TUBE)

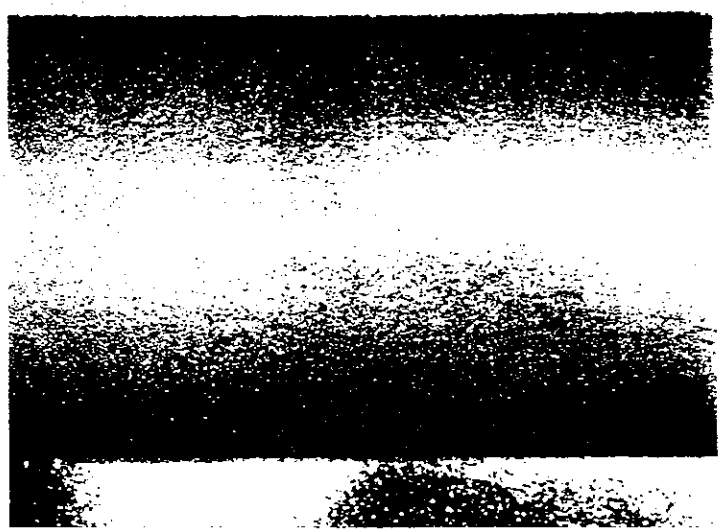
INTERNAL SURFACE OF TUBE SAMPLE

FURNACE SIDE

AS-RECEIVED CONDITION

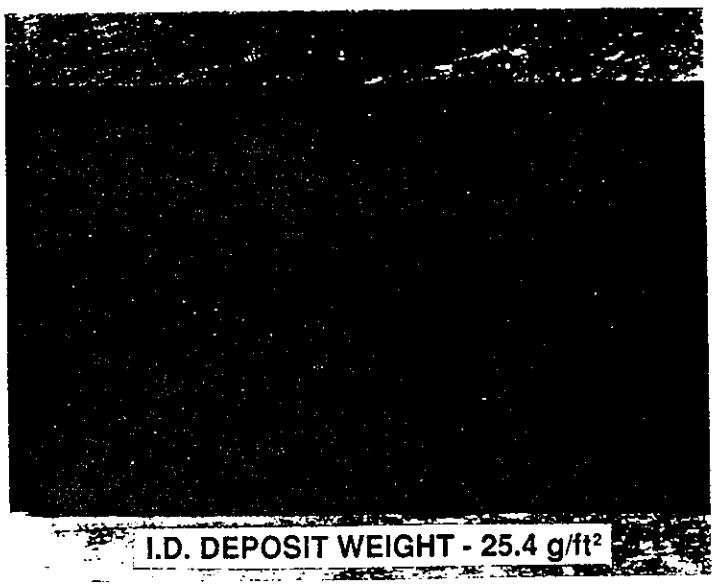


GRIT BLASTED CONDITION



OPPOSITE FURNACE SIDE

AS-RECEIVED CONDITION



GRIT BLASTED CONDITION

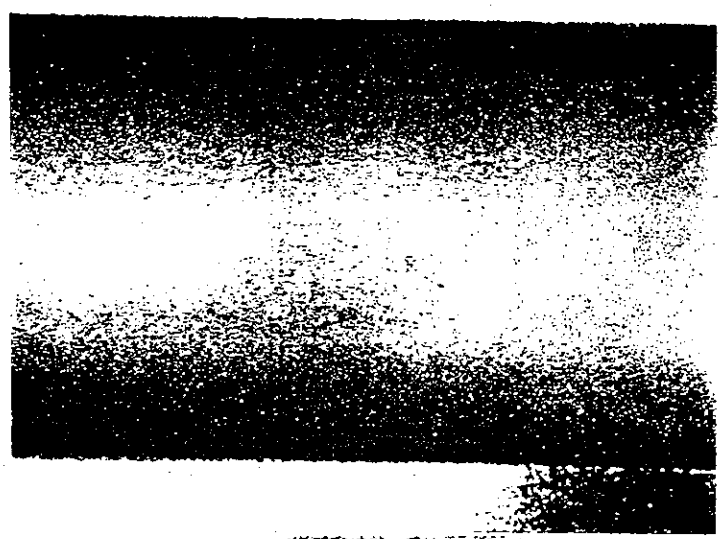


FIGURE 4 LONGITUDINAL HALF-SECTION ILLUSTRATING INTERNAL SURFACE OF TUBE SAMPLE

WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2 RB-369

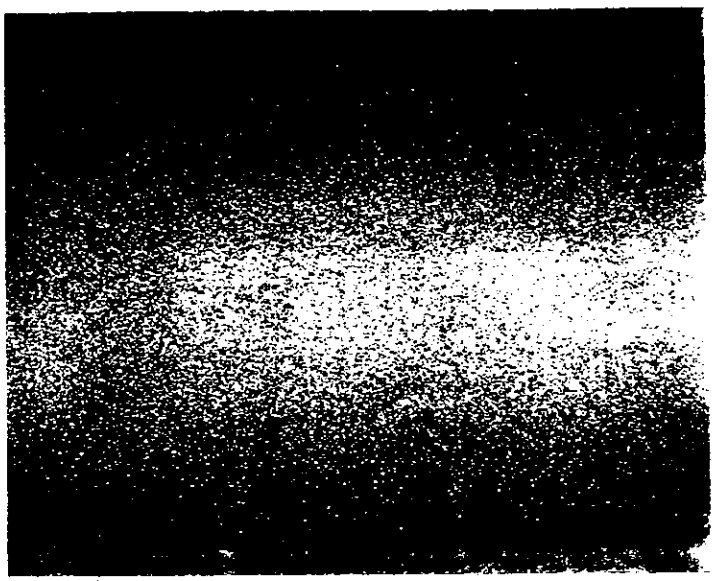
SAMPLE #2
FURNACE TUBE

EXTERNAL SURFACE OF TUBE SAMPLE

FURNACE SIDE

AS-RECEIVED CONDITION

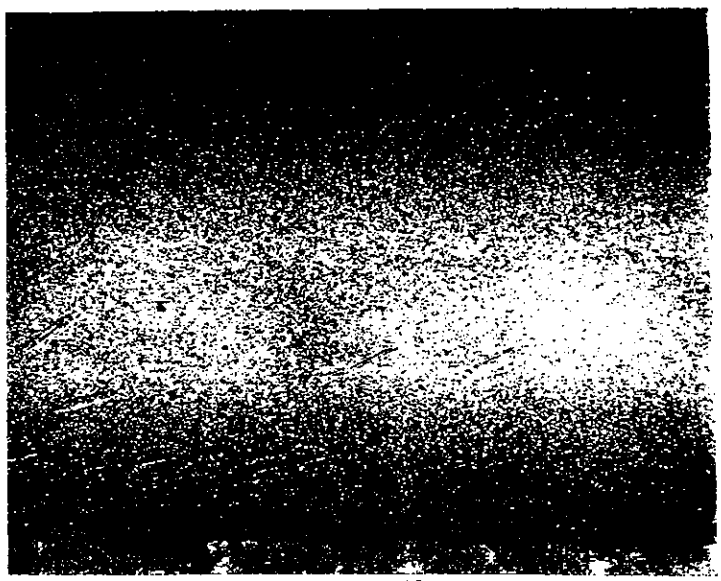
GRIT BLASTED CONDITION



OPPOSITE FURNACE SIDE

AS-RECEIVED CONDITION

GRIT BLASTED CONDITION



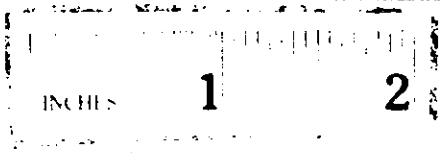


FIGURE 5 LONGITUDINAL HALF-SECTION ILLUSTRATING EXTERNAL SURFACE OF TUBE SAMPLE

WISCONSIN POWER & LIGHT COMPANY

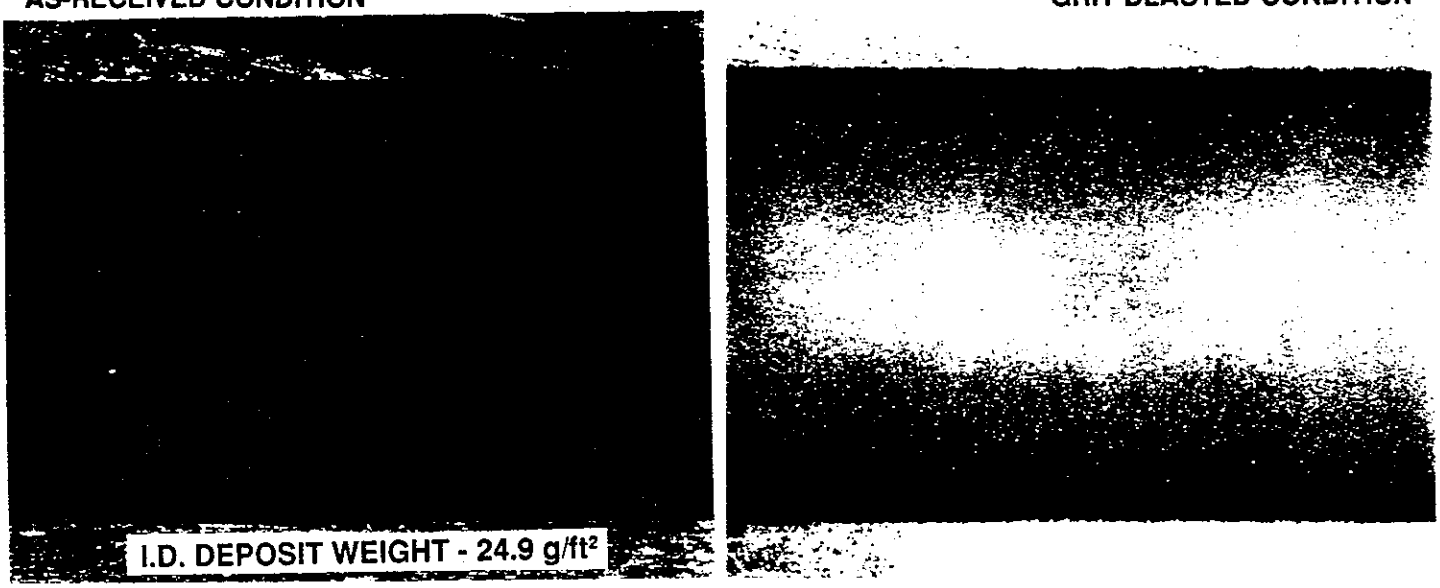
NELSON DEWEY STATION UNIT No.2 RB-369

SAMPLE #2
FURNACE TUBE

INTERNAL SURFACE OF TUBE SAMPLE

FURNACE SIDE

AS-RECEIVED CONDITION | **GRIT BLASTED CONDITION**



OPPOSITE FURNACE SIDE

AS-RECEIVED CONDITION | **GRIT BLASTED CONDITION**

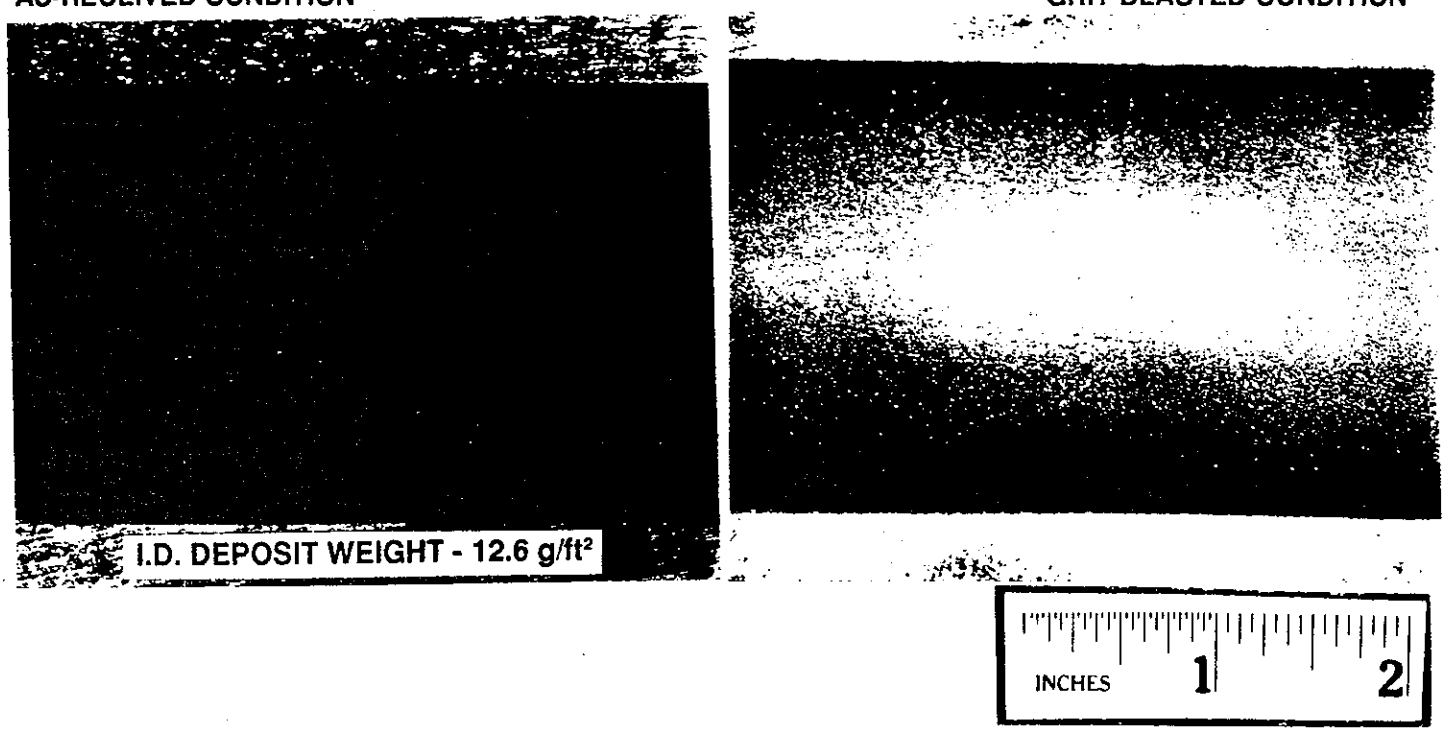
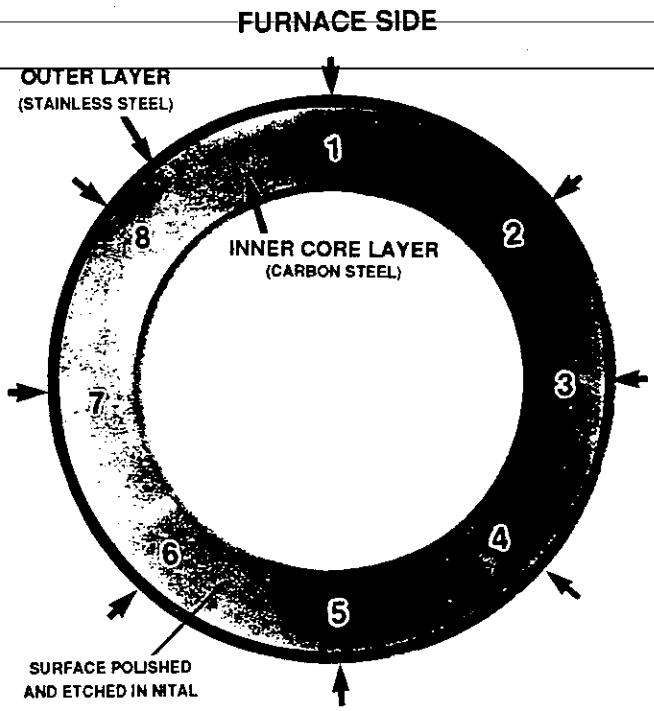


FIGURE 6 LONGITUDINAL HALF-SECTION ILLUSTRATING INTERNAL SURFACE OF TUBE SAMPLE

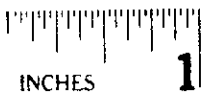
WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2 RB-369

O.D. & WALL THICKNESS MEASUREMENTS



SAMPLE #1
FURNACE TUBE (BIMETALLIC TUBE)
SPECIFIED TUBE SIZE: 3.0" O.D. x 0.420" MW



LOCATION NUMBER	OUTSIDE DIAMETER (inches)
1 - 5	3.003
2 - 6	3.003
7 - 3	3.002
8 - 4	3.003

LOCATION NUMBER	WALL THICKNESS (inches)		TOTAL WALL THICKNESS(inches)
	OUTER LAYER STAINLESS STEEL	INNER CORE LAYER CARBON STEEL	
1	0.063	0.394	0.457
2	0.063	0.391	0.454
3	0.065	0.390	0.455
4	0.064	0.396	0.460
5	0.062	0.404	0.466
6	0.064	0.404	0.468
7	0.064	0.403	0.467
8	0.066	0.396	0.462

FIGURE 7 GRIT BLASTED FULL RING SECTION

WISCONSIN POWER & LIGHT COMPANY

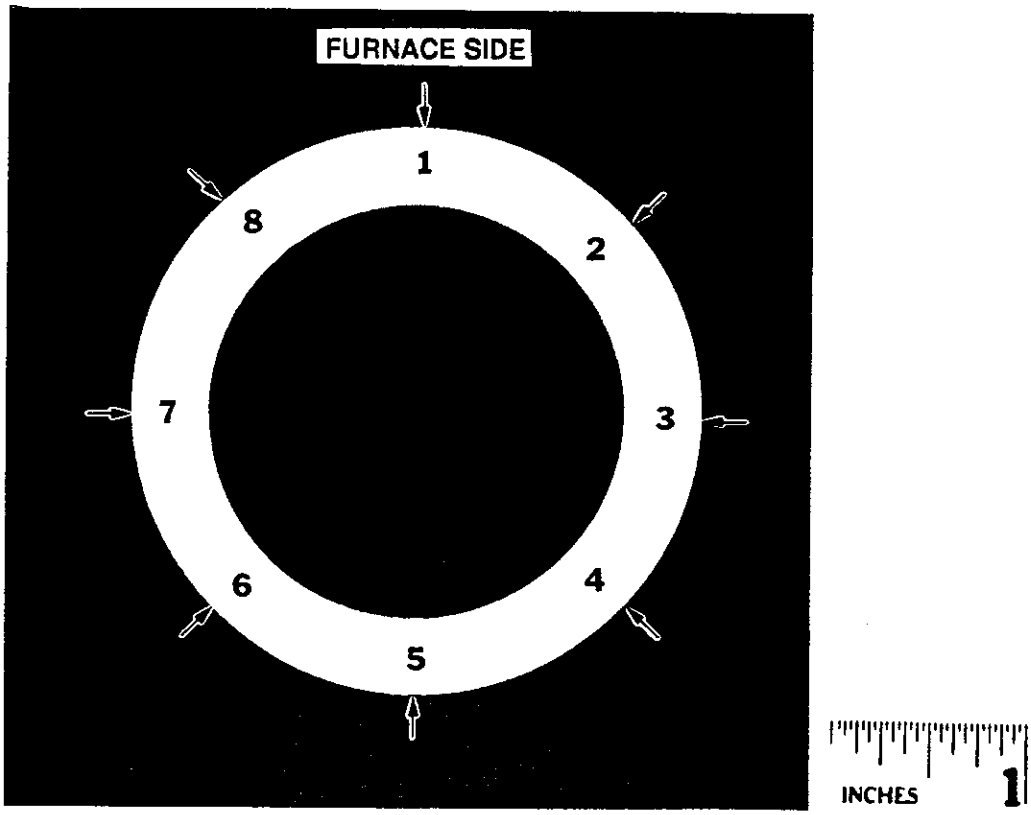
NELSON DEWEY STATION UNIT No.2 RB-369

O.D. & WALL THICKNESS MEASUREMENTS

SAMPLE #2

FURNACE TUBE

SPECIFIED TUBE SIZE: 3.0" O.D. x 0.420" MW



LOCATION NUMBER	OUTSIDE DIAMETER (inches)
1 - 5	3.001
2 - 6	3.000
7 - 3	3.000
8 - 4	3.001

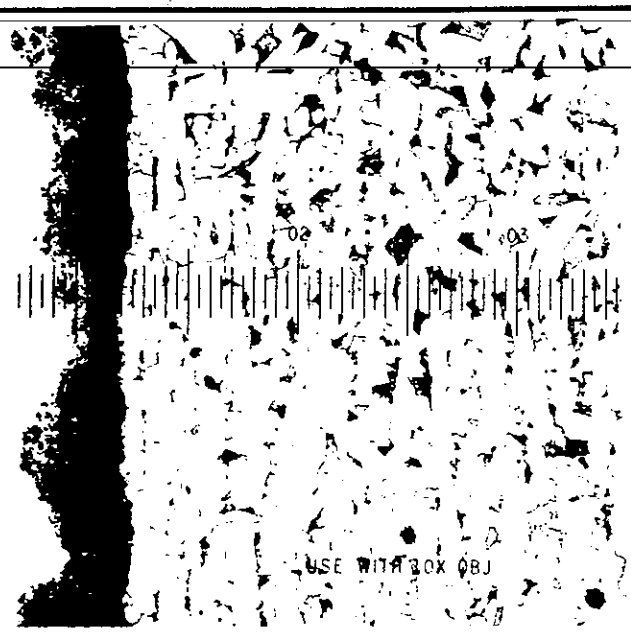
LOCATION NUMBER	WALL THICKNESS (inches)
1	0.439
2	0.440
3	0.442
4	0.443
5	0.444
6	0.443
7	0.442
8	0.440

FIGURE 8 GRIT BLASTED FULL RING SECTION

WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2

RB-369

	FURNACE SIDE (12 O' CLOCK POSITION)	OPPOSITE FURNACE SIDE (6 O' CLOCK POSITION)
INTERNAL SURFACE OF TUBE	VERNIER SCALE 1div. = 0.5 mils 100x	 VERNIER SCALE 1div. = 0.5 mils 100x
MID-WALL OF TUBE THICKNESS	HARDNESS R_B - 73 500x	HARDNESS R_B - 74 500x

SAMPLE #1

FURNACE TUBE

SA210A1

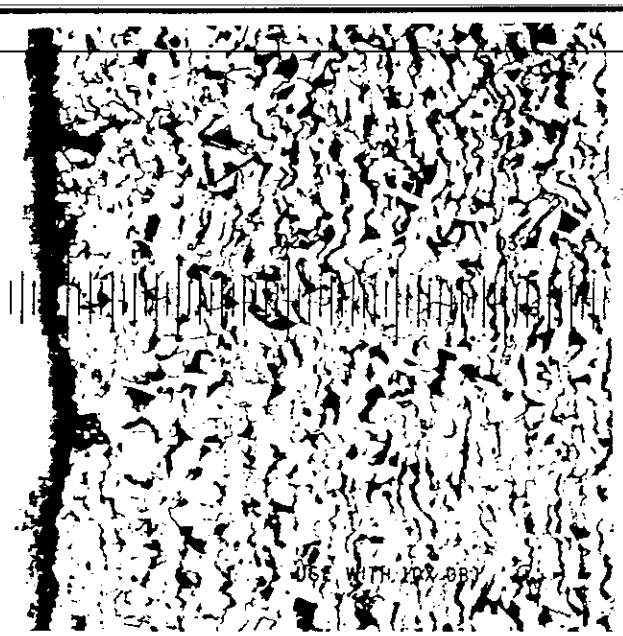
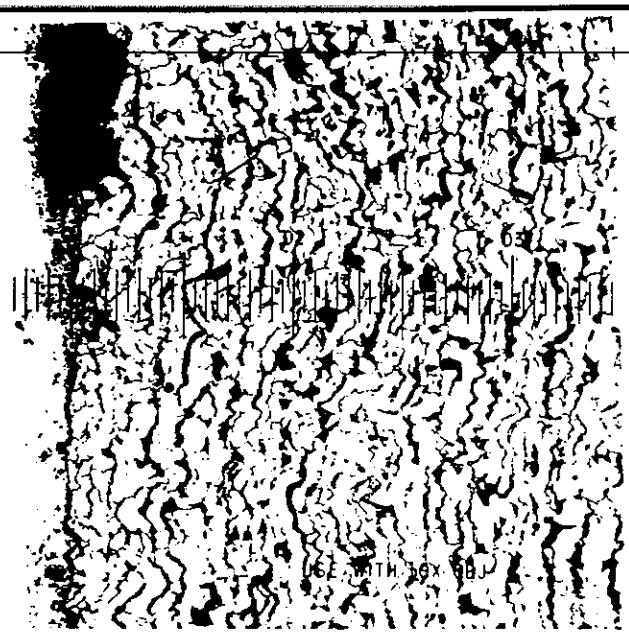
(BIMETALLIC TUBE)

FIGURE 9 TRANSVERSE SECTION OF TUBE SAMPLE

WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2

RB-369

	FURNACE SIDE (12 O' CLOCK POSITION)	OPPOSITE FURNACE SIDE (6 O' CLOCK POSITION)
INTERNAL SURFACE OF TUBE	 VERNIER SCALE 1div. = 0.5 mils 100x	 VERNIER SCALE 1div. = 0.5 mils 100x
MID-WALL OF TUBE THICKNESS	HARDNESS R_B - 75 500x	HARDNESS R_B - 76 500x

SAMPLE #2

FURNACE TUBE

SA210A1

FIGURE 10 TRANSVERSE SECTION OF TUBE SAMPLE

WISCONSIN POWER & LIGHT COMPANY

NELSON DEWEY STATION UNIT No.2 RB-369

EXTERNAL SURFACE OF TUBE SAMPLE

FURNACE SIDE

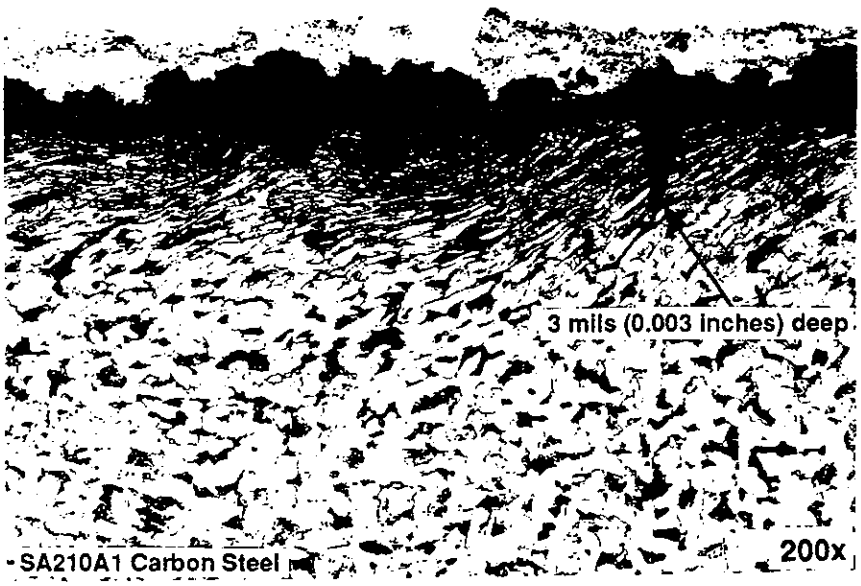
SAMPLE #1

FURNACE TUBE (BIMETALLIC TUBE)

TRANSVERSE CROSS SECTION OF TUBE SAMPLE

SAMPLE #2

FURNACE TUBE



TRANSVERSE CROSS SECTION OF TUBE SAMPLE

FIGURE 11 EXAMPLE OF DEPOSIT-SCALE MORPHOLOGY ON EXTERNAL SURFACE OF TUBE SAMPLE

APPENDIX NO. 22

Supplemental Economic Evaluation Information

Section 8.0 summarizes the economic evaluation for applying a coal reburning system to nominal 110 MW and 605 MW cyclone-equipped boilers. The following provides the worksheets used to generate the tables shown in Section 8.0. In addition, some background calculations are provided to clarify some of the assumptions.

Tables 8-1A and 8-2A show the spreadsheets used to create Tables 8-1 and 8-2 (which are presented in Section 8.0). The total capital costs are broken down into engineering and material, field labor, controls engineering/material/labor and miscellaneous (includes travel, living and freight).

The main operating costs that were identified include the extra power consumption needed to operate the reburn system and also the minimal increase in fuel consumption (since a decrease in boiler efficiency due to an increase in unburned carbon was observed). Table C in this appendix shows the power consumption variations between baseline and reburning operation at 110 MW and 82 MW loads. Since a 75% capacity factor is typical at WP&L, the corresponding power difference at 82 MW was used in this economic evaluation. Thus, 280 kWh additional power consumption at about $0.02 per kWh was used to calculate the added yearly costs due to reburning. The resultant operating cost due to the added power required at WP&L was therefore approximately $49,000/year. Since the 605 MW_e case would have 2 pulverizers operating, this figure was simply doubled for the hypothetical boiler case.

The additional fuel required on a yearly basis was calculated using the unburned carbon data collected at WP&L during the bituminous coal firing tests. The approximate impact on coal usage for the WP&L and hypothetical plant cases were 870 and 8980 tons of coal per year respectively. The cost of coal used to determine the economic impact from this factor was $35/ton for each of the cases.

TABLE 8-1A. WP&L NELSON DEWEY CYCLONE COAL REBURNING ECONOMIC ASSUMPTIONS

*** CALCULATION BASIS ***

A. CAPITAL INVESTMENT BASIS **********

1- Process Capital Cost Estimates
Major Activity Breakdown :

ENGINEERING/MATERIAL	------	3,859,122
FIELD LABOR	-------	2,080,000
CONTROLS ENGR./MAT./LABO	------	596,000
MISCELLANEOUS	------	161,400
Total Process Capital	------	6,696,522

2- General Facilities : 5 to 20 % of Process Capital

Enter GF factor between 5-20 % here :	0
General Facilities Cost ----------	$0

3- Engineering & Home Office Fees : 5 to 15 % of Process Capital

Enter E&H factor between 5-15 % here :	0
Engineering & Home Office Fees ----------	$0

4- Project Contingency based on Design Class shown below :

Class	Design	Factor range
1	Simplified	30 - 50
2	Preliminarly	15 - 30
3	Detailed	10 - 20
4	Finalized	5 - 10

Enter ProjCont factor from above here :	5
Project Contingency Cost ----------	$334,826

5- Process Contingency based on State of Technology shown below :

State of Technology	Factor range
Concept With Bench Scale Data	30 - 70%
Small Pilot Scale Plant Data	25 - 35%
Full Size Unit Operating	5 - 20%
Commercially Used	0 - 10%

Enter ProcCont factor from above here :	0
Process Contingency Cost ----------	$0

6- Sales Tax as percentage of Process Capital

Enter sales tax as percentage here :	6.50
Sales Tax Cost ----------	$122,876

TABLE 8-1A. (continued)

B. CAPACITY FACTOR **********

Type of Plant	Design Capacity Factor
Base	0.65
Intermediate	0.30
Peaking	0.10

Enter Capacity Factor (CF) here : 0.75

C. OPERATING COST BASIS **********

1. Operating & Maintenance Cost

(a) Operating Costs

Total Operating Costs	------	$79,412
Plant Capacity (MWe)	------	110
Annual Operating Costs	--------	$79,412

(b) Annual Maintenance Cost

Process Type	Maintenance (M) Factor
Corrosive & Abrasive Slurries	6.0 - 10.0
Severe (solids/high press & temp)	4.0 - 6.0
Clean (liquids & gases only)	2.0 - 4.0
Off-site & steam/elec systems	1.5 - 3.0

Enter M factor from above here : 2.0

Total Annual Maintenance Cost -------- $133,930

TABLE 8-2A. HYPOTHETICAL 605 MW CYCLONE COAL REBURNING ECONOMIC ASSUMPTIONS

*** CALCULATION BASIS ***

A. CAPITAL INVESTMENT BASIS **********

1- Process Capital Cost Estimates
Major Activity Breakdown :

ENGINEERING/MATERIAL	------	12,920,839
FIELD LABOR	-------	10,300,000
MISCELLANEOUS	------	420,752
Total Process Capital	------	23,641,591

2- General Facilities : 5 to 20 % of Process Capital

Enter GF factor between 5-20 % here :	0
General Facilities Cost ----------	$0

3- Engineering & Home Office Fees : 5 to 15 % of Process Capital

Enter E&H factor between 5-15 % here :	0
Engineering & Home Office Fees ----------	$0

4- Project Contingency based on Design Class shown below :

Class	Design	Factor range
1	Simplified	30 - 50
2	Preliminarly	15 - 30
3	Detailed	10 - 20
4	Finalized	5 - 10

Enter ProjCont factor from above here :	5
Project Contingency Cost ----------	$1,182,080

5- Process Contingency based on State of Technology shown below :

State of Technology	Factor range
Concept With Bench Scale Data	30 - 70%
Small Pilot Scale Plant Data	25 - 35%
Full Size Unit Operating	5 - 20%
Commercially Used	0 - 10%

Enter ProcCont factor from above here :	0
Process Contingency Cost ----------	$0

6- Sales Tax as percentage of Process Capital

Enter sales tax as percentage here :	6.50
Sales Tax Cost ----------	$668,470

TABLE 8-2A. (continued)

B. CAPACITY FACTOR **********

Type of Plant	Design Capacity Factor
Base	0.65
Intermediate	0.30
Peaking	0.10

Enter Capacity Factor (CF) here : 0.75

C. OPERATING COST BASIS **********

1. Operating & Maintenance Cost

(a) Operating Costs

Total Operating Costs	------	$412,377
Plant Capacity (MWe)	------	605
Annual Operating Costs	------	$412,377

(b) Annual Maintenance Cost

Process Type	Maintenance (M) Factor
Corrosive & Abrasive Slurries	6.0 - 10.0
Severe (solids/high press & temp)	4.0 - 6.0
Clean (liquids & gases only)	2.0 - 4.0
Off-site & steam/elec systems	1.5 - 3.0

Enter M factor from above here :		2.0
Total Annual Maintenance Cost	------	$472,832

TABLE C. POWER CONSUMPTION ANALYSIS

CYCLONE REBURN
WISCONSIN POWER & LIGHT
NELSON DEWEY STATION

110 MW FULL LOAD

REBURN	PA FAN	FD FAN A	FD FAN B	GR FAN A	GR FAN B	PULV	CLASS	SEAL AIR	
AMPERES	85.43	175.00	172.00	26.00	0.00	273.00	45.20		
VOLTAGE	460	460	460	460	460	460	460	460	TOTAL (kW)
POWER (kW)	60.24	132.46	130.19	19.68	0.00	171.83	26.07	60.14	600.61

BASELINE	PA FAN	FD FAN A	FD FAN B	GR FAN A	GR FAN B	PULV	CLASS	SEAL AIR	
AMPERES	0.00	179.00	178.00	0.00	0.00	0.00	0.00	0.00	
VOLTAGE	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	TOTAL (kW)
POWER (kW)	0.00	135.49	134.73	0.00	0.00	0.00	0.00	0.00	270.22

DIFFERENCE: 330.39

82 MW FULL LOAD

REBURN	PA FAN	FD FAN A	FD FAN B	GR FAN A	GR FAN B	PULV	CLASS	SEAL AIR	
AMPERES	63.56	143.00	140.00	0.00	36.00	258.00	45.80		
VOLTAGE	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	TOTAL (kW)
POWER (kW)	44.82	108.24	105.97	0.00	27.25	152.11	26.42	60.14	524.94

BASELINE	PA FAN	FD FAN A	FD FAN B	GR FAN A	GR FAN B	PULV	CLASS	SEAL AIR	
AMPERES	0.00	149.00	147.00	25.00	0.00	0.00	0.00	0.00	
VOLTAGE	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	TOTAL (kW)
POWER (kW)	0.00	112.78	111.27	18.92	0.00	0.00	0.00	0.00	242.97

DIFFERENCE: 281.97