INNOVATIVE CLEAN COAL TECHNOLOGY

500 MW DEMONSTRATION OF ADVANCED WALL-FIRED COMBUSTION TECHNIQUES FOR THE REDUCTION OF NITROGEN OXIDE (NOx) EMISSIONS FROM COAL-FIRED BOILERS

Phase 3 and Final
Environmental Monitoring Program Report

Prepared by:

Southern Company Services, Inc.
Birmingham, Alabama

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EXECUTIVE SUMMARY

This report summarizes the results obtained during Environmental Monitoring Program (EMP) activities conducted during the Phase 3 testing of an Innovative Clean Coal Technology (ICCT) demonstration of advanced wall-fired combustion techniques for the reduction of nitrogen oxide (NO_x) emissions from coal-fired boilers. This third phase included demonstrations of Low NO_x burners (LNB) and Advanced Overfire Air (AOFA) retrofits to existing Foster-Wheeler (FWEC) burners. Since this was the final test phase, this document also serves as the final EMP report; results from all previous test phases are included for comparison. The project was conducted at Georgia Power Company's Plant Hammond Unit 4, located near Rome, Georgia.

The primary goal of this project was to characterize the effectiveness of low NO_x combustion equipment through the collection and analysis of long-term emissions data supported by short-term characterization data. During each test phase, diagnostic, performance, long-term, and verification tests were performed. The advanced combustion techniques used in this demonstration project were tested using the following phased approach:

Phase 1: Baseline testing on the "as found" Unit 4 boiler;

Phase 2: AOFA installation and testing;

Phase 3a: LNB installation and testing; and

Phase 3b: LNB plus AOFA testing.

EMP activities included sampling and analyses performed during each phase's testing periods, together with compliance monitoring performed on gaseous and aqueous streams. Energy Technology Consultants, Inc. (ETEC) was responsible for the preparation of interim test reports on each project phase, as well as a comprehensive test report to be prepared at the end of the project. Radian Corporation was responsible to Southern Company Services, Inc. (SCS) for the preparation of the EMP reports.

During Phase 3a, a total of 52 diagnostic and 9 performance tests were performed, together with 93 days of long-term testing; time constraints precluded the performance of any verification tests during this phase. During Phase 3b, 53 diagnostic, 6 performance, and 12 verification tests were performed, together with 61 days of long-term testing. All of the sampling and analytical methods used were specified and approved in the Environmental Monitoring Plan prepared for this project.

The following conclusions were drawn from the results presented in this EMP Phase 3 and Final Report:

- NO_x emissions were progressively reduced relative to baseline levels using AOFA, LNB, and combined LNB/AOFA technologies. Based on the analysis of the long-term data, NO_x emissions reductions during high load operations were 24% using AOFA, 48% using LNB, and 67% during combined LNB/AOFA operation. The AOFA NO_x emissions reduction decreased to about 12% when operating at low loads (i.e., 300 MW); reductions using LNB and LNB/AOFA remained more nearly constant over the range of boiler operating conditions.

- All three NO_x reduction technologies resulted in increased levels of loss-on-ignition (LOI) and carbon in the boiler outlet solids, indicative of a small decrease in overall coal utilization compared to baseline operation. AOFA operation showed the greatest impact; both LOI and carbon levels in the fly ash were nearly twice as high as those observed during baseline testing. Smaller increases relative to baseline were observed during LNB and LNB/AOFA operations. The LOI appeared to consist primarily (i.e., over 90%) of unburned carbon.

- Carbon monoxide levels in the outlet gas streams appeared to be related primarily to the levels of excess oxygen used; CO levels were lower at higher oxygen levels. At lower oxygen levels, the average CO concentration during combined LNB/AOFA operation remained higher than that measured during other test phases.

- Total hydrocarbon (THC) emissions were low during all test phases. The average THC concentrations did not appear to be functions of either operating load or excess oxygen concentration.

- Sulfur dioxide emissions were comparable during all test phases. The average SO_2 emission rates appeared to vary directly with coal sulfur concentration, as expected, although individual results showed considerable variability.

- AOFA operation did not appear to have any appreciable impact on the ratio of SO_3 to SO_2 relative to baseline operation. However, this ratio was higher during LNB and combined LNB/AOFA operation at most load levels.

- Particulate loading was approximately 20% higher during LNB and combined LNB/AOFA operation than during baseline operation. The average fly ash resistivity was consistently high during combined LNB/AOFA operation, and approached levels at which the ESP operation could begin to be adversely affected; resistivities from all test phases approached these levels at high load operation.

- Aqueous stream monitoring showed exceedances of permit limits only during a single ash pond emergency discharge situation. This incident was not related to the NO_x reduction test program.

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1.0 INTRODUCTION

As an Innovative Clean Coal Technology demonstration, this project, entitled "500 MWe Demonstration of Advanced, Wall-Fired Combustion Techniques for the Reduction of Nitrogen Oxide (NO_x) Emissions from Coal-Fired Boilers," was required to develop and implement an approved Environmental Monitoring Plan (EMP). The EMP for this project was prepared by Radian Corporation for Southern Company Services, Inc. (SCS) and submitted to DOE on September 14, 1990 [1]. The EMP includes supplemental and compliance monitoring of a number of gaseous, aqueous, and solid streams.

This is the final EMP report prepared for this project. As such, it presents the results of EMP activities conducted during Phases 3a and 3b (Low NO_x Burner and combined Advanced Overfire Air and Low NO_x Burner configurations, respectively) and compares these results to those obtained during the previous phases of the project.

1.1 Project Description

Southern Company Services signed a Cooperative Agreement for this ICCT Round II project on December 20, 1989. The project investigated a number of retrofit NO_x reduction techniques on Unit 4 at Georgia Power Company's Plant Hammond, near Rome, Georgia. Emissions and performance were characterized for this wall-fired boiler while operating in the following configurations:

- Baseline ("as-found") configuration - Phase 1;
- Advanced Overfire Air (AOFA) retrofit - Phase 2;

[1] Some changes in the EMP are still under consideration by DOE.

- Low NO_x Burner (LNB) retrofit - Phase 3a; and
- Combined AOFA and LNB configuration - Phase 3b.

The major objectives of the project were to:

- Demonstrate (in a logical stepwise fashion) the performance of three combustion NO_x control technologies (i.e., AOFA, LNB, and AOFA plus LNB);
- Determine the short-term NO_x emission trends for each of the operating configurations;
- Determine the dynamic long-term NO_x emission characteristics for each of the operating configurations using advanced statistical techniques;
- Evaluate progressive cost-effectiveness (i.e., dollars per ton of NO_x removed) of the low NO_x technologies tested; and
- Determine the effects on other combustion parameters (e.g., CO production, carbon carry-over, particulate characteristics) of applying the low NO_x combustion technologies.

Each of the four project phases involved three distinct testing periods: short-term characterization, long-term characterization, and short-term verification. The short-term characterization testing established trends of NO_x emissions, as related to various operating parameters, and established the influence of the operating mode on other combustion parameters. The long-term characterization testing, which took place over 50-80 days (or more) of continuous testing, established the dynamic response of NO_x emissions while the unit was operated under normal system dispatch conditions. The short-term verification testing was conducted to determine if any fundamental changes in NO_x emission characteristics occurred during the long-term test period.

EMP activities consisted of sampling and analyses performed during each phase's testing periods, together with compliance monitoring performed on gaseous and aqueous streams. Energy Technology Consultants, Inc. (ETEC) has prepared Phase Reports containing all of the results obtained in fulfillment of the project's objectives as outlined above. Radian has prepared this EMP Phase Report which presents the data obtained during the monitoring outlined in the EMP. The reader is referred to the ETEC Topical Reports "Innovative Clean Coal Technology (ICCT) 500 MW Demonstration of Advanced Wall-Fired Combustion Techniques for the Reduction of Nitrogen Oxide (NO_x) Emissions from Coal-Fired Boilers" for Phases 3a and 3b, dated March 9, 1993, and December 10, 1993, respectively, for additional test results.

1.2 Project Organization

The project organization is shown in Figure 1-1. The SCS Project Manager has overall responsibility for project execution. ETEC has responsibility for both the on-site testing and the analysis of data for all project phases. Spectrum Systems, Inc. provides a full-time, on-site instrument technician who is responsible for operation and maintenance of the data acquisition system (DAS), which is housed within the instrument control room. Southern Research Institute (SoRI) is responsible for testing related to the flue gas particulate measurements during the performance testing portion of the short-term characterization tests. Flame Refractories, Inc. (Flame) is responsible for activities related to fuel/air input parameters and furnace output temperature measurements during the performance testing portion of the short-term characterization tests. W. S. Pitts, Inc. (WSPC) is responsible for analysis of the emission and performance data for the long-term characterization tests. Radian Corporation is responsible to SCS for EMP activities, including preparation of the Environmental Monitoring Plan, and associated quarterly, annual, and phase reports.

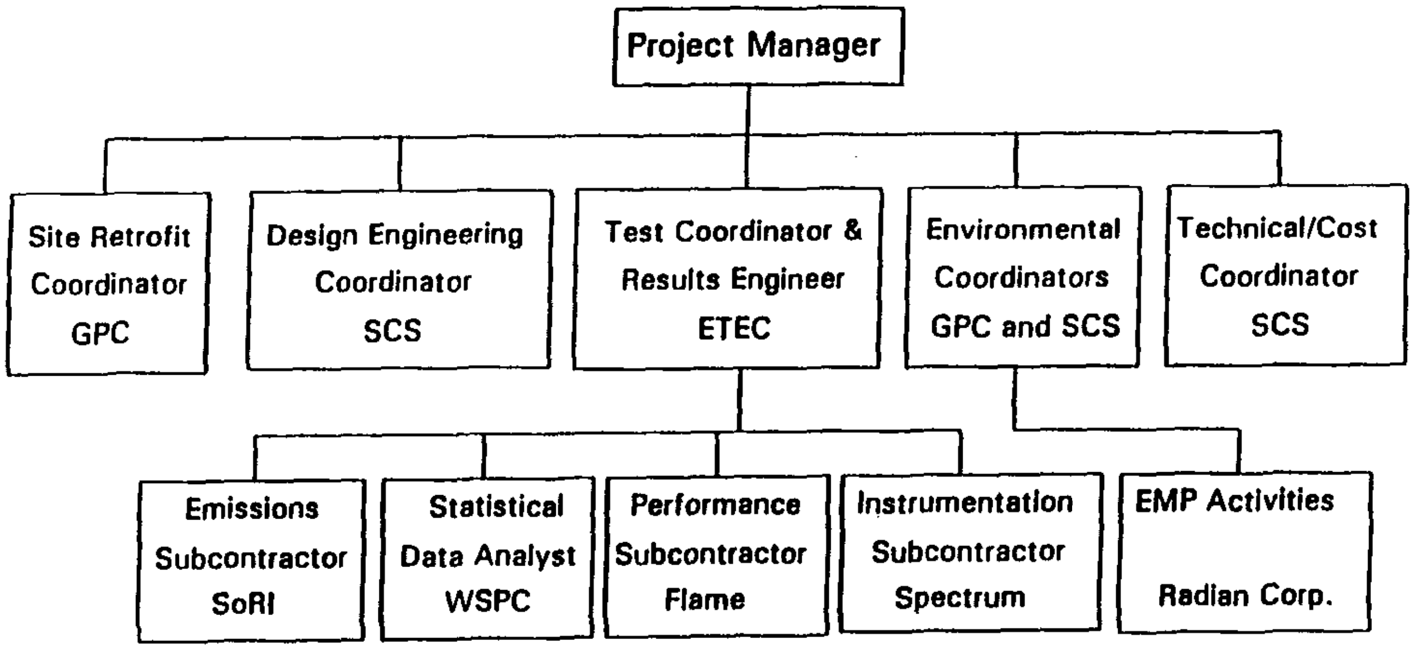

Figure 1-1. Plant Hammond Demonstration Project Organization

1.3 Hammond Unit 4 Description

Four generating units, with a total capacity of 800 MW, operate at Plant Hammond. Units 1 through 3 are 100 MW wall-fired boilers. Unit 4, a Foster Wheeler opposed wall-fired boiler rated at 500 MW, is the site of the ICCT combustion modification project. Six mills provide pulverized eastern bituminous coal to 24 Intervane burners arranged in a matrix of 12 (three rows of four burners) on the front and rear walls. Each mill provides coal to four burners.

Unit 4 is a balanced draft unit with two forced draft and three induced draft fans. Particulate emissions are controlled by a cold side ESP. The flue gases exit the economizer through two Ljungstrom air preheaters, pass through the cold side ESP, then through the induced draft fans and finally out to the stack. All four units at Plant Hammond exhaust to a single 750 foot high stack. The exhaust gas streams from Units 1-3 are combined and discharged through a single liner, while Unit 4 exhausts through a separate liner.

Wastewater from low-volume waste streams, coal pile runoff, and the ash sluice system flows into three on-site ash ponds, from which blowdown is discharged, along with once-through cooling water, to the Coosa River. Solid waste, in the form of bottom ash and fly ash, is sluiced to the ash pond system.

Figure 1-2 is a simplified schematic flow diagram of Unit 4 showing the major coal, air, and flue gas streams, as well as the locations of the EMP sampling points.

1.4 Report Organization

The remainder of this report is organized as follows:

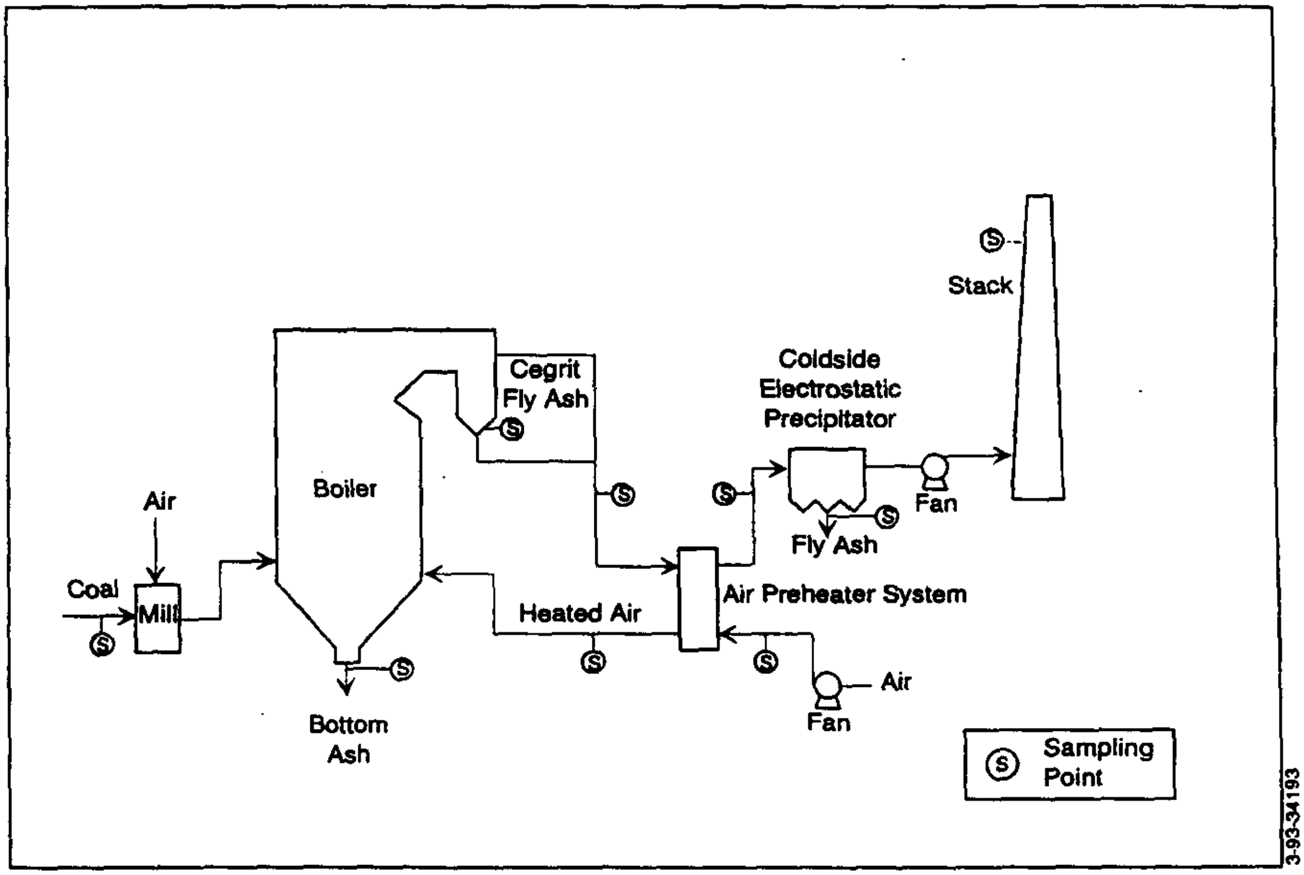

Figure 1-2. Unit 4 Schematic Flow Diagram

- Section 2 describes the NO_x reduction technologies tested and discusses the EMP monitoring planned for each of the test periods during Phases 3a and 3b;
- Section 3 briefly summarizes the sampling and analytical methods;
- Section 4 presents and discusses the gas stream monitoring results;
- Section 5 presents and discusses the aqueous stream monitoring results;
- Section 6 presents and discusses the solid stream monitoring results;
- Section 7 discusses EMP-related quality assurance/quality control activities performed during Phases 3a and 3b;
- Section 8 provides a summary of reports that were prepared of compliance monitoring activities; and
- Section 9 presents conclusions based on the EMP monitoring results.

Appendix A contains data tables for each of the streams monitored as part of the EMP.

2.0 TECHNOLOGY DESCRIPTION AND PHASE 3 EMP MONITORING

2.1 Technology Description

During this ICCT Round II program, three basic NO_x control technologies were demonstrated and compared to the "baseline" configuration. The technologies investigated are:

- Advanced Overfire Air (AOFA);
- Low NO_x Burner (LNB); and
- Combined LNB and AOFA operation.

For the purposes of this demonstration the baseline configuration was defined as the "as found" configuration of Unit 4. The "as found" configuration was further defined as the configuration under which the unit was operated in the recent past prior to retrofit activities. In the case of Hammond Unit 4, this consisted of operation with some existing burner-related problems.

The advanced overfire air system (AOFA) provided by Foster Wheeler Energy Corp. for Phases 2 and 3b of this demonstration incorporates separate injection port and duct configurations designed to provided increased secondary air penetration. This is done by supplying secondary air from completely separate aerodynamically designed ducts located above the existing burner windbox. The ports themselves are also designed to provide increased penetration velocities. The AOFA system was retrofitted to Unit 4 prior to Phase 2 testing. The retrofit consisted of ducts, dampers, various instrumentation and controls, and overfire air ports above the top burner rows on both the frond and rear furnace walls. The overfire air is extracted from the two main secondary air ducts between the air flow venturis and the entrances to the combustion air windbox. Figure 2-1 shows the major components of the AOFA retrofit.

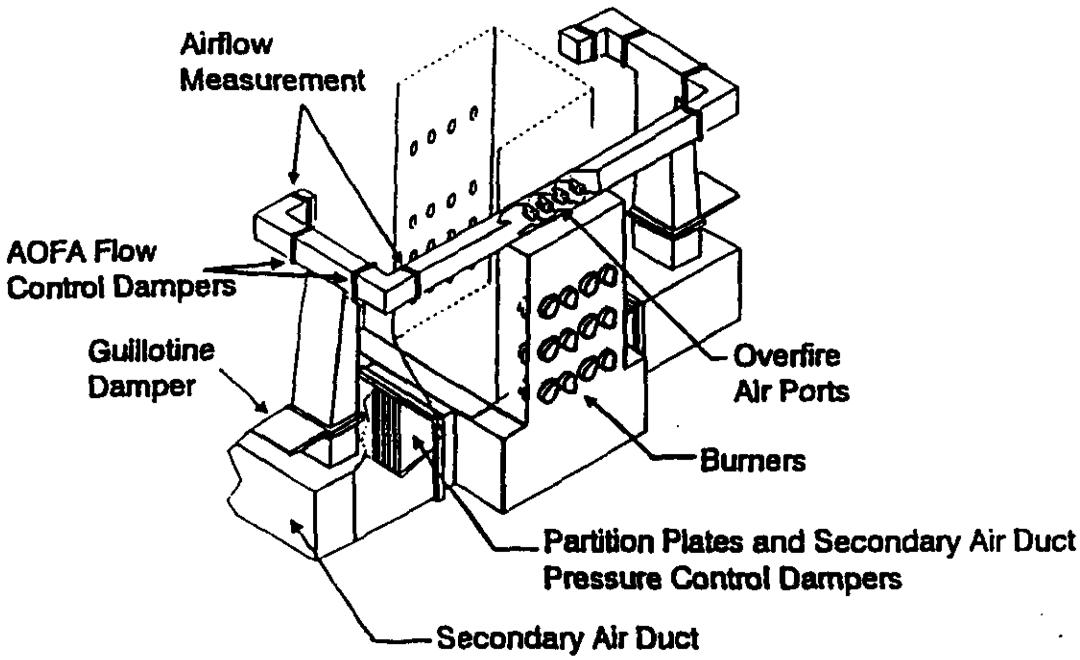

Figure 2-1. AOFA Retrofit Configuration (Source: ETEC Phase 2 Report)

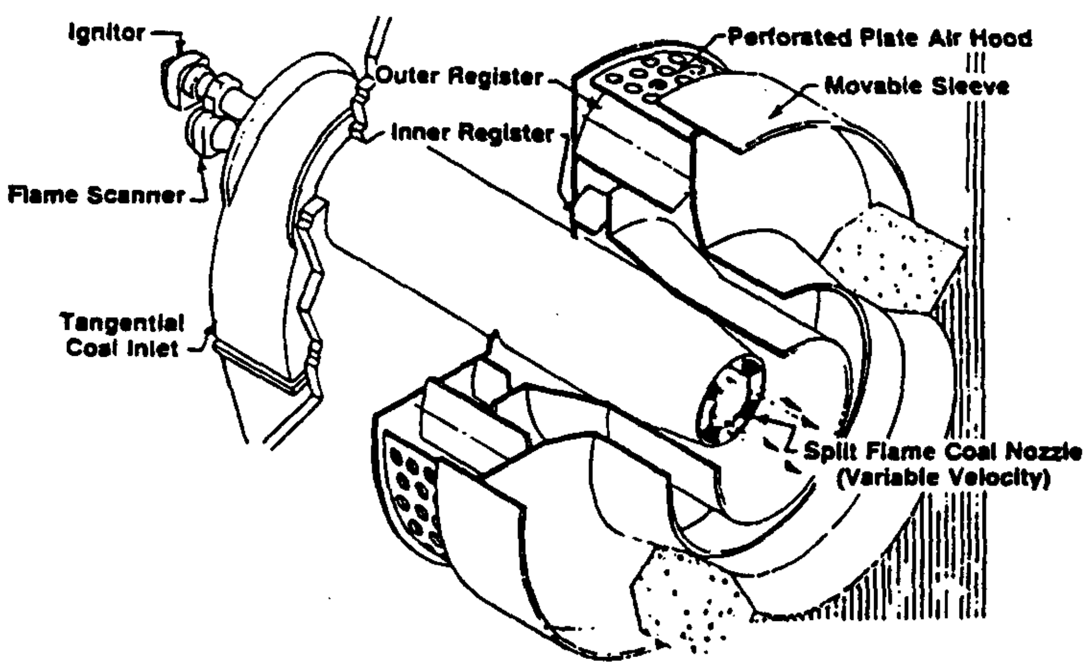

Figure 2-2. Low NO_x Burner Installed at Plant Hammond

For Phases 3a and 3b, Foster Wheeler supplied their Controlled Flow-Split Flame (CF/SF) burner for retrofit into the existing wall penetrations of the 24 Intervane burners. Figure 2-2 is a schematic illustrating the CF/SF burner. The CF/SF burner utilizes the principle of separating the fuel and air streams in the primary combustion zone. The unique design features of the burner allow low NO_x operation with shorter flames than may result from other wall-fired burner designs.

2.2 Phase 3 EMP Monitoring

Phases 3a (LNB) and 3b (LNB + AOFA) each consisted of three test elements: short-term characterization, long-term characterization, and short-term verification tests.

Short-term characterization tests were performed to establish the trends of NO_x emissions under the most commonly used boiler operating conditions. The short-term testing was divided into two elements: diagnostic tests and performance tests. Diagnostic tests were used to establish gaseous emission trends, and lasted from one to three hours at each set of operating conditions. Performance testing was used to establish boiler efficiency and steaming capability as well as gaseous and particulate emissions and mill performance. Each performance test lasted from 10 to 12 hours. All of the short-term characterization tests were conducted with the unit in a fixed configuration while it was off system load dispatch, to ensure steady boiler operation. The primary operating parameters that were varied during these tests included boiler load, excess oxygen, mill pattern, mill bias, and AOFA damper position. The emphasis of the EMP was on the gaseous and particulate emissions data obtained during these tests, as well as the coal feed characteristics. During Phase 3a, a total of 52 diagnostic tests and 9 performance tests were conducted. During Phase 3b, a total of 53 diagnostic tests and 6 performance tests were conducted.

Long-term testing was conducted under normal system load dispatch control. Long-term testing provided emission and operational results that were subsequently subjected to sophisticated statistical analyses to obtain a true representation of the emissions from the unit. Data were recorded continuously over each of the long-term testing periods, which lasted 93 days during Phase 3a and 61 days during Phase 3b.

Following the long-term testing period, verification testing was conducted to determine whether changes in unit condition and coal feed had occurred that might have had an impact on the interpretation of the long-term test data. Verification tests were conducted in a manner similar to the diagnostic tests; four or five basic test configurations were typically tested during this short effort. A total of 12 verification tests were conducted during Phase 3b; no verification tests were conducted during Phase 3a due to time constraints.

Table 2-1 is a summary of the tests performed during Phase 3. For each series of tests, the table shows the dates, number of tests, and the total days of testing. This information was used to determine the total number of planned samples for each parameter during each series of tests.

Tables 2-2, 2-3, and 2-4 present the EMP integrated monitoring schedules for gaseous, aqueous, and solid streams, respectively, for Phase 3.

Table 2-1

Test Summary for Phases 3a (LNB) and 3b (LNB + AOFA)

Test Series	Dates	Number of Tests	Number of Days
Phase 3a			
Diagnostic	07/09/91 - 07/15/91 07/18/91 - 07/20/91 11/16/91 - 11/19/91 01/14/92 - 01/15/92	52	15
Performance	07/16/91 - 07/17/91 07/22/91 - 07/28/91	9	8
Long-Term Characterization	08/07/91 - 12/19/91	NA	93
Verification	No tests performed	0	0
Phase 3b			
Diagnostic	05/06/93 - 05/10/93 06/08/92 - 06/16/93 06/24/93 - 06/25/93	53	16
Performance	06/17/93 - 06/23/93	6	7
Long-Term Characterization	06/24/93 - 08/13/93	NA	61
Verification	08/09/93 - 08/10/93 08/24/93 - 08/26/93	12	5

NA = Not applicable.

Table 2-2

Gaseous Streams: Integrated EMP Monitoring Schedule[1,2]

	Economizer Outlet Gas			Preheater Outlet Gas			Stack Gas								
							KVB CEM[3]			Opacity Monitor			Other		
Parameter	D/V	P	L	D/V	P	L	D/V	P	L	D/V	P	L	D/V	P	L
Opacity												C [c][4]			
SO_2							a	a	C						
CO	a	b		a	b		a	a	C						
NO_x	a	b		a	b		a	a	C						
O_2	a	b		a	b		a	a	C						
THC							a	a	C						
SO_2/SO_3					4/T										
Particulate Matter:															
Loading					3/T										A[c]
Size Distribution					3/T										
Carbon Content, %					d										
Loss-on-Ignition					d										
Resistivity					3/T										

[1] Monitoring phase elements:
- D = Diagnostic tests
- P = Performance tests
- L = Long-term tests
- V = Verification tests

[2] Monitoring frequency:
- a = At least 2 averages per test
- b = At least 10 averages per test
- d = Composite of solids from mass loading measurement
- n/T = Sampled a minimum of n times per test
- C = Continuous
- A = Annual
- [c] = Compliance parameter

[3] The KVB CEM is configured so that flue gas samples can be drawn from the economizer outlet, air heater outlet, and stack. Except for the stack probe, all lines pass through individual flow control valves and bubblers.

[4] Opacity is measured in the stack using a dedicated monitor.

Table 2-3

Aqueous Streams: Integrated Monitoring Schedule

Parameter	Ash Pond Emergency Overflow[1]	Ash Transport Water Blowdown	Ash Pond Final Discharge
Total Suspended Solids	2/M [c][2]	2/M [c]	
pH	2/M [c]		2/M [c]
Oil and Grease	2/M [c]	2/M [c]	

[1] Ash pond emergency overflow is sampled only during discharge.

[2] Monitoring frequency:

2/M = Twice per month.

[c] = Compliance monitoring.

Table 2-4

Solid Streams: Integrated Monitoring Schedule

Parameter	Coal[1]			Bottom Ash[2]			ESP Fly Ash[3]			CEGRIT Fly Ash[4]		
	D/V[5]	P	L	D/V	P	L	D/V	P	L	D/V	P	L
Proximate and Ultimate Analysis, Ash, Moisture, C, H, N, S, Cl, O (by diff.), and HHV	1/Da[6]	3/Da	1/W									
Volatile/Semivolatile Organics							a					
Loss-on-Ignition					1/Da			1/T		1/T	2/T	1/W
Laboratory Resistivity								1/T				

[1]Coal sample is a composite from all operating mills.

[2]Bottom ash sample is composited from east and west bottom ash hoppers.

[3]ESP ash is collected from precipitator ash hoppers.

[4]CEGRIT samples consist of east- and west-side samples, each analyzed separately.

[5]Monitoring phase elements:
- D = Diagnostic tests
- P = Performance tests
- L = Long-term tests
- V = Verification tests

[6]Monitoring frequency:
- a = Sampled once during Baseline (Phase 1) and once during one of the NO_x reduction test Phases.
- n/T = Sampled a minimum of n times per test
- n/Da = Minimum of n samples per day
- n/W = Minimum of n samples per week
- [c] = Compliance parameter

3.0 SAMPLING AND ANALYTICAL METHODS

The sampling and analytical methods specified by the Environmental Monitoring Plan and used during Phase 3 are summarized in Tables 3-1 through 3-3. The ETEC Phase Reports contain additional details on the sampling and analytical methods used in this project.

There were no deviations from the sampling and analytical methods specified in the EMP.

3.1 Gaseous Stream Parameters

The KVB Extractive Continuous Emissions Monitor was used to provide quantitative analyses for NO_x, SO_2, CO, O_2, and total hydrocarbons. SoRI was responsible for solid and sulfur (SO_2, SO_3) emissions testing, which included measurement of particulate matter loading, size distribution, ash resistivity, carbon content, and LOI.

3.2 Aqueous Stream Parameters

The streams and parameters to be monitored and the monitoring schedules are specified in the Georgia Department of Natural Resources NPDES Permit No. GA0001457. Georgia Power personnel obtained samples and performed all aqueous parameter analyses. Results presented in this EMP report were obtained from Operation Monitoring Reports submitted by Georgia Power.

3.3 Solid Stream Parameters

Plant personnel obtained coal, bottom ash, and ESP fly ash samples. The CEGRIT on-line samplers automatically collected grab samples of fly ash in the furnace

Table 3-1

Sampling and Analytical Methods Summary: Gaseous Streams

Parameter	Sampling Method	Analytical Method/Instrument
Opacity	--	Lear Siegler Opacity Monitor
SO_2	GAS	Western Research Ultraviolet
CO	GAS	Siemens NDIR
NO_x	GAS	TECO Chemiluminescence
O_2	GAS	Thermox O_2 Electroanalytic (stack gas) and Yokagawa in-situ O_2 probes (economizer outlet and air preheater outlet)
SO_3	Cheney-Homolya Controlled Condensation	Titration
Total Hydrocarbons	GAS	Rosemount FID
Particulate Matter:		
Loading	EPA Method 17	Gravimetric
Size Distribution	Isokinetic	Gravimetric
Carbon Content, %	EPA Method 17	
Resistivity	In-Situ Probe	Electrode Cell

GAS = Continuous extractive and in situ gas analysis system.

Table 3-2

Sampling and Analytical Methods: Aqueous Streams

Parameter	Sampling Method	Analytical Method/Instrument
Total Suspended Solids	Grab	Filtration/Drying/Gravimetric; EPA 160.2
pH	Grab	Electrometric; Std Methods 432
Oil and Grease	Grab	Freon Extraction/Gravimetric; EPA Method 413.1, SM 503A

Table 3-3

Sampling and Analytical Methods: Solids Streams

Parameter	Sampling Method	Analytical Method
Ultimate Analyses	Grab/Composite	Combustion/Gravimetric/Titration; ASTM D3176
Moisture Content	Grab/Composite	Gravimetric; ASTM D3173
Chlorine	Grab/Composite	Fusion/IC or Titration; ASTM D2361
Higher Heating Value	Grab/Composite	Combustion; ASTM D2015
Sulfur	Grab/Composite	High Temperature Combustion; ASTM D3177
Ash	Grab/Composite	Combustion/Gravimetric; ASTM D3174
Volatile/Semivolatile Organics	Grab/Composite	Purge-and-Trap or Extraction/GC/MS/ Analyses; EPA 8240, 8270
Loss-on-Ignition	Grab/Composite	Combustion/Gravimetric; ASTM D3174
Laboratory Resistivity	Grab/Composite	Resistivity Cell (ASME PTC 28); Descending Temperature Test (IEEE 548)

backpass. Coal samples were shipped to Alabama Power's General Test Laboratory in Birmingham, where they were subjected to proximate and ultimate analyses. Loss-on-Ignition (LOI) measurements were performed on bottom ash, ESP fly ash, and CEGRIT fly ash.

4.0 GASEOUS STREAM MONITORING RESULTS

This section presents the results of the gaseous stream EMP monitoring performed during Phases 3a and 3b. These results are also compared to those obtained during Phase 1 (baseline) and Phase 2 (AOFA) monitoring. Three gas streams were monitored as specified in the EMP: economizer outlet gas, air preheater outlet gas, and stack gas.

Table 4-1 presents the actual and planned Phase 3 gaseous stream monitoring. As shown in this table, most of the planned EMP monitoring was performed during Phases 3a and 3b. In some cases, especially for the economizer outlet gas and stack gas, more than the planned amount of monitoring was actually conducted. Monitoring of the CO, NO_x, and O_2 in the preheater outlet gas was not conducted during any Phase 3a and 3b test periods. However, SO_3/SO_2 and particulate matter monitoring data were obtained from the preheater outlet gas. These data, combined with the monitoring data from the economizer outlet gas and stack gas, were quite sufficient for a complete analysis and evaluation of the monitoring results.

Appendix A contains all of the short-term results for Phases 3a and 3b in tabular form. The daily averages obtained during the Phase 3a and 3b long-term testing periods are also listed.

The following sections present the results of the Phase 3a and 3b testing for gaseous streams, primarily in graphical form. These results are also compared to those from the Phase 1 baseline and Phase 2 AOFA testing. Short-term NO_x monitoring results for the economizer outlet gas stream are presented as a function of the oxygen content in the economizer outlet, since this eliminates any impact of flue gas dilution on the results. These results are given in Section 4.1. The short-term monitoring results for

Table 4-1

Gaseous Streams: Actual and Planned Monitoring [1,2]
Phase 3a

Parameter	Economizer Outlet Gas			Preheater Outlet Gas [3]			Stack Gas			
	D	P	V	D	P	V	D	P	L	V
SO_2							138/104	87/18	C/C	0/0 [4]
CO	202/104	93/90	0/0 [4]	0/104	0/90	0/0 [4]	138/104	87/18	C/C	0/0
NO_x	301/104	208/90	0/0	0/104	0/90	0/0	138/104	87/18	C/C	0/0
O_2	202/104	93/90	0/0	0/104	0/90	0/0	138/104	87/18	C/C	0/0
THC							138/104	87/18	C/C	0/0
SO_3/SO_2					30/36					
Particulate Matter:										
Loading					15/27					
Size Distribution					15/27					
Carbon Content, %					5/9					
Loss on Ignition (LOI)					5/9					
Resistivity (Spark, I/V Methods)					28/27					

Table 4-1 (Continued)

Phase 3b

Parameter	Economizer Outlet Gas			Preheater Outlet Gas[3]			Stack Gas			
	D	P	V	D	P	V	D	P	L	V
SO_2							169/106	48/12	C/C	21/24
CO	177/106	50/60	19/24	0/106	0/60	0/24	169/106	48/12	C/C	21/24
NO_x	243/106	93/60	40/24	0/106	0/60	0/24	169/106	40/12	C/C	21/24
O_2	177/106	50/60	19/24	0/106	0/60	0/24	169/106	48/12	C/C	21/24
THC							169/106	48/12	C/C	21/24
SO_3/SO_2					21/24					
Particulate Matter:										
Loading					9/18					
Size Distribution					9/18					
Carbon Content, %					3/6					
Loss on Ignition (LOI)					3/6					
Resistivity (Spark, I/V Methods)					21/18					

[1]202/104 = 202 measurements taken/104 measurements planned.

[2]Monitoring phase elements:

C = Continuous
D = Diagnostic tests
L = Long-term tests
P = Performance tests
V = Verification tests

[3]Preheater outlet gas was not analyzed for CO, NO_x, or O_2 during Phases 3a or 3b.

[4]Verification testing was not conducted during Phase 3a due to time constraints.

Additional gaseous stream monitoring (not shown above):

- Stack gas opacity is measured on a continuous basis in response to a compliance requirement.
- Stack gas particulate loading is measured annually in response to a compliance requirement.

SO_2, CO, and THC in the stack gas stream were selected for presentation in Section 4.2. Since bubblers were used as simple flow meters for the other gas stream sample probes, the results for these streams may have been biased because of analyte dissolution. The SO_3/SO_2 and particulate matter results for the preheater outlet gas are presented in Section 4.3. The long-term stack gas testing results are presented in Section 4.4. Section 4.5 presents the results of compliance monitoring conducted during Phases 3a and 3b.

4.1 Short-Term NO_x Results for the Economizer Outlet Gas

In Figures 4-1 through 4-5, NO_x emission data obtained during the short-term testing periods for all test phases are presented as a function of economizer outlet gas oxygen concentration for each of the five nominal operating load levels at which testing was performed (i.e., 480, 450, 400, 300, and 180 MW). Consistent results were obtained during diagnostic, performance, and verification tests at each load level. At most loads, the NO_x emission rate increased slightly at higher economizer outlet gas oxygen levels during both LNB and combined LNB/AOFA operation. Progressively lower NO_x emissions were obtained at each load level using AOFA, LNB, and combined LNB/AOFA. Although emission trends were investigated during short-term testing, only the long-term test results were intended to be used in determining achievable NO_x reductions. The long-term NO_x data are presented in Section 4.4.

4.2 Short-Term Results for the Stack Gas

4.2.1 Sulfur Dioxide Emissions

As expected, no relationships were found between stack gas SO_2 emissions and operating load or flue gas oxygen concentration. SO_2 emissions are related to coal sulfur content as shown in Figure 4-6 where the average SO_2 emissions are plotted

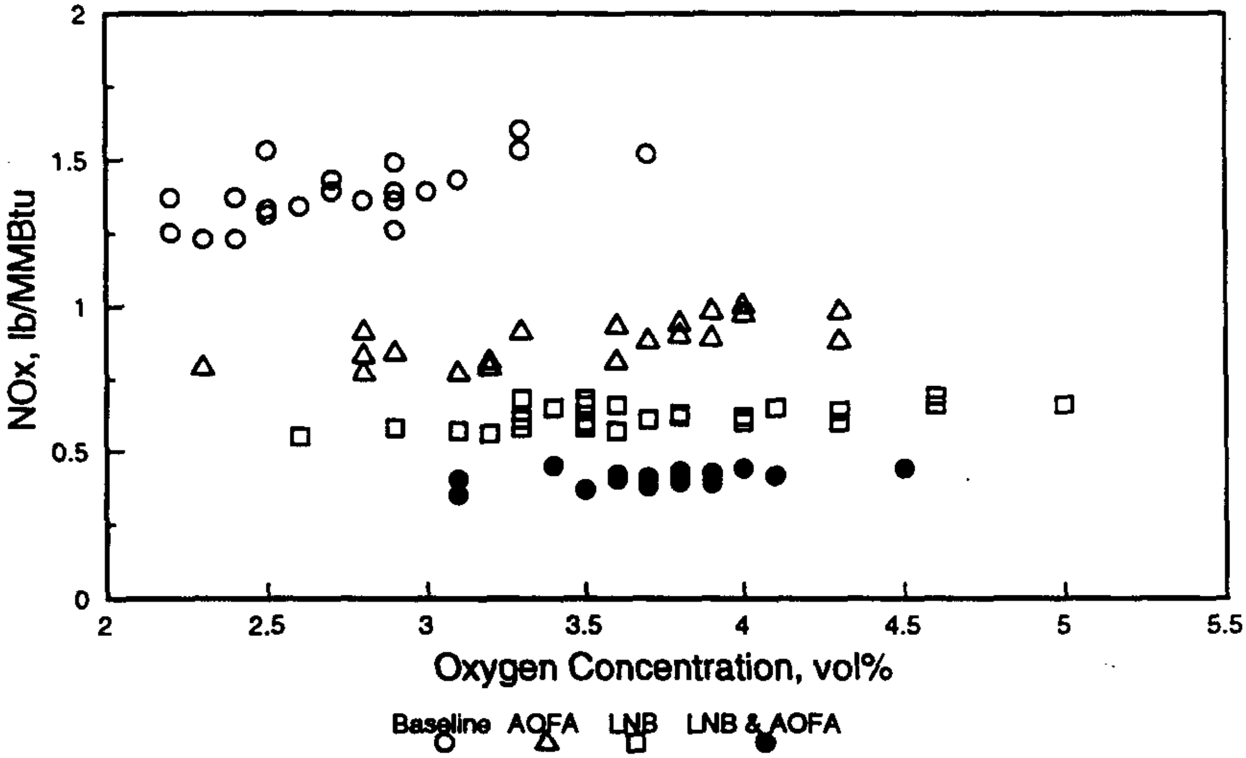

Figure 4-1. Short-Term NO_x Emissions Versus Economizer Outlet Gas Oxygen Concentration at 480 MW: All Test Phases

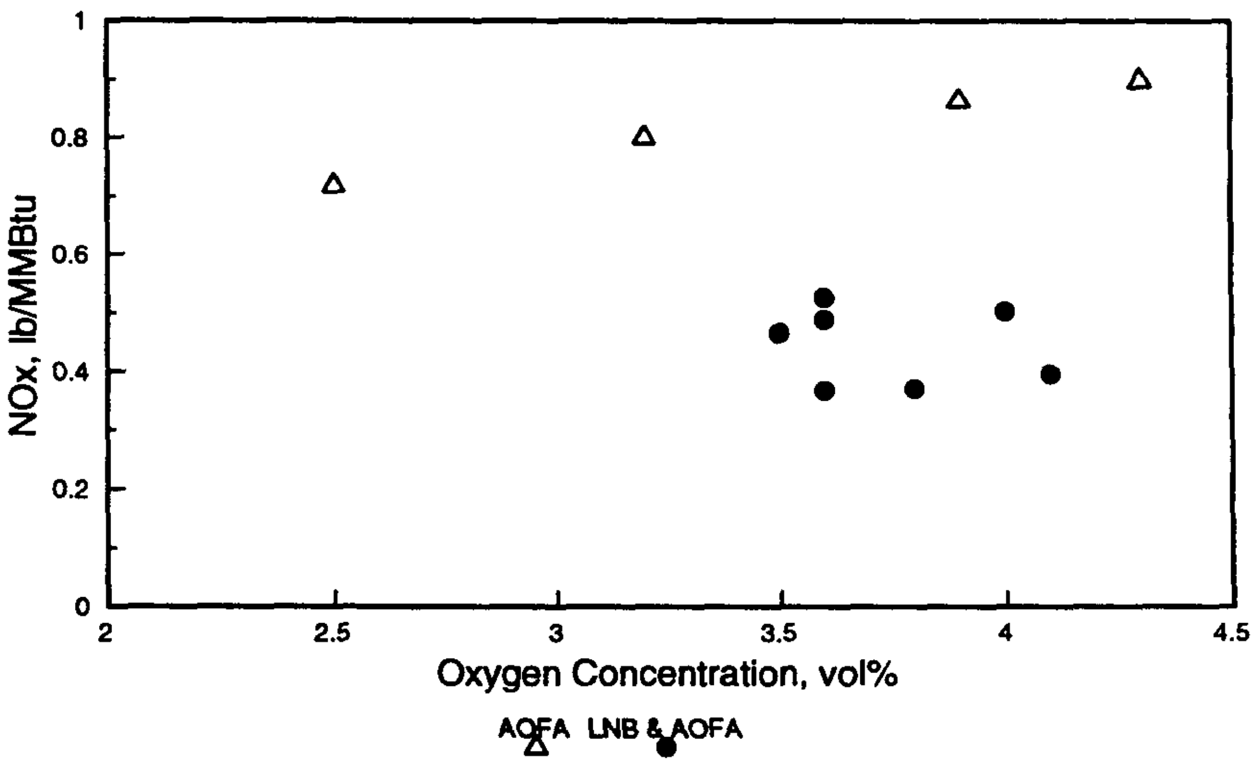

Figure 4-2. Short-Term NO_x Emissions Versus Economizer Outlet Gas Oxygen Concentration at 450 MW: All Test Phases

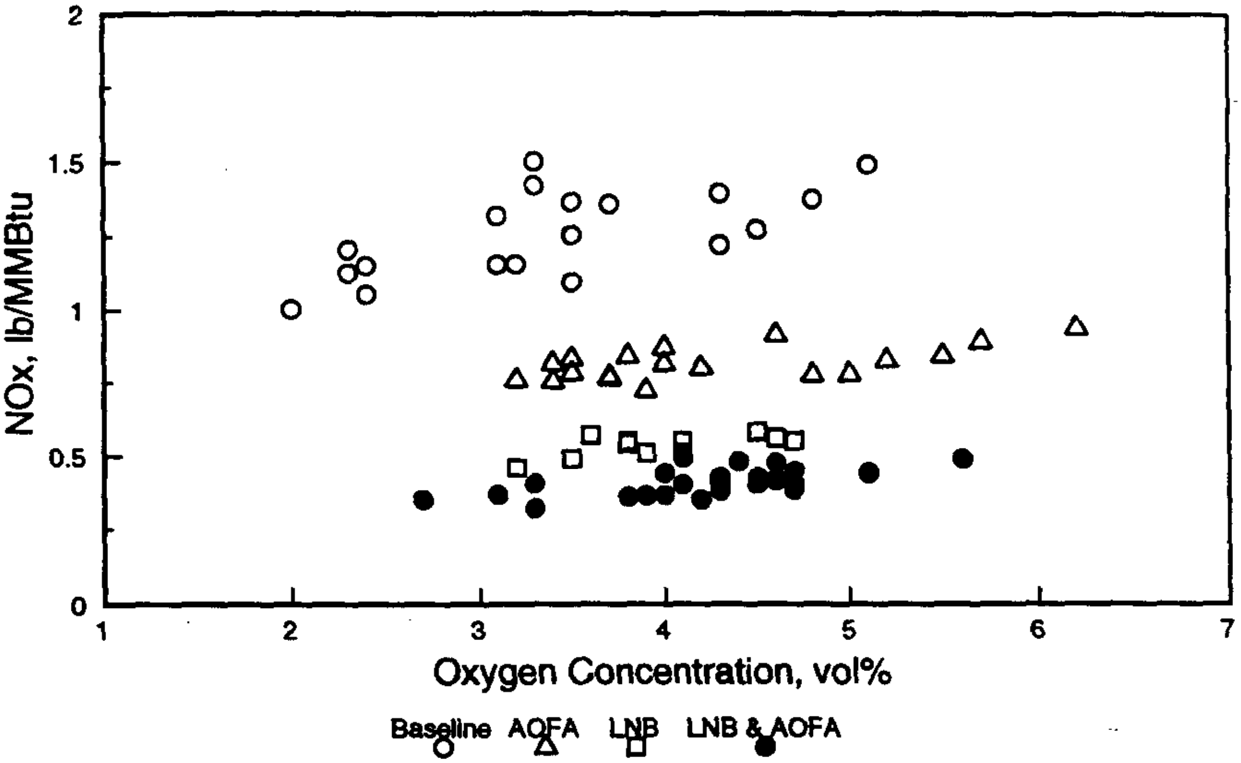

Figure 4-3. Short-Term NO_x Emissions Versus Economizer Outlet Gas Oxygen Concentration at 400 MW: All Test Phases

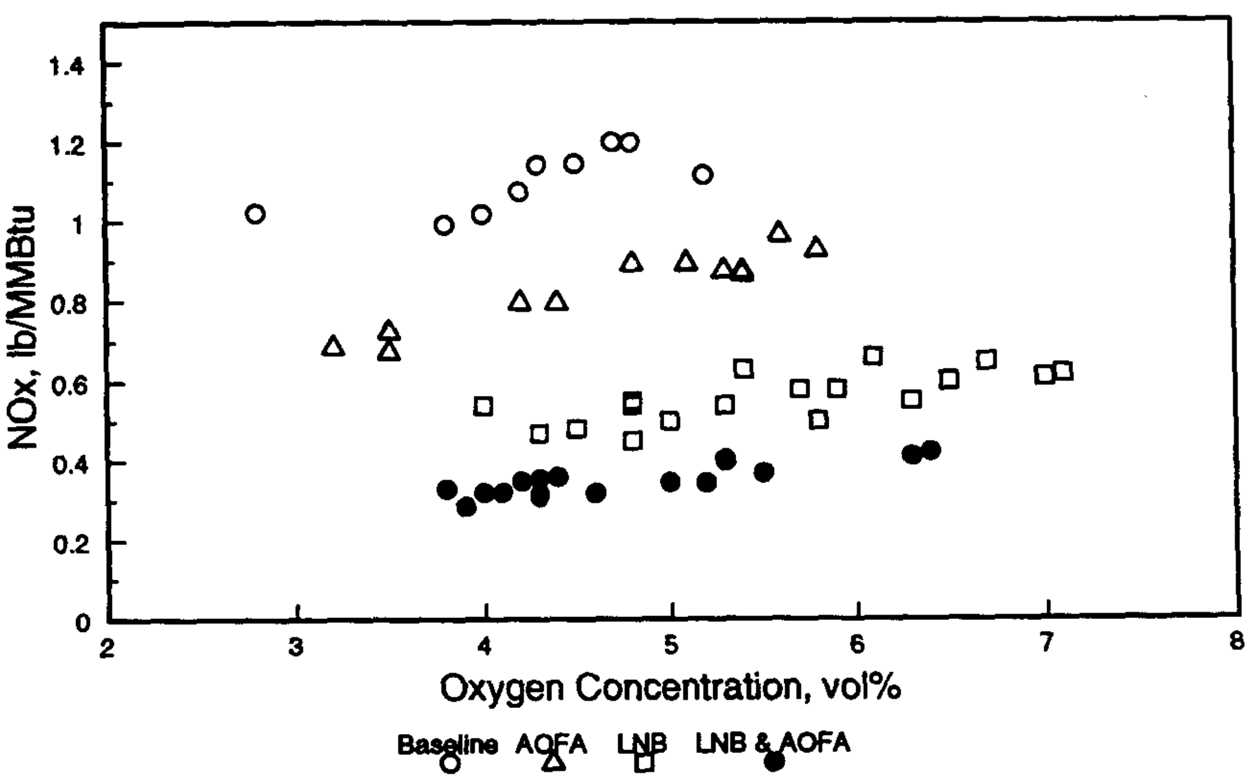

Figure 4-4. Short-Term NO_x Emissions Versus Economizer Outlet Gas Oxygen Concentration at 300 MW: All Test Phases

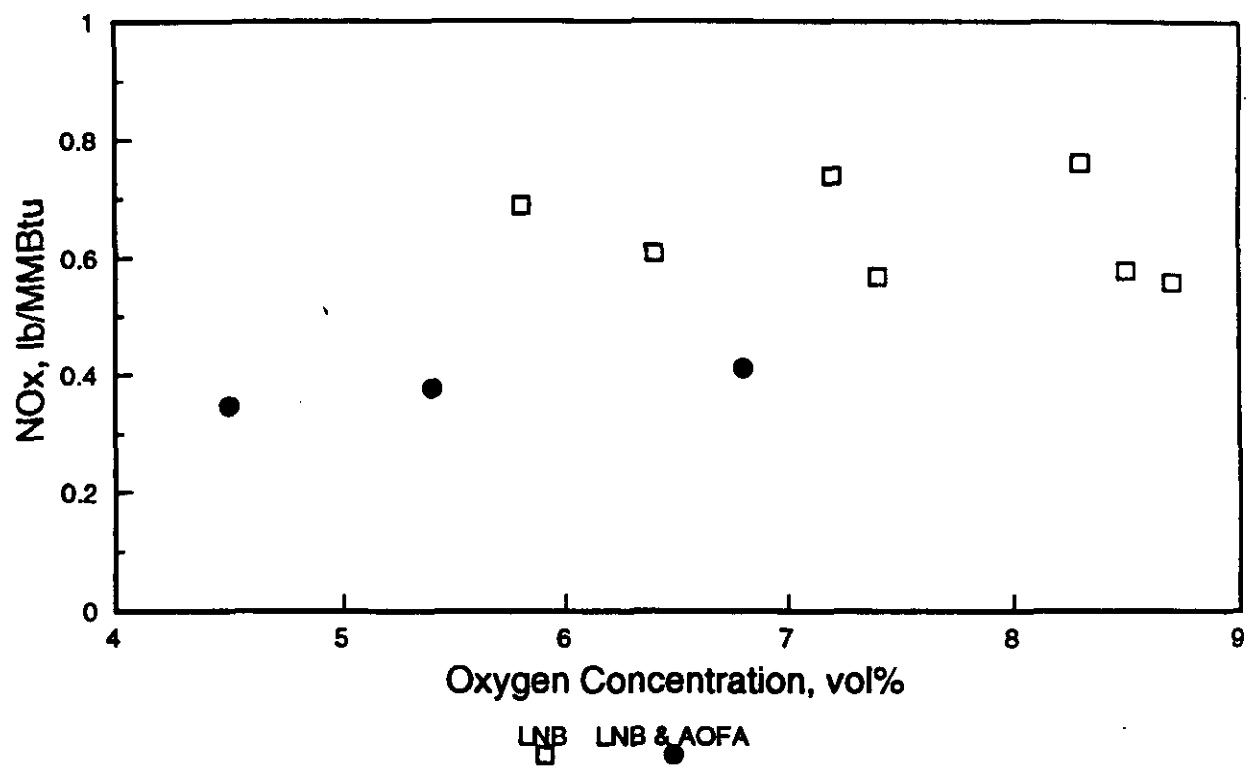

Figure 4-5. Short-Term NO_x Emissions Versus Economizer Outlet Gas Oxygen Concentration at 180 MW: All Test Phases

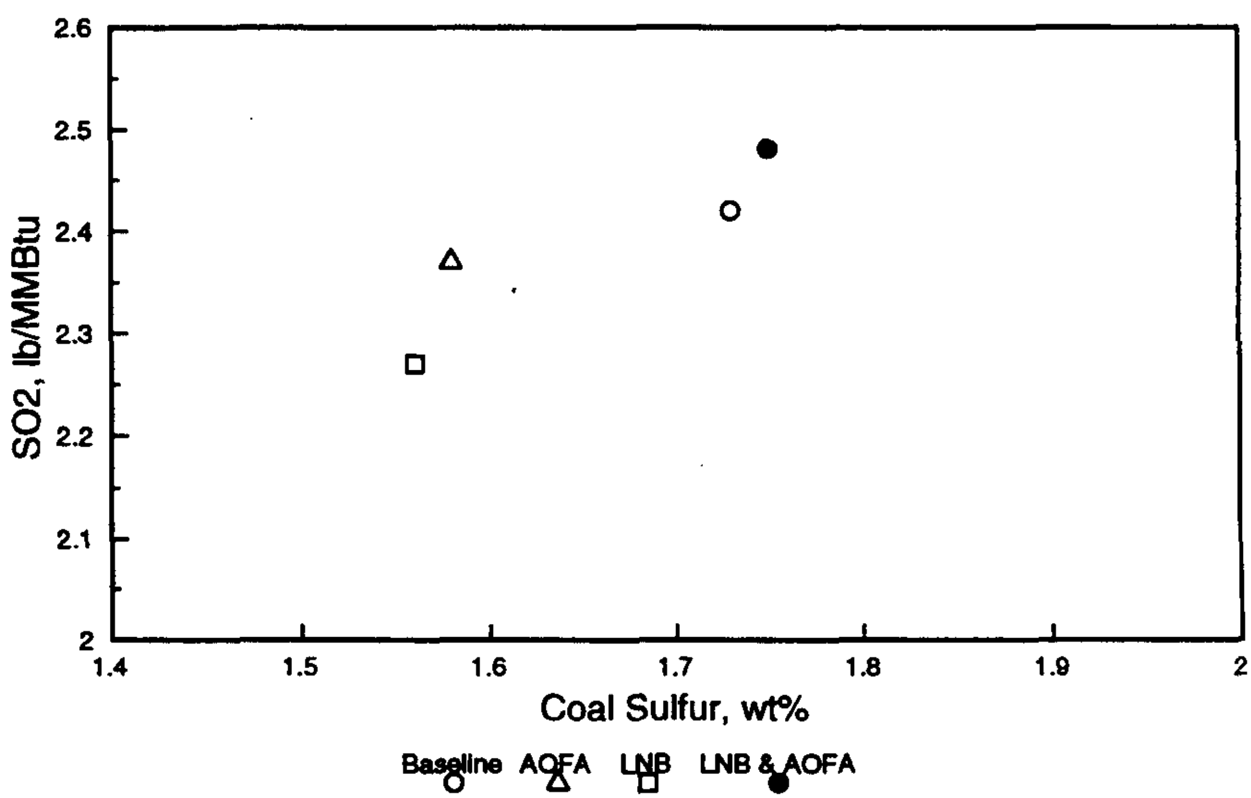

Figure 4-6. Average Short-Term Stack Gas SO_2 Emissions Versus Average Coal Sulfur Content: All Test Phases

against the average coal sulfur content for each of the test phases. Average SO_2 emissions were slightly higher during the phases when the coal sulfur content was higher; there was significant scatter in the individual data points during all test phases.

4.2.2 Carbon Monoxide Emissions

The average short-term stack gas CO concentrations for all test phases are plotted versus the average stack gas oxygen content in Figure 4-7. Although there was significant scatter in the individual data points during all test phases, the average CO concentration decreased, at the lower oxygen levels, as the excess oxygen content increased. At the higher oxygen levels, the CO content was relatively insensitive to oxygen level, and no significant differences were observed between test phases. Only the general trends can be inferred from Figure 4-7, however, because for some ranges of oxygen content there were relatively few data points from which the averages were computed. This was especially true for tests performed at low oxygen levels.

4.2.3 Total Hydrocarbon Emissions

Figure 4-8 presents the average total hydrocarbon (THC) concentration in the stack gas as a function of the oxygen concentration in the stack. The average THC concentration shown for LNB operation at 5% oxygen was based on a single data point. With the exception of this data point, it appears that average THC concentrations did not vary greatly with oxygen content for any of the test phases. The average THC levels during short-term baseline tests were somewhat higher than those observed during tests of the various NO_x reduction technologies. There were a large number of "zero" THC values during the combined LNB/AOFA short-term tests; it is not known whether the THC monitor was functioning properly during these periods. Thus, the average THC levels shown in Figure 4-8 may be biased low.

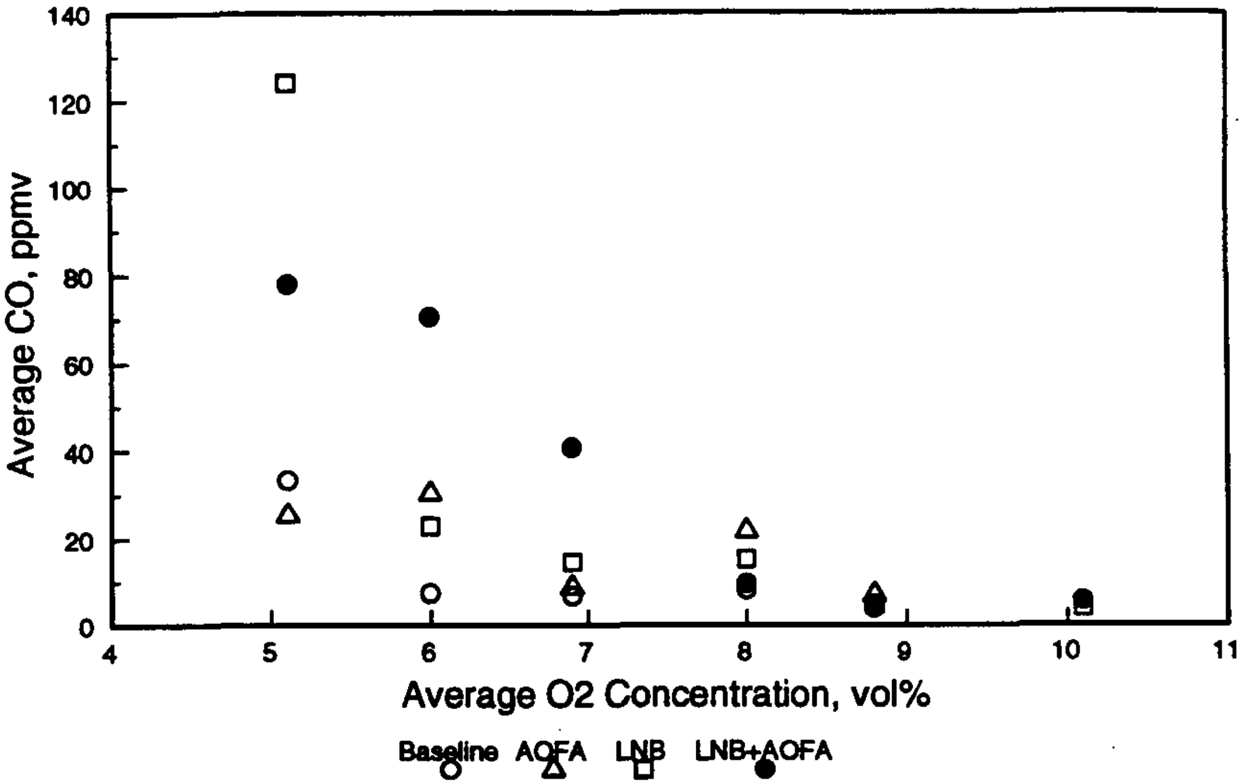

Figure 4-7. Average Short-Term Stack Gas CO Concentration Versus Oxygen Concentration: All Test Phases

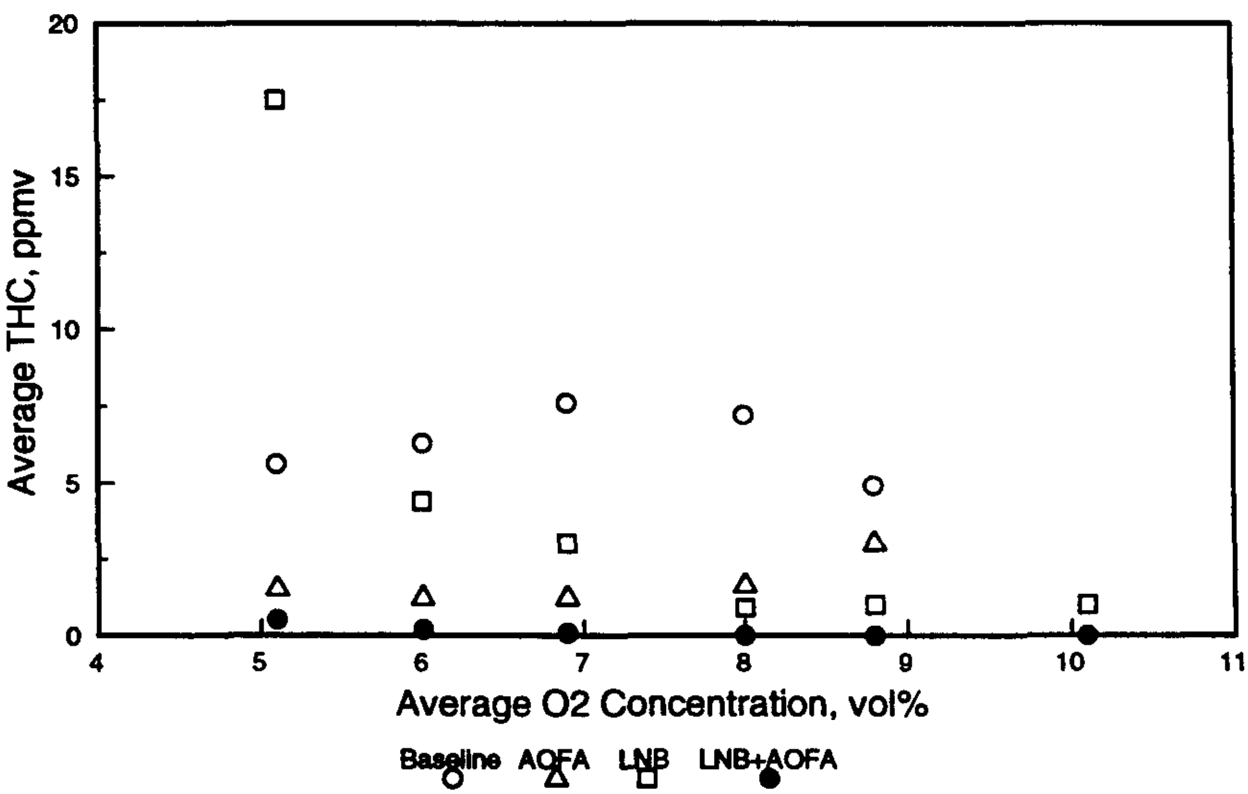

Figure 4-8. Average Short-Term Stack Gas Total Hydrocarbon Concentration Versus Oxygen Concentration: All Test Phases

4.3 Short-Term Results for Preheater Outlet Gas

Monitoring for SO_3/SO_2 and several particulate matter parameters in the preheater outlet gas stream was conducted during the Phase 3a and 3b performance testing periods. Results are summarized in this section.

4.3.1 SO_3/SO_2 Ratio

During combustion, the majority of the coal sulfur is converted to sulfur dioxide, while a small fraction is further oxidized to sulfur trioxide. The concentration of sulfur trioxide is important from an environmental standpoint, since it will form sulfuric acid in the presence of water vapor. It is also important from a process standpoint, since it can have a beneficial impact on the particulate removal efficiency of the electrostatic precipitators.

The average ratios of SO_3 to SO_2 concentrations measured at each load level are shown in Figure 4-9 for all test phases. At loads of 400 and 480 MW, the SO_3/SO_2 ratios were higher by a factor of 2 to 3 for LNB and combined LNB/AOFA operation than for AOFA alone or baseline operation. At 300 MW, LNB operation resulted in a higher SO_3/SO_2 ratio than was observed during the other test phases.

4.3.2 Particulate Loading

Particulate loading was measured in the flue gas exiting the air preheater. Average loadings measured at 300, 400, and 480 MW are shown in Figure 4-10 for all test phases. These results show that the average particulate loading was slightly higher during LNB and combined LNB/AOFA operation than was measured during baseline tests.

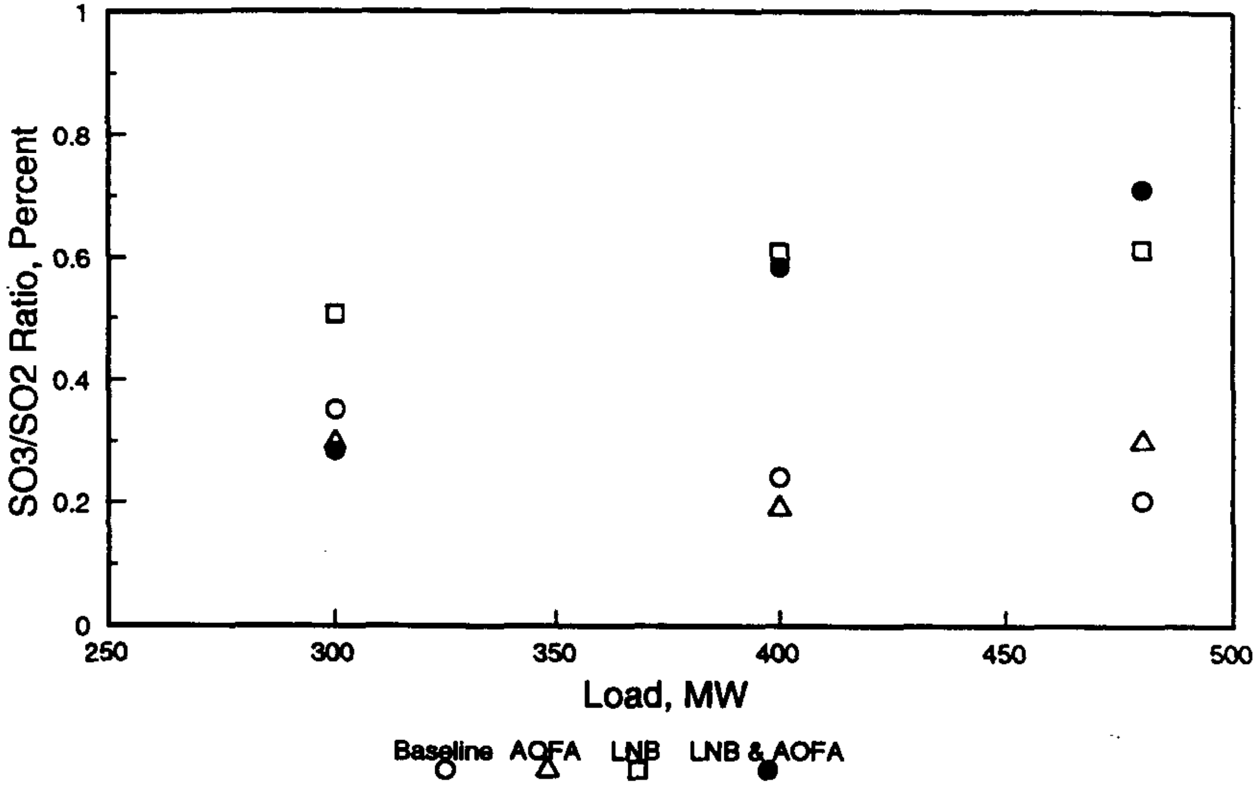

Figure 4-9. Average Preheater Outlet Gas SO_3/SO_2 Ratio Versus Load: All Test Phases

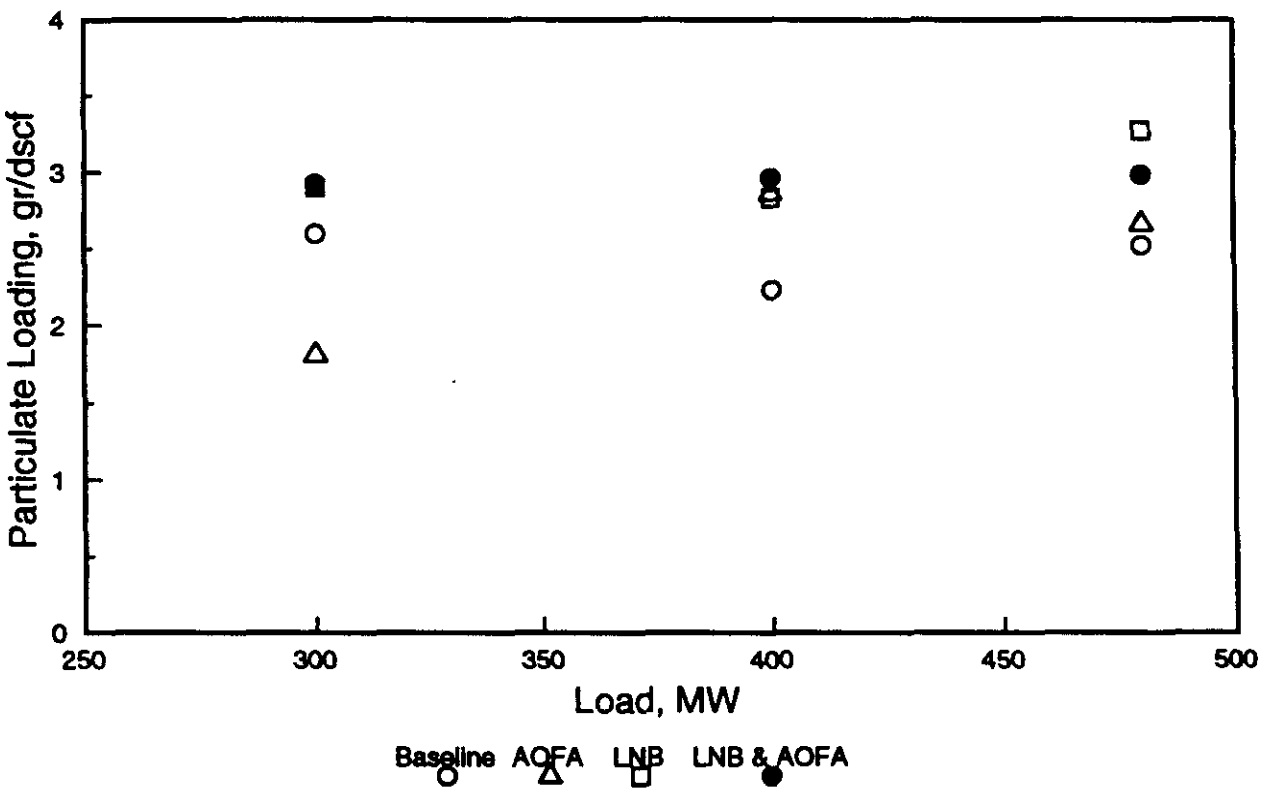

Figure 4-10. Average Preheater Outlet Gas Particulate Loading Versus Load: All Test Phases

4.3.3 Particle Size Distribution

Figure 4-11 shows the size distribution of the particulate matter in the preheater outlet gas measured during Phase 3a. The results are very similar to those obtained during previous test phases. The Phase 3b data were not available for inclusion in this report.

4.3.4 Carbon and LOI Content

The amount of unburned carbon and the loss on ignition (LOI) measured in samples of fly ash particulates are indicators of Unit 4 combustion efficiency during each test period. These two parameters were measured using the particulate samples collected to determine particulate loading. The results, shown in Figures 4-12 and 4-13 indicate that AOFA operation had the greatest impact on the amount of carbon remaining in the fly ash; the amount of carbon in the fly ash during AOFA operation was nearly twice that observed during baseline testing. Levels of carbon and LOI above baseline levels were also observed during LNB and combined LNB/AOFA operation. Figure 4-14 shows the relationship between the LOI and the carbon content of the fly ash, indicating that the measured LOI was primarily carbon.

4.3.5 In-Situ Particle Resistivity

The resistivity of the particulate matter entering an ESP is an important variable that may impact particulate removal efficiency. ETEC has suggested that ESP performance may be adversely impacted if the resistivity exceeds 2 - 5 x 10^{10} ohm-cm. The average resistivities of the particulates, measured in situ using the spark method, during each test phase are plotted versus nominal load in Figure 4-15. Similar resistivities were obtained using the voltage-current (V-I) method. No consistent trends in resistivity were observed between test phases. At 300 MW, the resistivities measured during the combined LNB/AOFA operation were somewhat higher than for the other

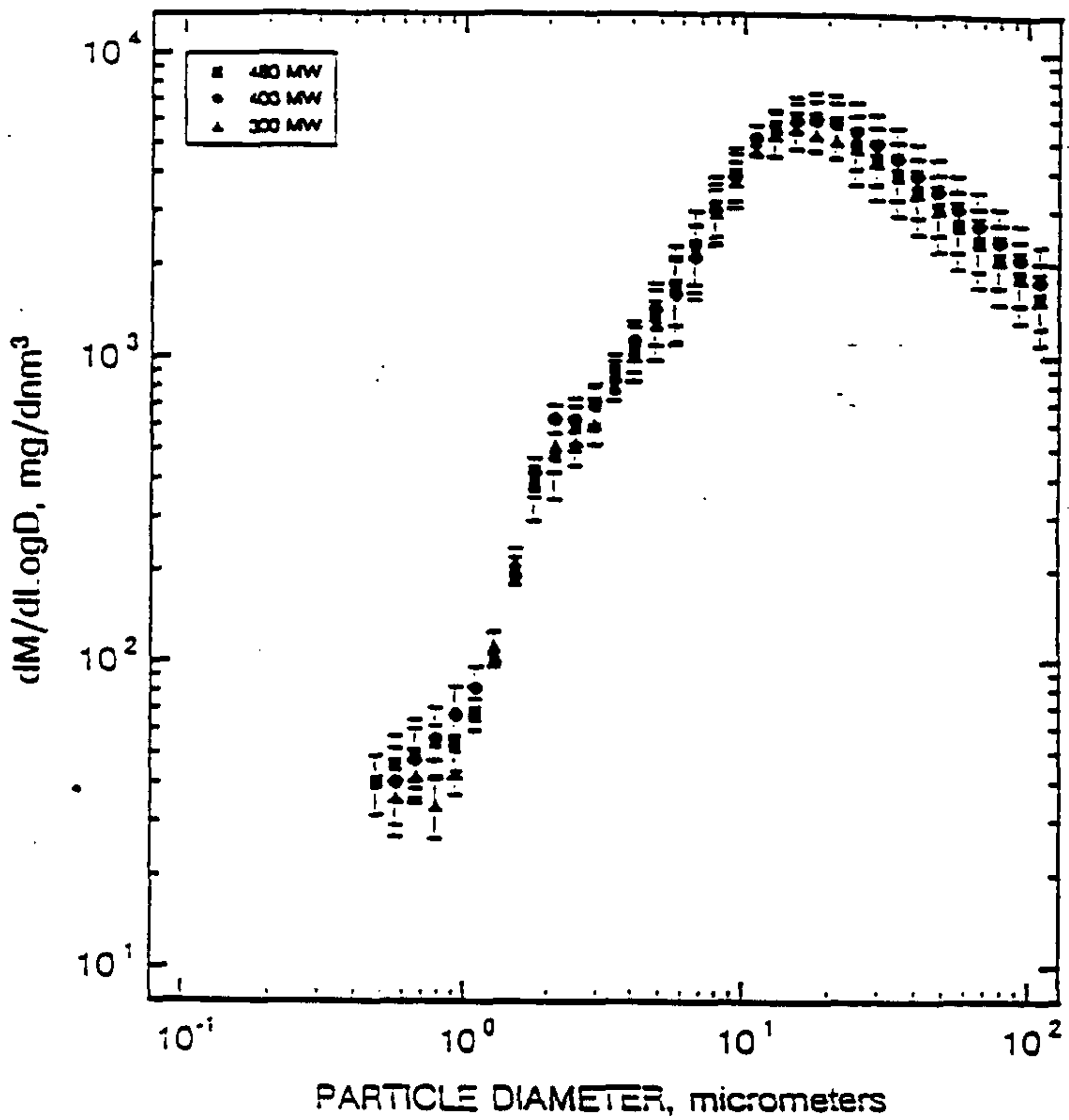

Figure 4-11. Preheater Outlet Gas Differential Particle Mass Distribution: Phase 3a (LNB) (Source: ETEC Phase Report)

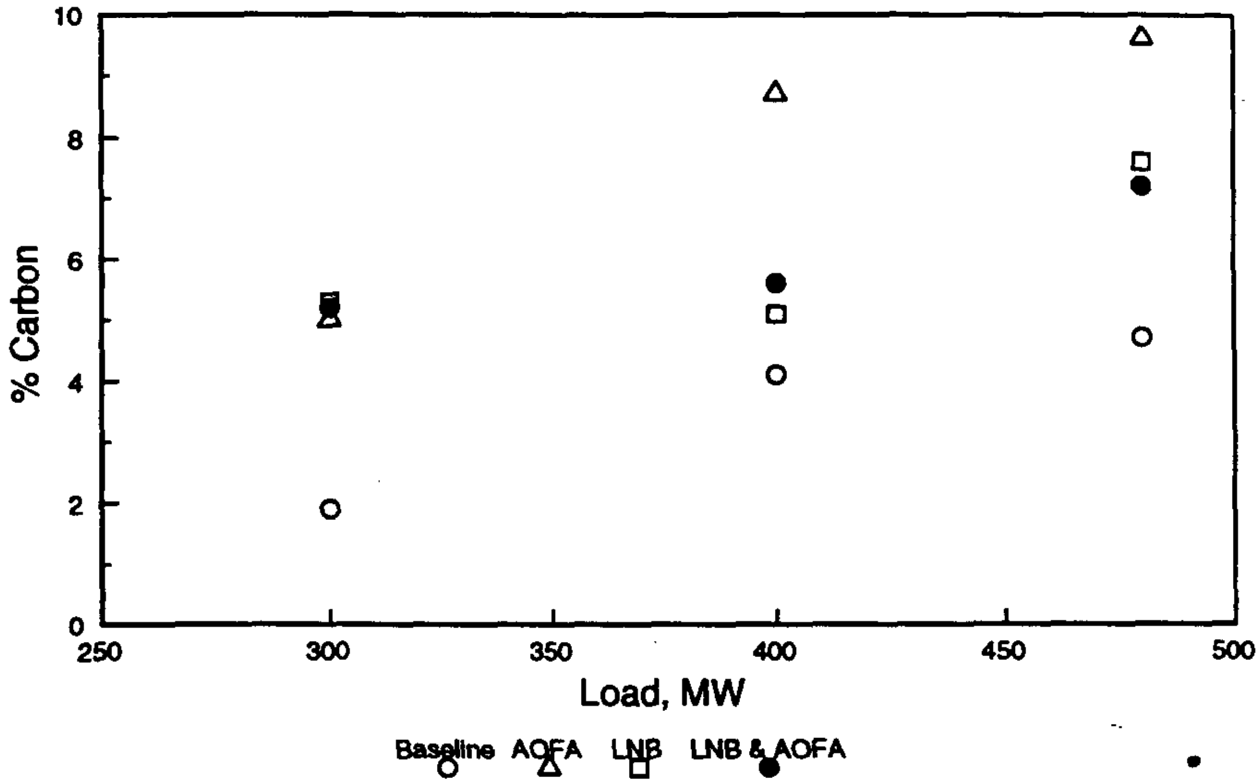

Figure 4-12. Carbon Content of Preheater Outlet Gas Particulates Versus Load: All Test Phases

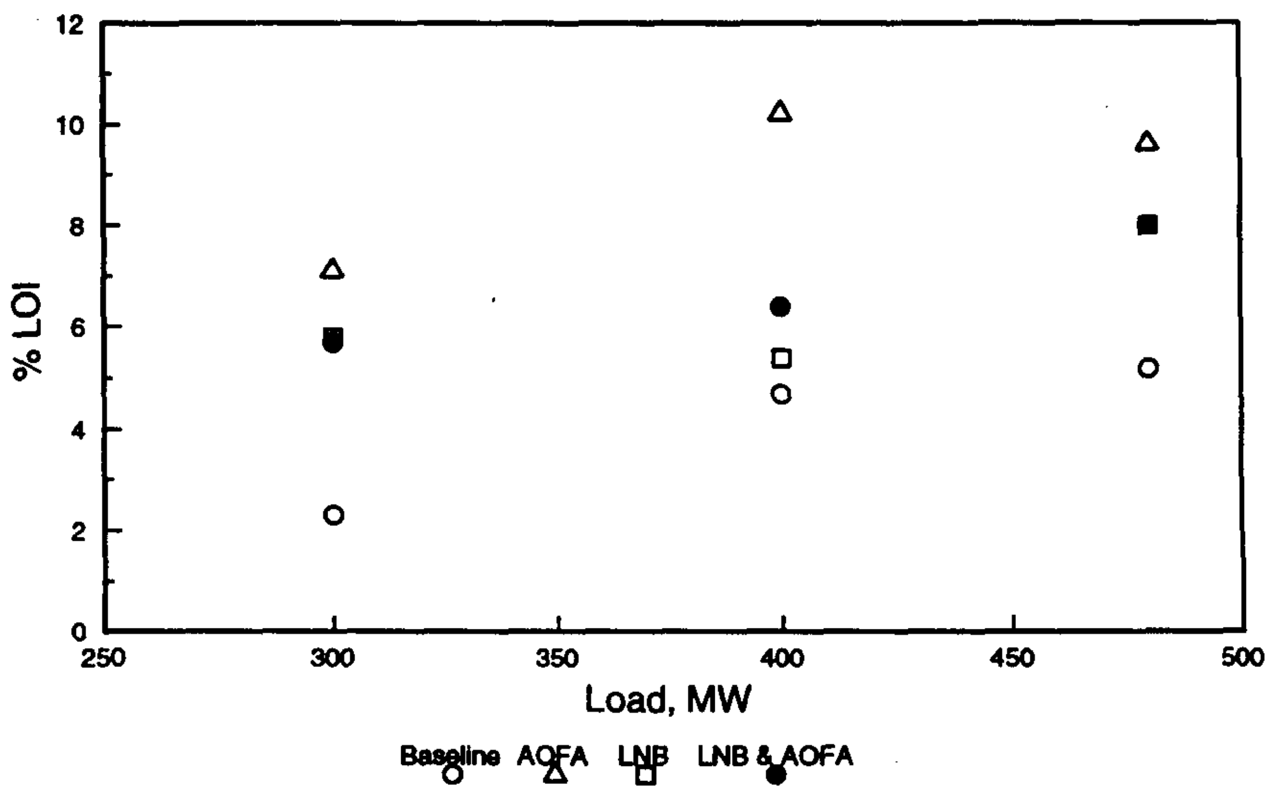

Figure 4-13. LOI Measurements of Preheater Outlet Gas Particulates Versus Load: All Test Phases

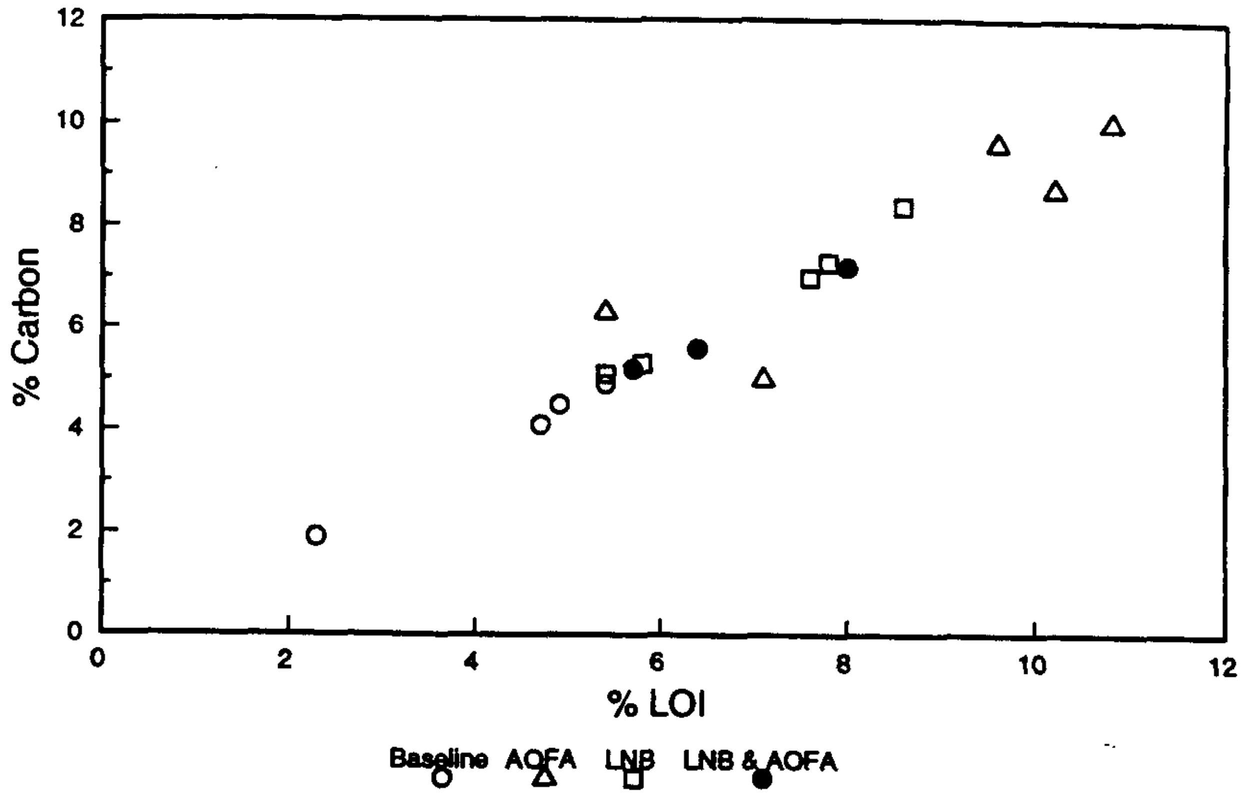

Figure 4-14. Relationship Between Carbon Content and LOI of Preheater Outlet Gas Particulate: All Test Phases

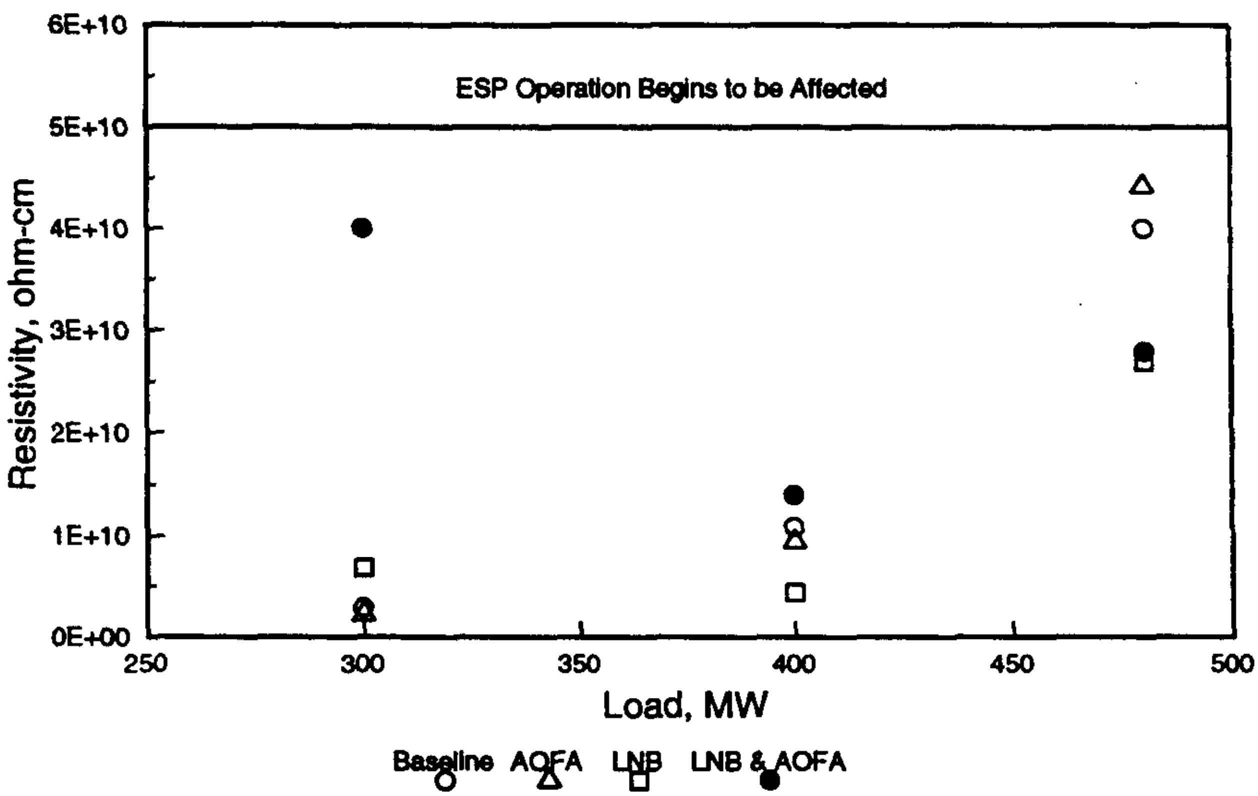

Figure 4-15. Average In-Situ Resistivity Measurements for Particle Resistivity in Preheater Outlet Gas - Spark Method

test phases. At 400 MW, the resistivities measured during all test phases were similar. At 480 MW, the measured resistivities were actually lower during LNB and combined LNB/AOFA operation than for baseline or AOFA operation. This may be due, in part, to the impacts of higher SO_3 concentrations found during LNB and combined LNB/AOFA operation.

4.4 Long-Term Monitoring Results

Long-term testing consisted of continuous measurements of selected operating parameters while the unit was under system load dispatch control. Unit load and concentrations of O_2, NO_x, SO_2, CO, and THC were measured and results recorded using the computerized data acquisition system. Five-minute average data were used to compute hourly averages that were in turn used to compute daily averages. Some five-minute data were occasionally lost due to CEM outages. In these cases, data were treated using an adaptation of EPA's NSPS guidelines for determining how much data are sufficient to compute an hourly average for emission monitoring purposes. In the case of daily average emissions, only those days meeting the NSPS guideline of at least 18 hours of valid hourly data per day were used.

Five-minute average data were used to evaluate the relationship between NO_x and load, and between the NO_x and O_2 levels in the stack gas at various load levels. Hourly average emissions, calculated from the five-minute average data, were used to assess hour-to-hour variations in NO_x emissions, O_2 levels, and load. Daily average emission data were used to establish trends in emissions as functions of O_2 levels and load, and to calculate 30-day rolling NO_x emission levels for the entire long-term period. The ETEC Phase Reports focus on the NO_x emission results. This EMP report summarizes the emission trends for NO_x (from the ETEC reports), but also presents the emission trends for SO_2, CO, and THC, based on the daily average data.

4.4.1 Nitrogen Oxides Emissions

Daily average NO_x emissions for all long-term test phases are plotted versus load in Figure 4-16. The data show that NO_x emissions were progressively reduced using AOFA, LNB, and combined LNB/AOFA technologies compared to baseline operation. A statistical analysis of the five-minute average data shows this relationship more clearly. Figure 4-17 presents the mean NO_x emission rate as a function of load; the reduction in NO_x emissions due to each low NO_x technology is shown as a function of load level in Figure 4-18. A maximum reduction in NO_x emissions of 24% was obtained during AOFA operation at high load conditions (460-490 MW); somewhat lesser reductions were obtained at lower loads. NO_x emissions during LNB operation were reduced by about 48% at high loads; the effectiveness of this technology actually increased slightly at lower loads. Combined LNB/AOFA operation produced a reduction in NO_x emissions of 67% at high load; slightly lower reductions were observed at low loads.

4.4.2 Sulfur Dioxide Emissions

Although there was considerable scatter in the measured data, average SO_2 emissions were found to be directly proportional to the average coal sulfur content during each long-term test phase, as shown in Table 4-19. These results were consistent with those from the short-term testing phases.

4.4.3 Carbon Monoxide Emissions

Daily average stack gas CO concentrations from all four long-term testing periods are plotted against stack gas oxygen concentration in Figure 4-20. Trends observed from these data are similar to those of the short-term data shown previously. The CO concentration tended to decrease with increasing oxygen concentration, although

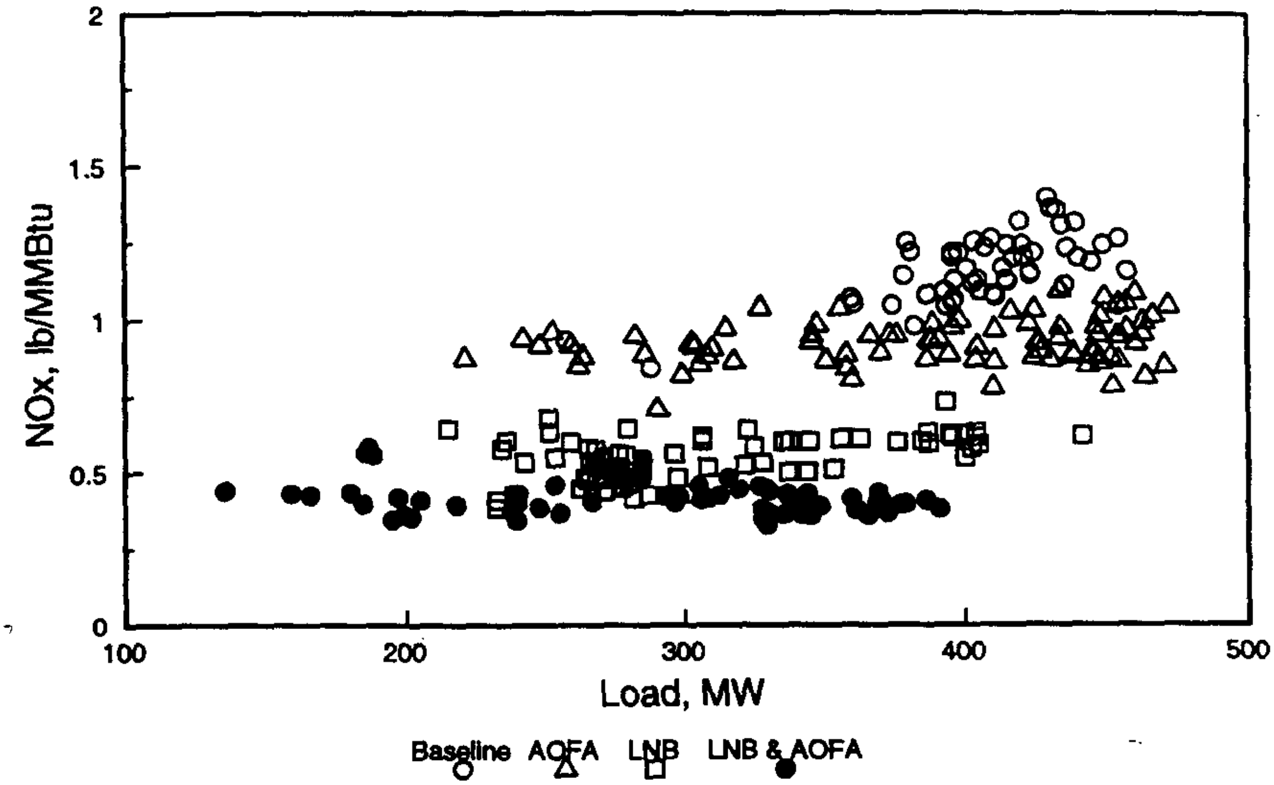

Figure 4-16. Long-Term Daily Average NO_x Emissions Versus Load: All Test Phases

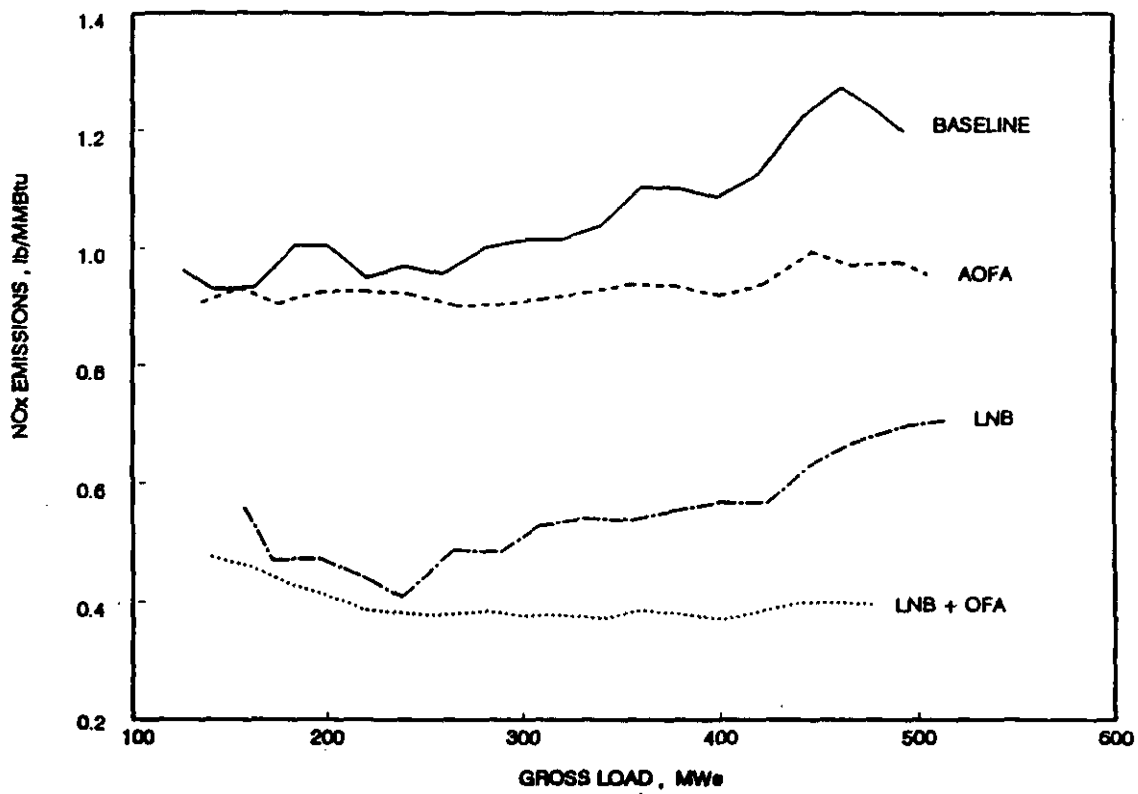

Figure 4-17. Average Long-Term NO_x Emissions Versus Load: All Test Phases

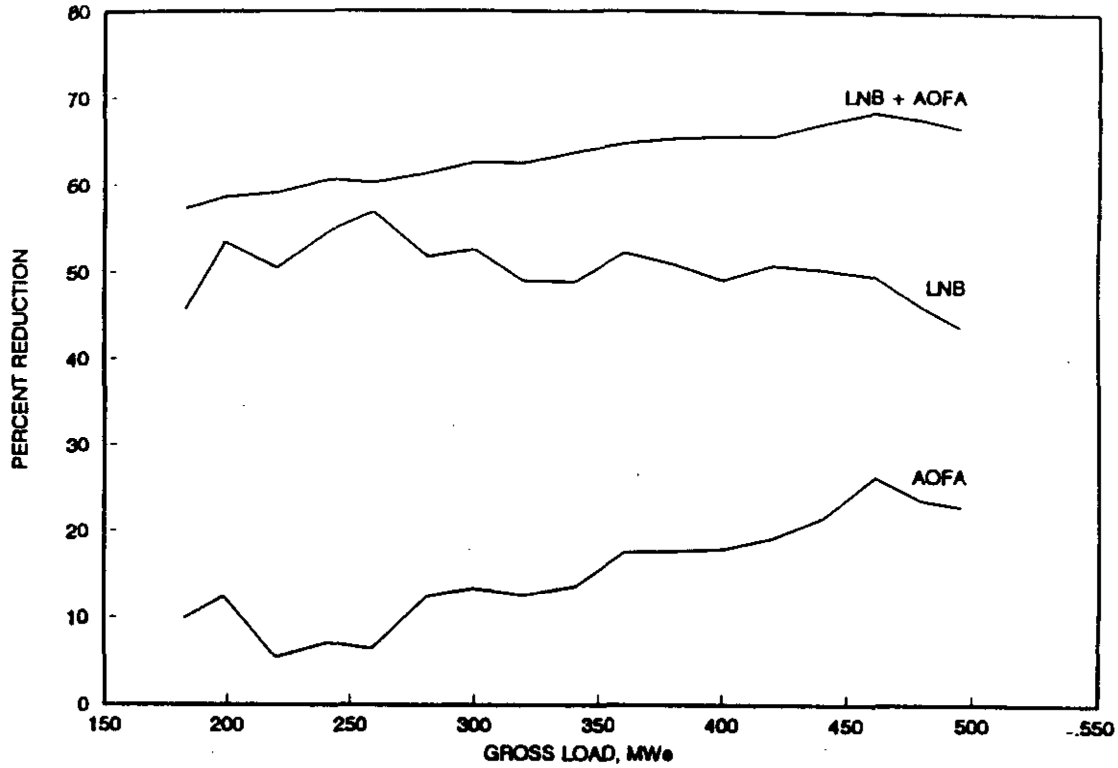

Figure 4-18. Comparison of NO_x Control Technology Effectiveness Relative to Baseline

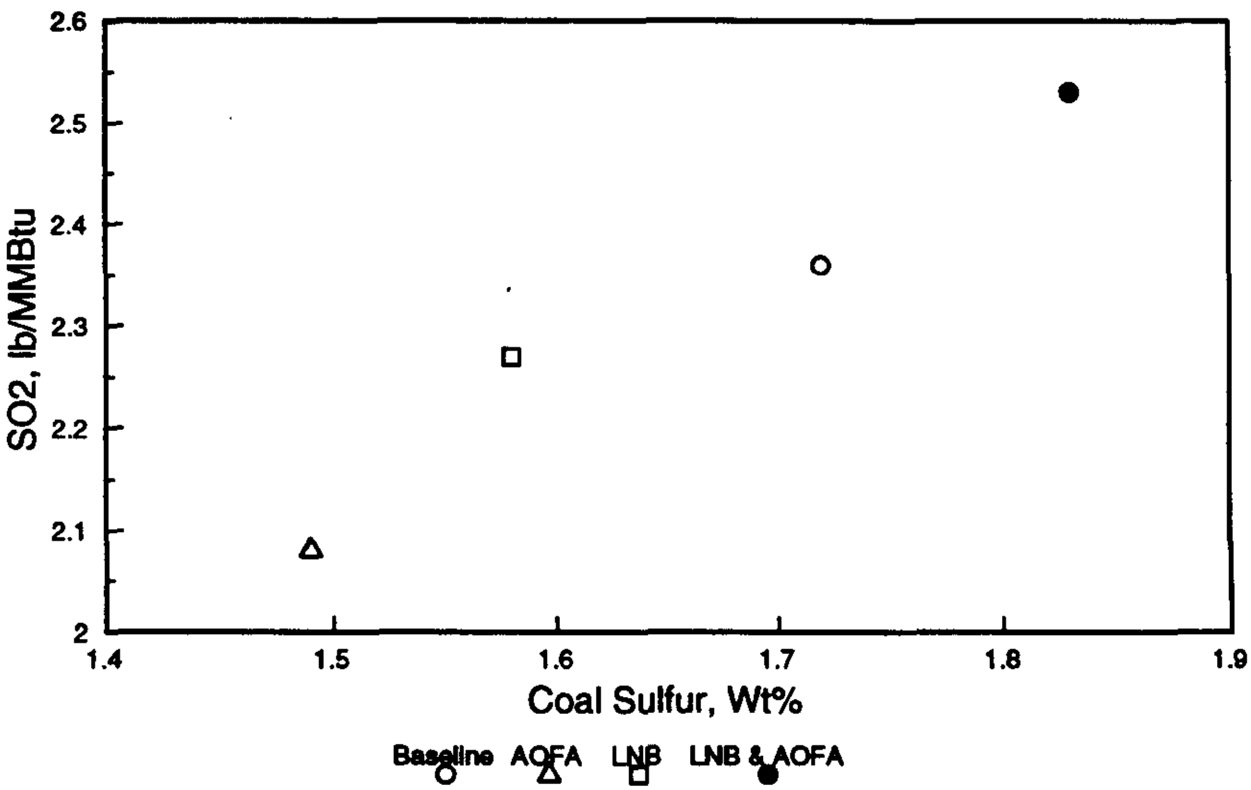

Figure 4-19. Long-Term Daily Average SO_2 Emissions Versus Coal Sulfur: All Test Phases

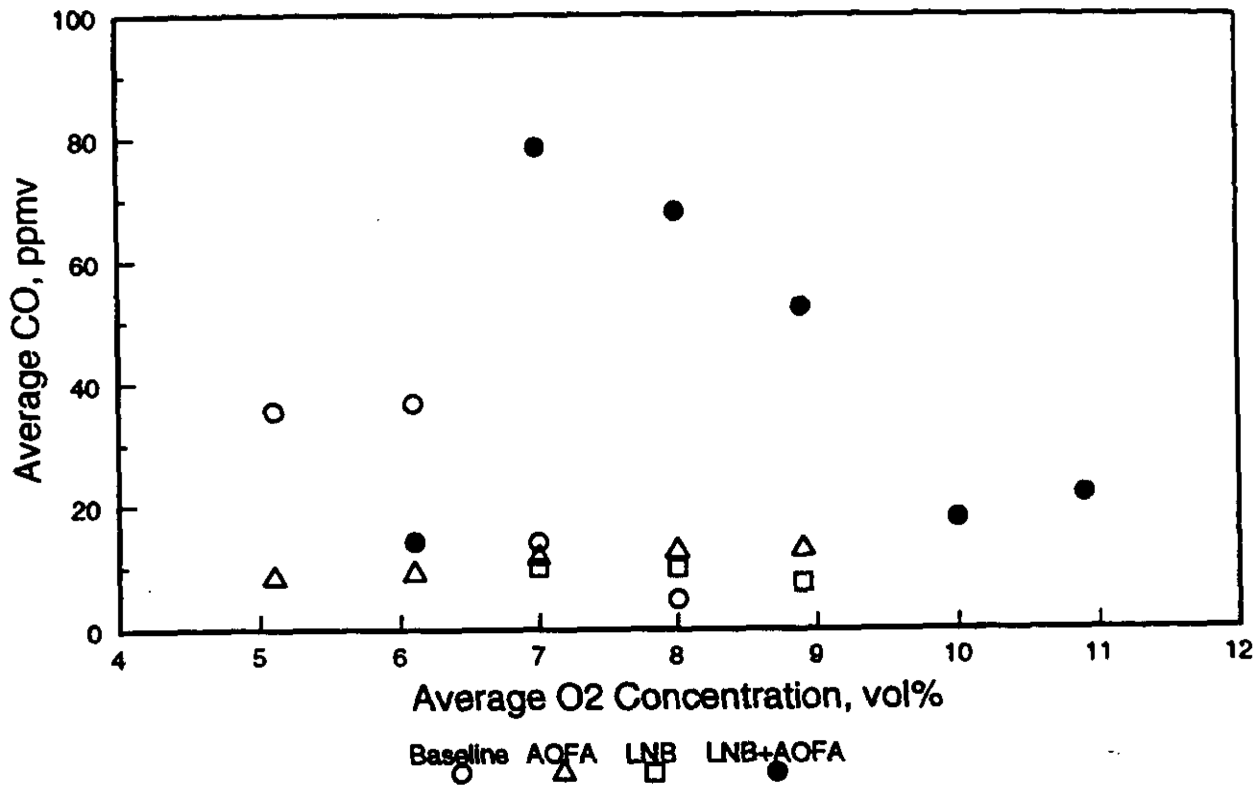

Figure 4-20. Long-Term Daily Average Stack Gas CO Versus Oxygen: All Test Phases

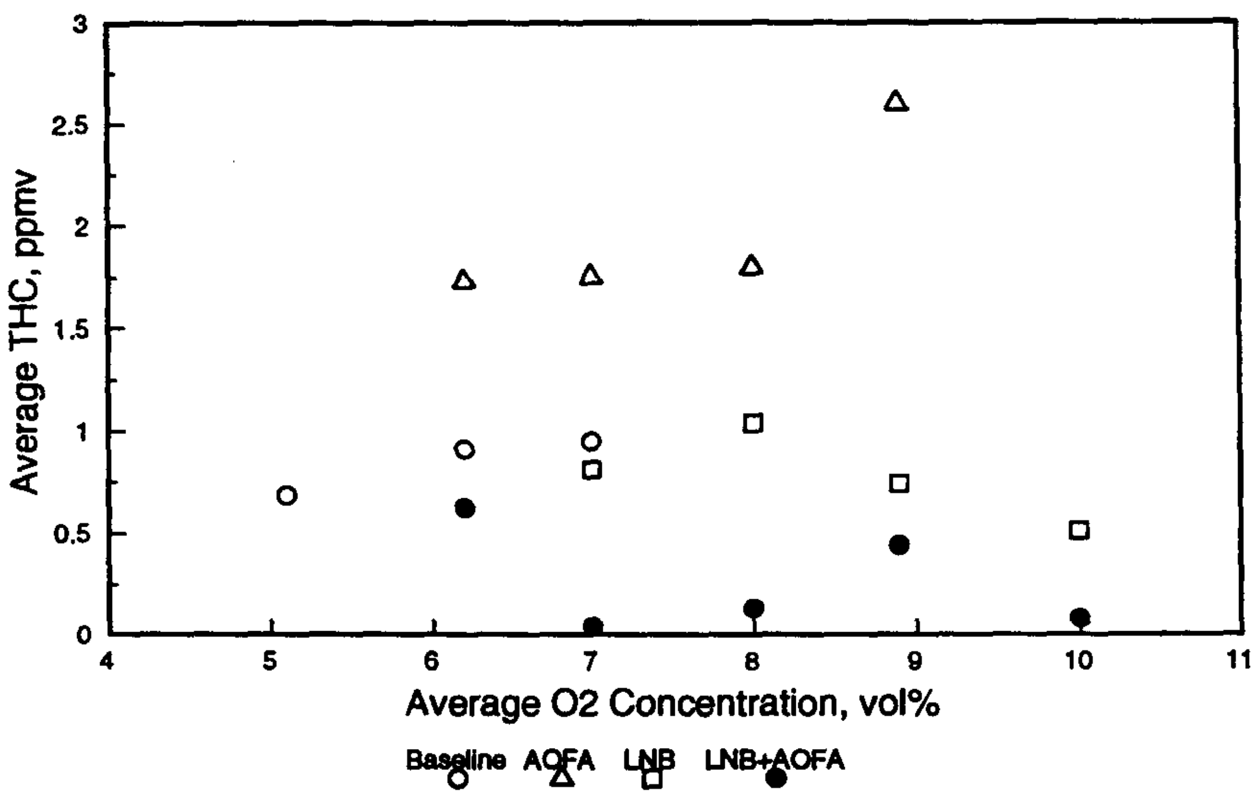

Figure 4-21. Long-Term Daily Average Stack Gas THC Versus Oxygen: All Test Phases

during long-term combined LNB/AOFA testing the CO concentration decrease occurred at a higher oxygen level than was observed for the short-term tests.

4.4.4 Total Hydrocarbons Emissions

The long-term daily average stack gas THC concentrations are plotted against oxygen concentration in Figure 4-21. In general, THC concentrations for a given testing period varied over a small range, and no consistent trends in the effects of oxygen concentration or load as THC concentrations were observed. The THC levels measured during all long-term test phases were relatively low; average levels measured during tests with combined LNB/AOFA were lower than those found during any previous test phase. These results are qualitatively consistent with the results from the short-term tests.

4.5 Compliance Monitoring Results

As a part of the EMP, data were obtained on the opacity of the stack gas stream using a continuous opacity monitor. Georgia Power provides periodic reports to the Department of Natural Resources detailing the daily excess opacity emissions from each of the two plant stacks (i.e., Units 1-3 and Unit 4). Copies of these reports have been provided as appendices to the quarterly EMP progress reports.

A summary of the daily excess opacity emissions data from the Phase 3a and Phase 3b long-term testing periods (third and fourth quarters of 1991 and third quarter of 1993, respectively) is provided in Table 4-2. The table shows the dates when the stack gas opacity exceeded the permitted limit, the number of six-minute averages during each day with excess emissions, the average opacity over all of these periods, and a short explanation of the reasons for the exceedances. The applicable emission limit is 40% opacity during any six-minute monitoring period. It is important to remember that the table contains information only for those periods when opacity exceedances occurred.

Table 4-2

Stack Gas Opacity: Summary of Excess Emissions During Phase 3 Long-Term Testing Periods[1,2]

Date	Number of Six-Minute Averages with Excess Emissions[3]	Average Opacity, %	Reason(s) for Excess Emissions
Phase 3a (August 7 - December 19, 1991)			
08/07/91	1	53	Precipitator section tripped
08/08/91	1	46	False reading on opacity monitor
08/10/91	1	42	Precipitator out of service
08/11/91	19	64	Start up
08/18/91	Printer malfunction--no printout		
08/18/91	69	62	Start up
08/19/91	147	70	Start up
08/20/91	1	43	I.D. fan put into service
08/22/91	1	42	Precipitator section tripped
08/23/91	2	40	I.D. fan put into service; boiler swing
08/24/91	1	46	Unit off line with rappers on
08/25/91	48	67	Start up
08/26/91	44	72	Start up; I.D. fan put into service
08/27/91	1	40	I.D. fan put into service
08/28/91	1	42	Sootblower maintenance
08/29/91	1	43	I.D. fan put into service
09/03/91	1	41	Precipitator section tripped
09/04/91	2	42	I.D. fan put into service; load increase for precip. compliance test
09/22/91	1	51	Precipitator section tripped
09/28/91	115	57	Start up; fans put into service
09/29/91	81	76	Start up
10/08/91	1	40	Raising load for ESP compliance tests -- boiler upset
10/09/91	1	41	Raising load for ESP compliance test - ESP sections tripped
10/12/91	2	44	ESP section tripped; adjusting boiler air for ESP compliance test
10/14/91	2	57	ESP sections tripped
10/15/91	1	40	ESP section tripped
10/18/91	1	48	ESP section tripped

Table 4-2 (Continued)

Date	Number of Six-Minute Averages with Excess Emissions[a]	Average Opacity, %	Reason(s) for Excess Emissions
10/21/91	12	73	Start up
10/22/91	95	76	Start up
11/01/91	1	45	Put I.D. fan into service
11/04/91	1	58	I.D. fan damper closed off, lost fire
11/26/91	1	51	ESP section tripped
12/01/91	98	60	Start up
12/02/91	66	76	Start up
12/05/91	1	47	Unit off line, ESP out of service
12/08/91	20	67	Start up
12/09/91	102	76	Start up
12/10/91	1	47	Put I.D. fan into service
12/16/91	5	56	I.D. fan damper closed off, lost fire; coal mill malfunction
Phase 3b (June 24 - August 19, 1993)			
06/28/93	1	43	Adjusting ammonia to help opacity
07/10/93	1	41	Boiler pressure swing
07/13/93	5	50	"B" mill put into service; precipitator sections tripped
07/16/93	1	40	Precipitator section tripped
07/17/93	22	68	Unit trip due to e.h. control problem; "C" mill put into service
07/18/93	2	42	"B" mill put into service; reduced load due to increasing opacity
07/20/93	5	48	Precipitator rapper control failure
07/21/93	2	41	Continuing rapper control problem; "C" mill loaded up
07/22/93	4	41	Raising load - pressure swinging; rapper controls tripped
07/24/93	1	43	Fuel and air control problems
07/26/93	2	45	Put "A" I. D. fan and "B" pulverizer into service
07/28/93	1	42	Fuel problems while raising load
07/30/93	1	41	Upset caused by slag falling in boiler
08/05/93	4	41	Precipitator sections out of service during increase in load

Table 4-2 (Continued)

Date	Number of Six-Minute Averages with Excess Emissions[3]	Average Opacity, %	Reason(s) for Excess Emissions
08/08/93	1	51	Pressure swinging during load increase
08/09/93	4	53	E.H. control problem; boiler swinging; ammonia system adjustment
08/10/93	6	47	Air flow swinging; precipitator sections tripped
08/11/93	3	43	Precipitator sections tripped; raising load for NO_x testing
08/14/93	7	50	Unit off-line; precipitator not in service
08/15/93	49	59	Start-up
08/16/93	39	69	Start-up; precipitator tripped
08/17/93	1	47	Precipitator section tripped
08/18/93	3	44	Raising load; precipitator problems

[1] This summary was taken from Quarterly Compliance Reports submitted by Georgia Power to the Georgia Department of Natural Resources as required by the Georgia Air Quality Control rules and the operating permit for Unit 4 [3rd Quarter 1991, 4th Quarter 1991].

[2] Data are shown for Unit 4 only.

[3] The emission limit is 40% opacity for any six-minute averaging period.

During the majority of the time when the boiler was in operation the stack gas opacity was below the opacity limit.

An examination of the table shows that the majority of the excess emissions occurred during boiler start up or shut down periods, or when there were difficulties with the ESP (e.g., low power levels, arcing, trip-outs, problems or adjustments to the rapping mechanism or SO_3 injection system). Excess emissions also occurred during periods of upset or unusual operation of the coal feeders or fans, or when the boiler tubes were being cleaned by soot blowing or deslagging. None of these conditions appears to have been directly attributable to the LNB or LNB/AOFA technologies, since similar causes of excess emissions were also observed during baseline testing.

5.0 AQUEOUS STREAM MONITORING RESULTS

This section presents the results of aqueous stream monitoring performed during the periods covered by Phases 3a and 3b. Three aqueous streams were monitored: ash pond emergency overflow, ash transport water blowdown, and final discharge. The parameters selected for monitoring were those required for compliance with Plant Hammond's existing NPDES permit.

Table 5-1 presents the actual and planned aqueous stream monitoring. As shown in this table, all of the planned monitoring was performed during Phases 3a and 3b. Since there were discharges from the ash pond emergency overflow only during the period May 3-8, this stream was monitored only during that period. The aqueous stream monitoring results were taken from quarterly compliance reports submitted by Georgia Power Company to the Environmental Protection Division of the Georgia Department of Natural Resources. These compliance reports have also been included as appendices to the EMP Quarterly Reports prepared and submitted to DOE as part of this project. The data summarized in this section were taken from the compliance reports for the following periods: third and fourth quarters of 1991, first quarter of 1992 (Phase 3a), and second and third quarters of 1993 (Phase 3b).

Table 5-2 summarizes the environmental monitoring results obtained during Phases 3a and 3b; averages, standard deviations, number of data points, and ranges are shown for each parameter. Permit limits are also given for comparison purposes. The results from Phases 3a and 3b are similar to those obtained during previous test phases. The only parameter to show exceedances of the regulatory limits imposed by the plant's NPDES permit was the pH of the ash pond emergency overflow during the period May 3-8, 1993.

Table 5-1

Aqueous Streams: Actual and Planned Monitoring[1]

Parameter	Ash Pond Emergency Overflow	Ash Transport Water Blowdown	Final Discharge
Phase 3a			
Total Suspended Solids	0/12[2]	16/12	0/0
pH	0/12[2]	0/0	14/12
Oil & Grease	0/12[2]	15/12	0/0
Phase 3b			
Total Suspended Solids	2/2[3]	9/8	0/0
pH	6/2[3]	0/0	9/8
Oil & Grease	1/2[3]	9/8	0/0

[1] 16/12 = 16 measurements made/12 measurements planned.

[2] There were no discharges during the reporting period.

[3] An emergency discharge occurred between May 3 and May 8, 1993.

Table 5-2

Aqueous Streams: Phase 3 Results

Parameter	Average	Standard Deviation	No. of Data Points	Range
Phase 3a				
Ash Pond Emergency Overflow				
TSS (mg/L)	NA[1]			
pH	NA			
Oil & Grease (mg/L)	NA			
Ash Transport Water Blowdown				
TSS (mg/L)	6.3	2.8	16	2 - 11
Oil & Grease (mg/L)	<5	0	15	<5
Final Discharge				
pH	7.34	0.14	14	7.09 - 7.56
Phase 3b				
Ash Pond Emergency Overflow				
TSS (mg/L)	4	0	2	4.0
pH	4.84	0.08	6	4.75 - 4.92
Oil & Grease (mg/L)	<5	--	1	<5
Ash Transport Water Blowdown				
TSS (mg/L)	3.7	1.8	9	<1 - 6
Oil & Grease (mg/L)	<5	0	9	<5
Final Discharge				
pH	7.42	0.18	9	7.20 - 7.82

[1] NA - There were no discharges during the Phase 3a reporting period.

6.0 SOLID STREAM MONITORING RESULTS

The results of solid stream monitoring performed during Phases 3a and 3b are presented in this section.

Monitoring of four solid streams was conducted as specified in the project's Environmental Monitoring Plan: coal feed, bottom ash, ESP fly ash, and CEGRIT fly ash. The coal was monitored to detect changes in composition that might impact the results obtained for the NO_x reduction technologies. The bottom and fly ash were monitored for loss on ignition to determine the potential impacts of the NO_x reduction technologies on coal utilization. The fly ash streams were monitored for resistivity to determine whether the NO_x reduction technologies might affect ESP control efficiency.

Table 6-1 shows the actual and planned monitoring frequencies for each of the solid stream parameters.

6.1 Coal Analyses

A statistical summary of the coal analyses performed during each of the test periods for Phases 3a and 3b is presented in Table 6-2. Figures 6-1a and 6-1b present, in graphical form, the average ultimate analyses for each of the test periods for Phases 3a and 3b, respectively. As can be seen, the coal analyses were quite consistent between each of the Phase 3a and 3b test periods. These results are also comparable to the coal analyses performed during previous phases; Table 6-3 compares the 95% confidence intervals computed using all of the data for all test phases. Sulfur levels were slightly lower during Phases 2 and 3a than for Phases 1 and 3b. The values for most of the other parameters were similar across all testing phases, especially if the variability due to different moisture levels is eliminated.

Table 6-1

Solid Streams: Actual and Planned Monitoring [1,2]

Phase 3a

Parameter	Coal				Bottom Ash			ESP Fly Ash			CEGRIT Fly Ash			
	D	P	L	V[3]	D	P	V[3]	D	P	V[3]	D	P	L	V[3]
Proximate/Ultimate Analysis	7/15	29/24	15/13	0/0										
Volatile/Semivolatile Organics														
Loss-on-Ignition (LOI)						9/18			9/9		33/52	19/18	22/13	0/0
Laboratory Resistivity									9/9					

Phase 3b

Parameter	Coal				Bottom Ash			ESP Fly Ash			CEGRIT Fly Ash			
	D	P	L	V	D	P	V	D	P	V	D	P	L	V
Proximate/Ultimate Analysis	19/16	26/21	37/9	3/5										
Volatile/Semivolatile Organics														
Loss-on-Ignition (LOI)						6/7			5/6		0/53	22/12	0/9	0/12
Laboratory Resistivity									6/6					

[1] 29/24 = 29 measurements taken/24 measurements planned.

[2] Monitoring phase elements: D = Diagnostic Tests; L = Long-term Tests; P = Performance Tests; and V = Verification Tests.

[3] Verification testing was not performed during Phase 3a.

Table 6-2

Summary of Phase 3 Coal Analyses

Phase 3a									
	Diagnostic Tests			Performance Tests			Long-Term Tests		
Parameter	Average	Std. Dev.	Range	Average	Std. Dev.	Range	Average	Std. Dev.	Range
Carbon, wt%	72.58	0.55	71.81 - 73.18	72.53	1.90	63.98 - 74.71	72.65	0.86	70.99 - 73.82
Hydrogen, wt%	4.67	0.06	4.62 - 4.76	4.67	0.15	4.13 - 4.96	4.69	0.08	4.53 - 4.81
Nitrogen, wt%	1.37	0.03	1.33 - 1.42	1.39	0.05	1.24 - 1.47	1.34	0.05	1.28 - 1.44
Sulfur, wt%	1.63	0.18	1.38 - 1.99	1.53	0.12	1.30 - 1.77	1.58	0.09	1.40 - 1.75
Chlorine, wt%	0.04	0.04	0.01 - 0.12	0.01	0.01	0.01 - 0.03	0.06	0.07	0.02 - 0.18
Oxygen, wt%	4.55	0.24	4.25 - 4.95	4.74	0.37	4.20 - 5.65	4.72	0.24	4.40 - 5.17
Ash, wt%	9.51	0.59	8.56 - 10.41	9.44	0.43	8.87 - 10.59	10.05	0.33	9.33 - 10.68
Moisture, wt%	5.69	0.84	4.64 - 6.75	5.69	1.94	3.59 - 14.90	5.00	1.13	3.67 - 7.02
HHV, Btu/lb	12,862	102	12,691 - 13,000	12,869	345	11,364 - 13,259	12,858	161	12,600 - 13,131

Phase 3b												
	Diagnostic Tests			Performance Tests			Long-Term Tests			Verification Tests		
Parameter	Average	Std. Dev.	Range	Average	Std. Dev.	Range	Average	Std. Dev.	Range	Average	Std. Dev.	Range
Carbon, wt%	69.82	1.94	67.25 - 74.03	70.68	1.59	67.78 - 73.52	70.22	2.36	66.06 - 73.19	69.30	1.78	67.69 - 71.21
Hydrogen, wt%	4.61	0.10	4.40 - 4.79	4.65	0.06	4.52 - 4.76	4.58	0.14	4.33 - 4.80	4.50	0.07	4.43 - 4.56
Nitrogen, wt%	1.40	0.05	1.32 - 1.48	1.40	0.04	1.32 - 1.49	1.35	0.03	1.28 - 1.41	1.31	0.00	1.31 - 1.31
Sulfur, wt%	1.72	0.14	1.47 - 1.89	1.68	0.12	1.51 - 1.96	1.82	0.20	1.35 - 2.21	1.77	0.10	1.66 - 1.84
Chlorine, wt%	0.04	0.02	0.02 - 0.06	0.04	0.02	0.02 - 0.08	0.02	0.01	0.01 - 0.04	0.02	0.01	0.02 - 0.03
Oxygen, wt%	6.01	0.61	4.70 - 6.94	5.60	0.53	4.21 - 6.46	5.41	0.76	4.17 - 6.99	5.03	0.66	4.34 - 5.66
Ash, wt%	9.75	0.84	7.86 - 10.92	9.53	0.48	8.69 - 10.25	10.38	0.56	9.11 - 11.33	10.62	0.23	10.36 - 10.78
Moisture, wt%	6.69	1.17	4.81 - 9.76	6.47	0.78	5.14 - 8.25	6.24	1.47	3.75 - 9.18	7.48	0.90	6.56 - 8.36
HHV, Btu/lb	12,341	384	11,790 - 13,128	12,473	287	11,976 - 12,915	12,408	445	11,560 - 12,959	12,180	343	11,852 - 12,536

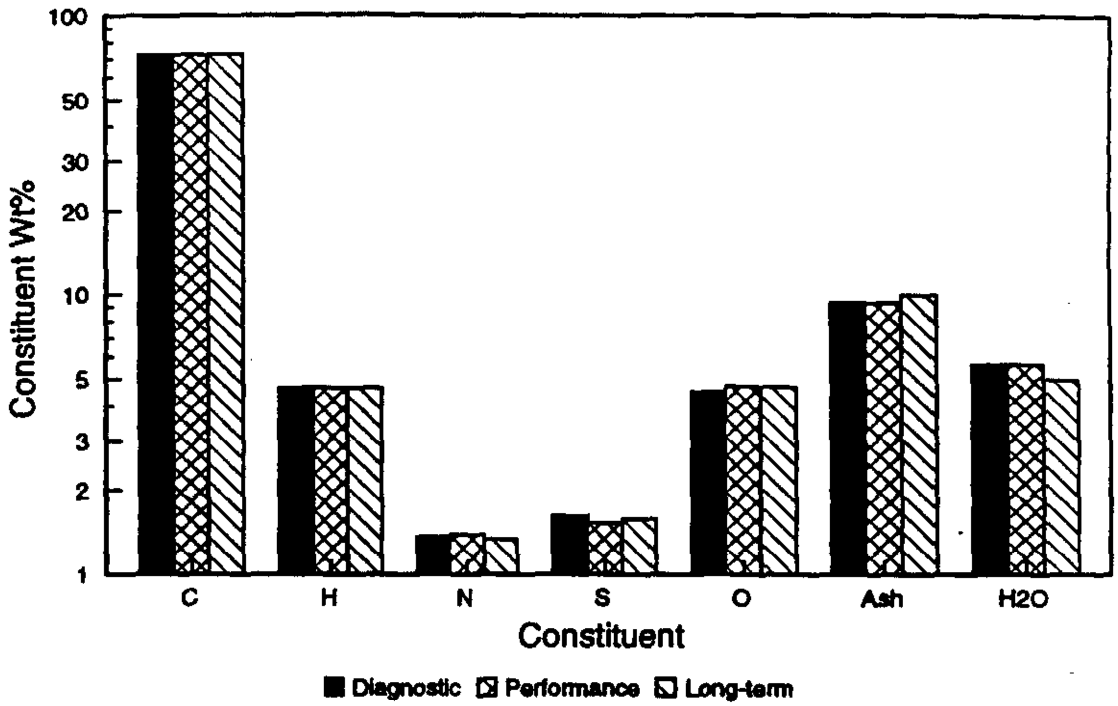

Figure 6-1a. Average Ultimate Analysis Results for Coal Feed During Phase 3a (LNB) Testing Periods

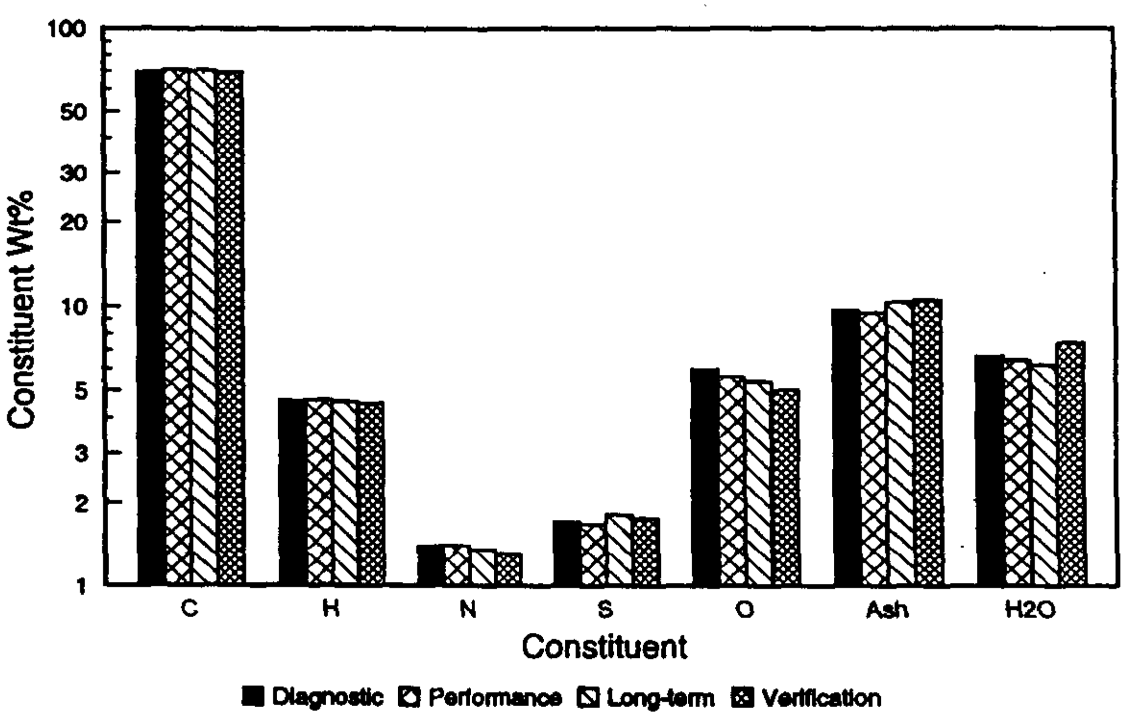

Figure 6-1b. Average Ultimate Analysis Results for Coal Feed During Phase 3b (LNB + AOFA) Testing Periods

Table 6-3

Coal Analyses: Comparison of Phases 1, 2, 3a, and 3b (95% Confidence Intervals)

Parameter	Phase 1	Phase 2
Carbon, wt%	72.03 ± 0.39	73.59 ± 0.48
Hydrogen, wt%	4.69 ± 0.03	4.69 ± 0.11
Nitrogen, wt%	1.44 ± 0.02	1.44 ± 0.02
Sulfur, wt%	1.73 ± 0.03	1.58 ± 0.05
Chlorine, wt%	0.039 ± 0.005	0.045 ± 0.006
Oxygen, wt%	5.70 ± 0.16	4.70 ± 0.27
Ash, wt%	9.93 ± 0.12	9.25 ± 0.23
Moisture, wt%	4.52 ± 0.31	4.76 ± 0.41
HHV, Btu/lb	12,845 ± 64	13,038 ± 56

Parameter	Phase 3a	Phase 3b
Carbon, wt%	72.57 ± 0.42	70.24 ± 0.44
Hydrogen, wt%	4.67 ± 0.03	4.61 ± 0.02
Nitrogen, wt%	1.37 ± 0.01	1.38 ± 0.01
Sulfur, wt%	1.56 ± 0.03	1.75 ± 0.04
Chlorine, wt%	0.03 ± 0.01	0.03 ± 0.00
Oxygen, wt%	4.71 ± 0.09	5.59 ± 0.15
Ash, wt%	9.63 ± 0.09	9.99 ± 0.15
Moisture, wt%	5.48 ± 0.46	6.45 ± 0.26
HHV, Btu/lb	12,865 ± 77	12,405 ± 83

6.2 Bottom Ash

Bottom ash was analyzed for loss-on-ignition (LOI) as a measure of the completeness of combustion. The average results (after eliminating samples that appeared to have been contaminated with coal, according to ETEC) are plotted versus nominal load in Figure 6-2 for all phases. LOI values were higher during all low NO_x test phases than during baseline operation. The highest values were observed during Phase 3a (LNB operation); values obtained during Phase 3b (LNB + AOFA) were closer to those obtained during baseline operation.

6.3 ESP Fly Ash

ESP fly ash was analyzed for LOI, and samples were also subjected to resistivity measurements in the laboratory.

Figure 6-3 presents the average LOI values at each nominal load level for all test phases. These results show that at the higher load levels the amount of uncombusted material present in the ESP fly ash during LNB and combined LNB/AOFA operation was similar to that measured during baseline monitoring. At 300 MW, the LOI was higher during LNB operation. During AOFA operation at 400 MW, significantly higher LOI levels were observed than for the other test phases. These results are consistent with the LOI measurements made on other solid streams leaving the boiler.

The resistivity of the ESP fly ash samples was measured at a series of temperatures in the laboratory. The results for the ESP fly ash obtained during the 480 MWe LNB tests are shown in Figure 6-4a, while those from combined LNB/AOFA operation are given in Figure 6-4b. Tests were also conducted at a single temperature in the presence of 3 ppm SO_3; this concentration is representative of the SO_3 level measured in the flue gas for these tests. The data indicate that in the presence of the

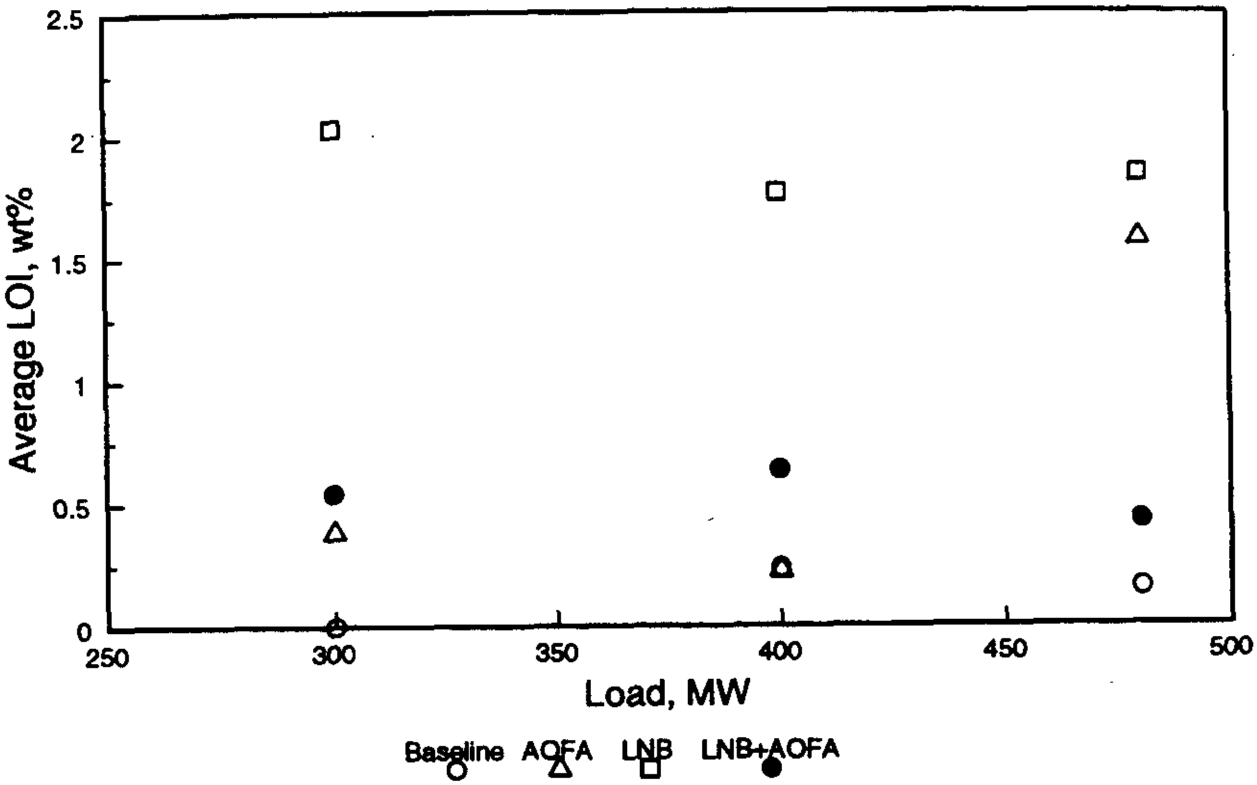

Figure 6-2. Average Bottom Ash LOI Measurement Versus Load: All Test Phases

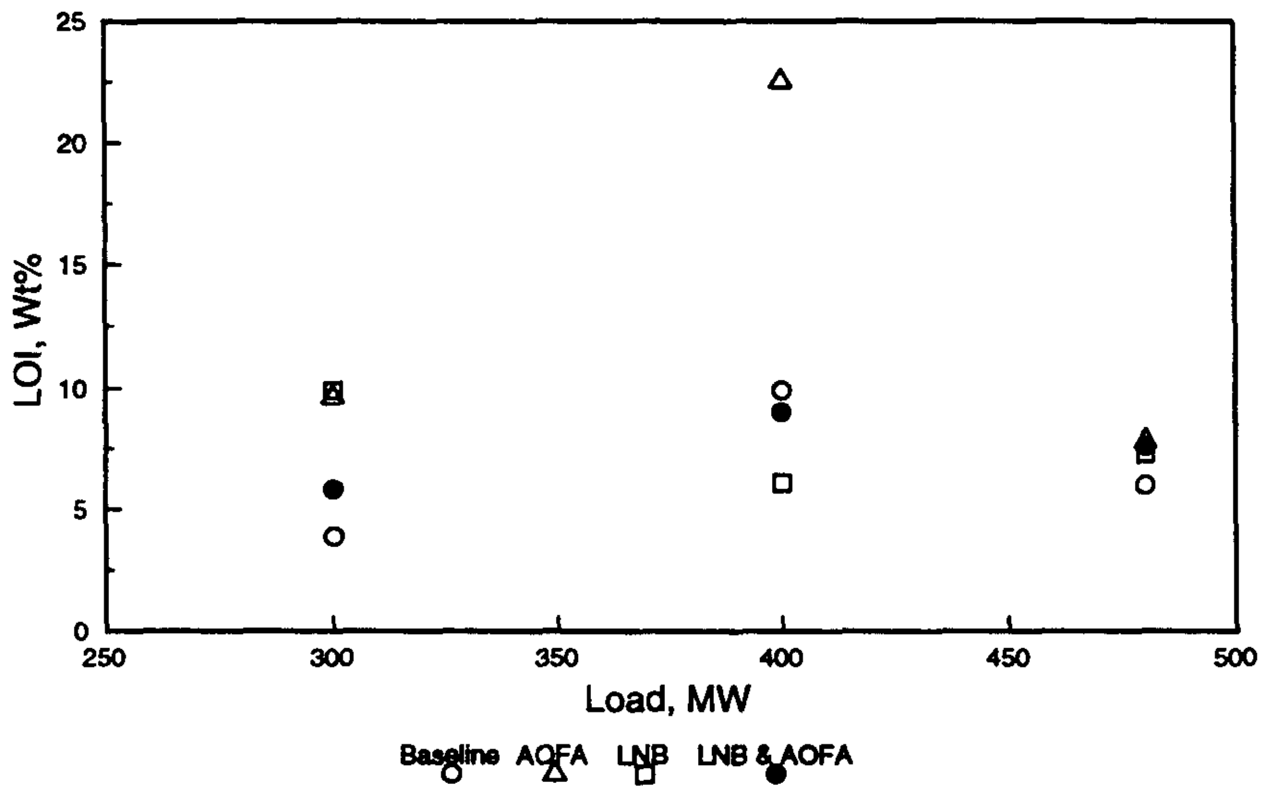

Figure 6-3. Average ESP Fly Ash LOI Measurement Versus Load: All Test Phases

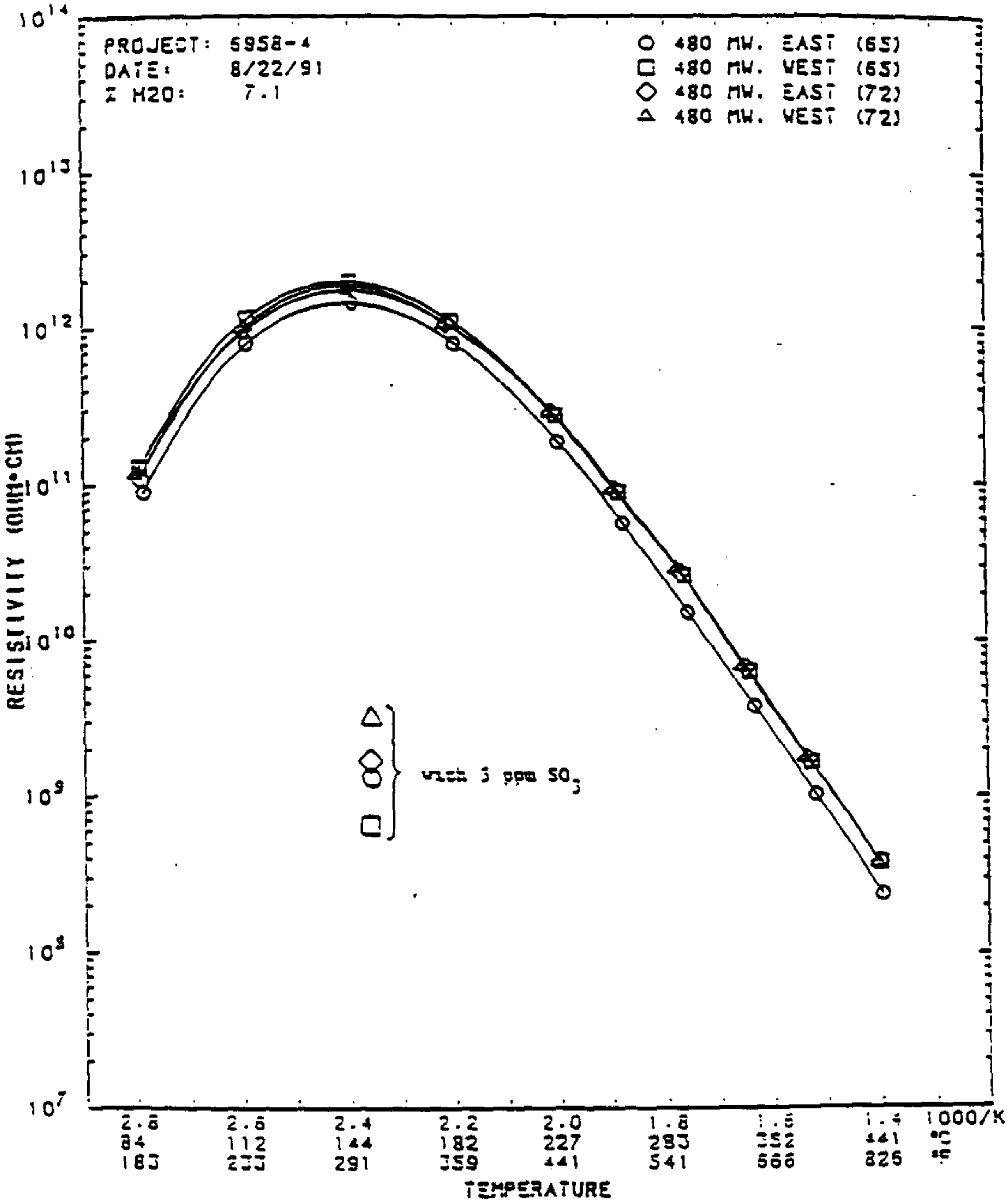

Figure 6-4a. ESP Hopper Ash Resistivity: Phase 3a (LNB)
(Source: ETEC Phase 3a Report)

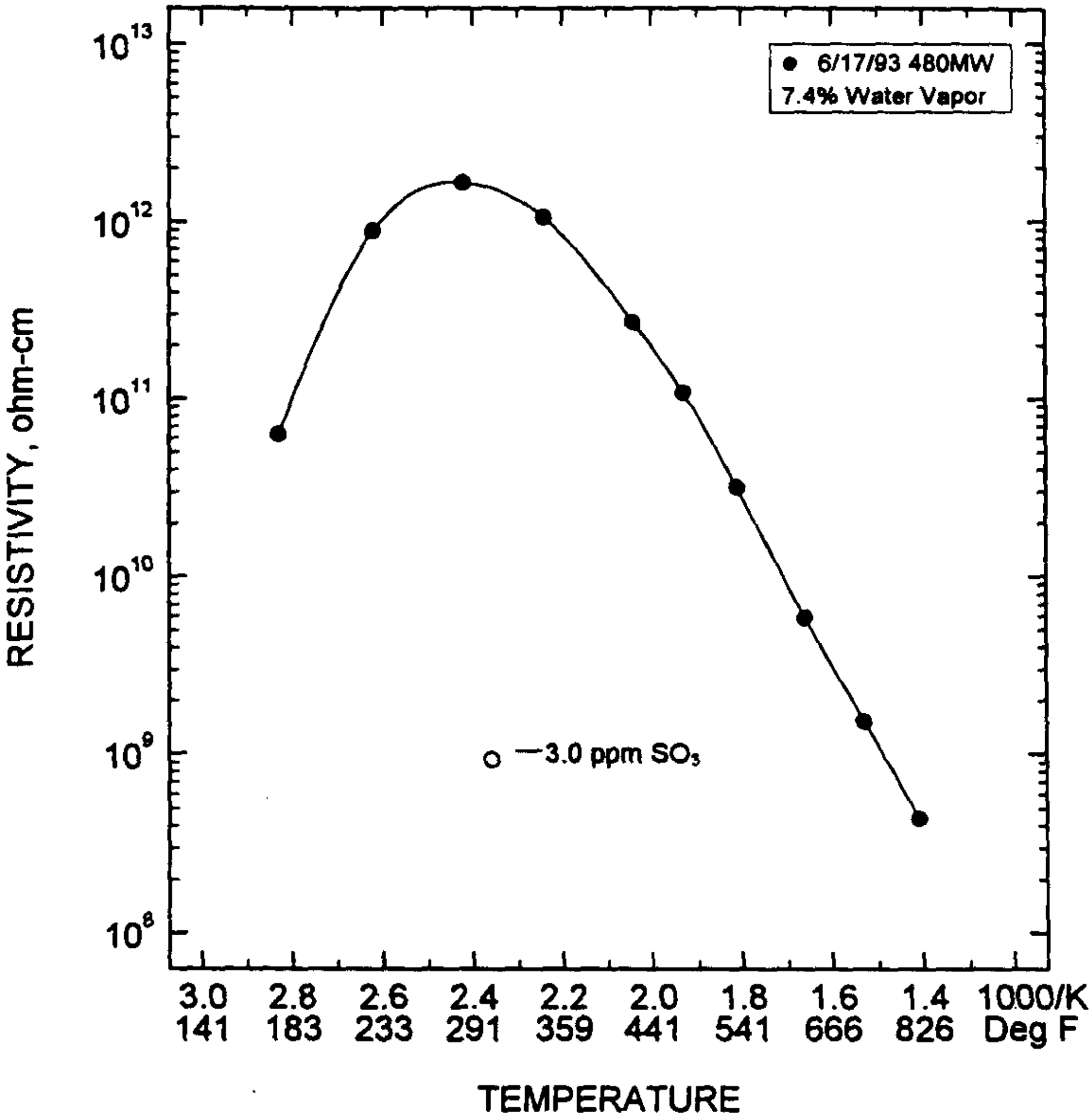

Figure 6-4b. ESP Hopper Ash Resistivity: Phase 3b (LNB + AOFA)
(Source: SRI)

measured SO_3 concentrations, ESP performance should not be limited by fly ash resistivity. Similar results were obtained during baseline and AOFA test phases.

6.4 CEGRIT Fly Ash

Grab samples of the fly ash in the furnace backpass were collected using the on-line CEGRIT Samplers. These samples were analyzed for LOI; the mean values at each load level are presented graphically in Figure 6-5. For comparison purposes, the mean values from all test phases are plotted on the same graph. The data show that the LOI measured in the CEGRIT fly ash was higher during AOFA operation than during the baseline testing, while the levels during LNB and combined LNB/AOFA operations were similar to the baseline measurements. This is consistent with the LOI measurements made on other solid streams leaving the boiler. The highest LOI level was measured during AOFA operation at a load of 400 MW; this was also the case with ESP fly ash.

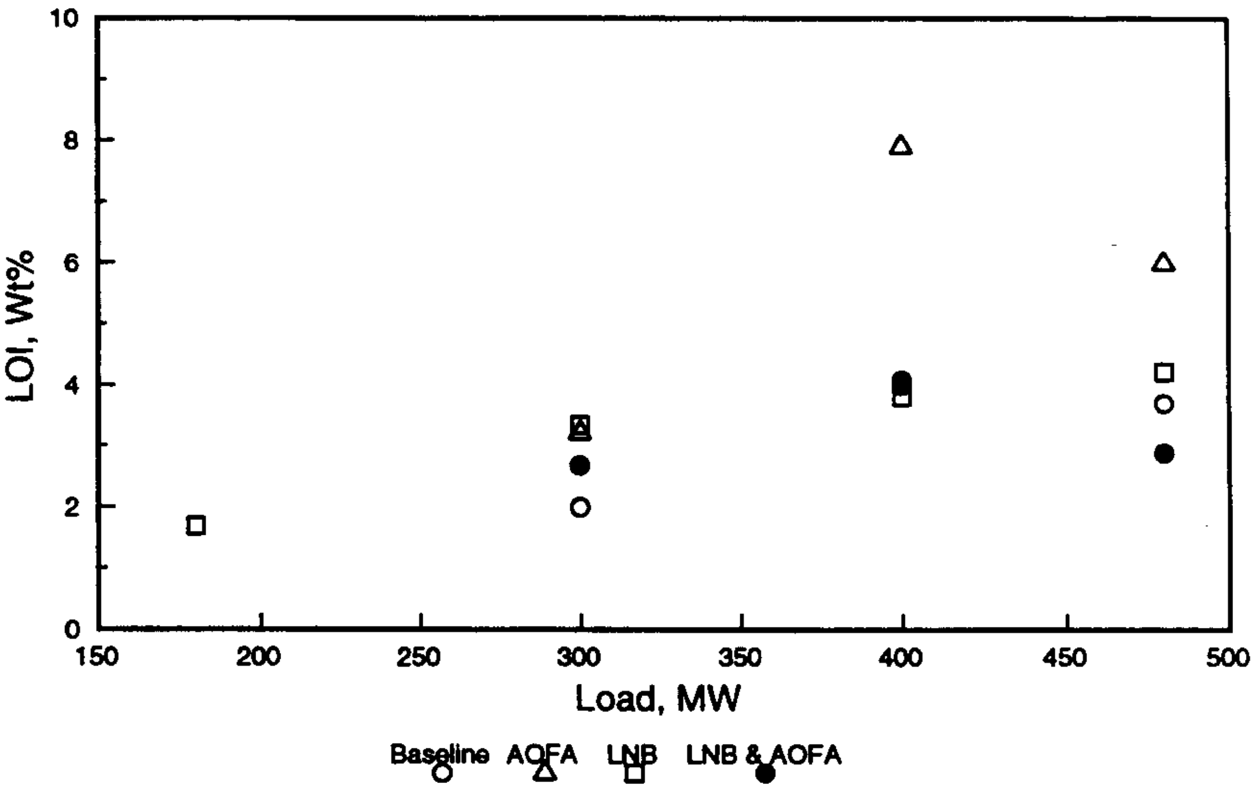

Figure 6-5. Average CEGRIT Ash LOI Measurements Versus Load: All Test Phases

7.0 QUALITY ASSURANCE AND QUALITY CONTROL

The Environmental Monitoring Plan for the Plant Hammond Clean Coal project includes, as an appendix, a quality assurance/quality (QA/QC) control plan. That plan describes procedures for producing acceptable data, including:

- Adherence to accepted methods;
- Adequate documentation and sample custody; and
- Quality assessment.

This section presents the results of each of these QA/QC procedures performed during Phase 3 testing.

7.1 Adherence to Accepted Methods

The sampling and analytical methods specified by the EMP and used during Phase 3 are summarized in Section 3 of this report.

As discussed in Section 3, there were no deviations from the procedures specified in the EMP during Phase 3.

7.2 Adequate Documentation and Sample Custody

At Plant Hammond, documentation and sample custody procedures that are part of the existing compliance monitoring programs have been approved by the state regulatory agency and were followed during EMP activities. Documentation was reviewed during audits of both compliance and supplemental monitoring.

Procedures for documentation and sample custody for supplemental monitoring were reviewed as part of a Technical Systems Audit conducted by Radian

Corporation from July 11 to 13, 1990, during the Phase 2 performance testing period. The audit included activities of Spectrum Systems, Inc. (the CEM); ETEC (coal and ash sampling); and SoRI (outlet gas sampling and analysis). A report containing the detailed results of this audit was prepared and included in the Quarterly EMP Report for the period July - September 1991. This audit found no major problems, but informal recommendations were made for improvements in the sample tracking system for coal and ash samples that are sent off-site for analysis. A follow-up to this audit, conducted in March 1991, found that these recommendations had been successfully implemented.

7.3 Quality Assessment

Quality assessment was provided by the collection and analysis of replicate samples and "blind" audit samples. The results of these analyses provided the basis for estimating precision and accuracy for the parameters measured.

During Phase 3, replicate samples of the coal feed were collected and analyzed as summarized in Table 7-1. The results show that satisfactory accuracy (as measured using the coefficient of variation, defined as the sample standard deviation divided by the sample mean) was obtained for nearly all of the ultimate/proximate analysis parameters measured under the EMP. As expected, the results were not as good for chlorine, which was present at very low concentrations.

Table 7-1

Summary of Replicate Coal Samples for Supplemental Monitoring

Date/Test	H_2O, %	C, %	H, %	N, %	Cl, %	S, %	Ash, %	BTU/lb
07/17/91	4.62	73.54	4.74	1.38	0.02	1.66	9.31	13,094
	4.68	72.93	4.57	1.44	0.03	1.71	9.37	13,058
% COV	0.91	0.59	2.58	3.01	28.28	2.10	0.45	0.19
07/24/91	6.00	72.66	4.65	1.37	0.01	1.42	8.87	12,833
	6.36	71.64	4.39	1.35	0.01	1.42	9.48	12,714
% COV	4.12	1.00	4.07	1.04	0.00	0.00	4.70	0.66
07/28/91	5.74	72.99	4.73	1.43	0.01	1.50	9.16	12,938
	4.87	72.29	4.50	1.39	0.01	1.47	9.83	13,035
% COV	11.60	0.68	3.52	2.01	0.00	1.43	4.99	0.53

COV is the coefficient of variation, defined as (Standard Deviation/Mean) x 100 percent.

8.0 COMPLIANCE REPORTING

During Phase 3a, which began on July 9, 1991 and ended on January 15, 1992, and Phase 3b, which began on May 6, 1993 and ended on August 26, 1993, compliance reports were submitted by Georgia Power Company to the Environmental Protection Division of the Georgia Department of Natural Resources, in accordance with the requirements of Unit 4's air operating permit (No. 4911-057-5011-0), as amended, and of Plant Hammond's NPDES permit (GA0001457). The air operating permit was amended effective February 2, 1990, to account for the AOFA system and the low NO_x burners.

The air operating permit requires the monitoring of coal feed composition (i.e., sulfur, ash, moisture, and heating value), particulate matter emissions (as total particulate loading), and opacity. The NPDES permit requires that the pH and concentrations of suspended solids and oil and grease be reported for various aqueous discharge streams.

Copies of the compliance reports have been included as appendices to the quarterly and annual EMP reports for this project.

9.0 CONCLUSIONS

The following conclusions were drawn from the results presented in this EMP Phase 3 and Final Report:

- NO_x emissions were progressively reduced relative to baseline levels using AOFA, LNB, and combined LNB/AOFA technologies. Based on the analysis of the long-term data, NO_x emissions reductions during high load operations were 24% using AOFA, 48% using LNB, and 67% during combined LNB/AOFA operation. The AOFA NO_x emission reduction decreased to about 12% when operating at low loads (i.e., 300 MW); reductions using LNB and LNB/AOFA remained more nearly constant over the range of boiler operating conditions.

- All three NO_x reduction technologies resulted in increased levels of loss on ignition (LOI) and carbon in the boiler outlet solids, indicative of a small decrease in overall coal utilization compared to baseline operation. AOFA operation showed the greatest impact; both LOI and carbon levels in the fly ash were nearly twice as high as those observed during baseline testing. Smaller increases relative to baseline were observed during LNB and LNB/ AOFA operations. The LOI appeared to consist primarily (i.e., over 90%) of unburned carbon.

- Carbon monoxide levels in the outlet gas streams appeared to be related primarily to the levels of excess oxygen used; CO levels were lower at higher oxygen levels. At lower oxygen levels, the average CO concentration during combined LNB/AOFA operation remained higher than that measured during other test phases.

- Total hydrocarbon (THC) emissions were low during all test phases. The average THC concentrations did not appear to be functions of either operating load or excess oxygen concentration.

- Sulfur dioxide emissions were comparable during all test phases. The average SO_2 emission rates appeared to vary directly with coal sulfur concentration, as expected, although individual results showed considerable variability.

- AOFA operation did not appear to have any appreciable impact on the ratio of SO_3 to SO_2 relative to baseline operation. However, this ratio was higher during LNB and combined LNB/AOFA operation at most load levels.

- Particulate loading was approximately 20% higher during LNB and combined LNB/AOFA operation than during baseline operation. The average fly ash resistivity was consistently high during combined LNB/AOFA operation, and approached levels at which the ESP operation could begin to be adversely affected; resistivities from all test phases approached these levels at high load operation.

- Aqueous stream monitoring showed exceedances of permit limits only during a single ash pond emergency discharge situation. This incident was not related to the NO_x reduction test program.

APPENDIX A

PHASE 3 EMP MONITORING DATA

SUMMARY TABLES

LIST OF TABLES

Table A-1

Economizer Outlet Gas Short-Term Test Results

Test No.	Date	Load, MW	MOOS	O_2, vol% (dry)	NO_x, ppmv @ 3% O_2	NO_x, lb/MMBtu	CO, ppmv
Diagnostic Tests--Phase 3a							
58-1	09-Jul-91	477	None	4.6	508	0.69	11
58-2	09-Jul-91	475	None	4.1	480	0.65	11
58-3	09-Jul-91	473	None	2.9	426	0.58	67
59-1	10-Jul-91	471	None	5.0	483	0.66	12
59-2	10-Jul-91	473	None	4.0	441	0.60	11
59-3	10-Jul-91	475	None	3.1	418	0.57	26
59-4	10-Jul-91	474	None	2.6	401	0.55	127
59-5	10-Jul-91	474	None	3.7	448	0.61	31
60-1	11-Jul-91	393	None	4.6	408	0.56	11
60-2	11-Jul-91	398	None	3.9	377	0.51	13
60-3	11-Jul-91	397	None	3.5	360	0.49	119
60-4	11-Jul-91	502	None	4.0	503	0.69	22
61-1	12-Jul-91	392	None	4.7	401	0.55	6
61-2	12-Jul-91	392	None	4.1	377	0.51	6
61-3	12-Jul-91	390	None	3.2	340	0.46	81
61-4	12-Jul-91	498	None	3.9	480	0.65	15
62-1	13-Jul-91	289	E	7.1	458	0.62	7
62-2	13-Jul-91	291	E	5.9	424	0.58	7
62-3	13-Jul-91	290	E	4.8	398	0.54	9
62-4	13-Jul-91	289	E	4.0	398	0.54	14
62-5	13-Jul-91	474	None	4.3	471	0.64	18
63-1	14-Jul-91	302	B&E	5.8	366	0.50	13
63-2	14-Jul-91	305	E	5.7	425	0.58	10
63-3	14-Jul-91	303	E	4.8	402	0.55	26
64-1	15-Jul-91	467	None	4.6	487	0.66	13
64-2	15-Jul-91	470	None	3.3	426	0.58	56
67-1	18-Jul-91	472	None	4.3	443	0.60	16
67-2	18-Jul-91	471	None	3.6	422	0.57	171
67-3	18-Jul-91	470	None	3.5	425	0.58	22
67-4	18-Jul-91	485	None	3.5	430	0.59	16
68-1	19-Jul-91	460	None	3.5	442	0.60	37

Table A-1 (Continued)

Test No.	Date	Load, MW	MOOS	O_2, vol% (dry)	NO_x, ppmv @ 3% O_2	NO_x, lb/MMBtu	CO, ppmv
69-1	20-Jul-91	473	None	3.2	413	0.56	19
69-2	21-Jul-91	469	None	3.3	448	0.61	15
77-1	16-Nov-91	180	B&C	8.7	413	0.56	6
77-2	16-Nov-91	180	B&C	8.5	428	0.58	6
77-3	16-Nov-91	182	B&C	7.4	416	0.57	6
77-4	16-Nov-91	185	B&C	6.4	444	0.61	5
78-1	17-Nov-91	181	B&E	8.3	558	0.76	5
78-2	17-Nov-91	183	B&E	7.2	543	0.74	5
78-3	17-Nov-91	180	B&E	5.8	507	0.69	5
79-1	18-Nov-91	305	B&E	6.7	476	0.65	9
79-2	18-Nov-91	305	B&E	6.1	487	0.66	9
79-3	18-Nov-91	305	B&E	5.3	399	0.54	49
80-1	19-Nov-91	310	E&F	4.8	333	0.45	101
80-2	19-Nov-91	306	E&F	6.3	405	0.55	11
80-3	19-Nov-91	310	E&F	6.2	342	0.47	14
81-1	14-Jan-92	302	B&E	5.0	369	0.50	49
81-2	14-Jan-92	299	B&E	6.5	438	0.60	10
81-3	14-Jan-92	301	B&E	7.0	445	0.61	10
82-1	15-Jan-92	395	None	3.8	395	0.54	74
82-2	15-Jan-92	395	None	4.5	427	0.58	5
82-3	15-Jan-92	295	None	5.4	464	0.63	4
Performance Tests--Phase 3a							
65-1	16-Jul-91	470	None	4.0	458	0.62	13
66-1	17-Jul-91	475	None	3.8	452	0.62	13
66-2	17-Jul-91	474	None	3.8	460	0.63	15
70-1	22-Jul-91	479	None	3.3	498	0.68	19
70-2	22-Jul-91	470	None	3.6	485	0.66	32
71-1	23-Jul-91	473	None	3.5	483	0.66	15
71-2	23-Jul-91	465	None	3.5	496	0.68	15
72-1	24-Jul-91	477	None	3.4	475	0.65	17
73-1	26-Jul-91	388	None	4.1	400	0.55	11
73-2	26-Jul-91	389	None	4.1	407	0.55	7
74-1	27-Jul-91	403	None	3.8	404	0.55	8

Table A-1 (Continued)

Test No.	Date	Load, MW	MOOS	O_2, vol% (dry)	NO_x, ppmv @ 3% O_2	NO_x, lb/MMBtu	CO, ppmv
74-2	27-Jul-91	405	None	3.6	415	0.57	9
75-1	28-Jul-91	299	E	4.3	347	0.47	8
76-1	28-Jul-91	298	E	4.5	349	0.48	8

Test No.	Date	Load, MW	MOOS	OFA Flow, klb/hr	O_2, vol% (dry)	NO_x, ppmv @ 3% O_2	NO_x, lb/MMBtu	CO, ppmv
Diagnostic Tests--Phase 3b								
101-1	06-May-93	449	None	600	3.5	341	0.465	26
101-2	06-May-93	452	None	455	3.6	359	0.490	75
101-3	06-May-93	446	None	300	3.6	386	0.525	29
102-1	07-May-93	394	None	400	4.4	351	0.479	14
102-2	07-May-93	397	None	400	3.3	296	0.404	33
102-3	07-May-93	397	None	400	2.7	255	0.349	145
102-4	07-May-93	479	None	763	2.8	298	0.405	234
103-1	08-May-93	407	E	310	4.1	360	0.492	18
103-2	08-May-93	402	B	320	4.7	349	0.476	33
103-3	08-May-93	398	B	300	3.9	322	0.440	27
103-4	08-May-93	399	B	303	3.1	268	0.365	82
104-1	09-May-93	305	D&F	305	5.3	252	0.344	10
104-2	09-May-93	295	D&F	295	4.0	210	0.286	11
105-1	10-May-93	395	F	300	3.9	265	0.362	68
105-2	10-May-93	396	F	344	5.1	324	0.442	32
106-1	08-Jun-93	450	None	595	3.5	269	0.367	234
106-2	08-Jun-93	477	None	794	3.9	287	0.391	140
106-3	08-Jun-93	468	None	829	4.5	324	0.441	27
107-1	09-Jun-93	465	None	813	4.1	367	0.501	25
108-1	10-Jun-93	463	None	824	4.1	290	0.395	28
108-2	10-Jun-93	449	None	792	3.7	272	0.371	62
108-3	10-Jun-93	472	None	802	3.0	257	0.351	239
109-1	11-Jun-93	470	None	797	3.7	278	0.380	100
109-2	11-Jun-93	470	None	952	3.7	271	0.369	183
109-3	11-Jun-93	474	None	611	3.6	297	0.405	183

Table A-1 (Continued)

Test No.	Date	Load, MW	MOOS	OFA Flow, klb/hr	O_2, vol% (dry)	NO_x, ppmv @ 3% O_2	NO_x, lb/MMBtu	CO, ppmv
110-1	12-Jun-93	302	E	314	5.4	296	0.404	9
110-2	12-Jun-93	305	B&E	250	4.6	233	0.318	57
110-3	12-Jun-93	305	B&E	326	5.5	270	0.369	12
110-4	12-Jun-93	302	B&E	315	6.4	309	0.421	9
110-5	12-Jun-93	394	B	327	5.5	359	0.489	19
110-6	12-Jun-93	391	B	313	4.2	295	0.402	59
110-7	12-Jun-93	391	B	403	4.2	276	0.377	50
111-1	13-Jun-93	293	B&D	310	6.2	298	0.408	8
111-2	13-Jun-93	295	B&D	317	5.0	253	0.345	11
111-3	13-Jun-93	292	B&D	306	4.3	226	0.309	30
112-1	14-Jun-93	400	None	396	4.4	315	0.429	77
112-3	14-Jun-93	404	None	416	4.7	334	0.456	50
113-1	15-Jun-93	476	None	799	3.8	289	0.395	122
113-2	15-Jun-93	474	None	585	3.6	309	0.422	214
113-3	15-Jun-93	474	None	276	3.4	335	0.456	315
114-1	16-Jun-93	179	B,D&E	94	6.8	306	0.418	8
114-2	16-Jun-93	186	B,D&E	93	5.4	279	0.379	10
114-3	16-Jun-93	183	B,D&E	90	4.5	254	0.347	14
121-1	24-Jun-93	483	None	954	3.7	304	0.414	43
121-2	24-Jun-93	482	None	791	3.9	304	0.414	57
121-3	24-Jun-93	481	None	603	3.8	305	0.416	191
121-4	24-Jun-93	495	None	777	3.8	314	0.427	43
122-1	25-Jun-93	401	None	409	4.0	275	0.375	56
122-2	26-Jun-93	402	None	275	4.1	305	0.416	44
122-3	27-Jun-93	397	None	516	4.2	261	0.355	34
122-4	28-Jun-93	396	None	510	4.7	291	0.396	15
122-5	29-Jun-93	395	None	401	4.7	303	0.413	14
122-6	30-Jun-93	392	None	395	3.3	239	0.326	83
Performance Tests--Phase 3b								
115-1A	17-Jun-93	480	None	790	3.9	317	0.433	31
115-1B	17-Jun-93	467	None	784	4.0	320	0.437	29
115-1C	17-Jun-93	462	None	774	3.7	313	0.427	38

Table A-1 (Continued)

Test No.	Date	Load, MW	MOOS	OFA Flow, klb/hr	O_2, vol% (dry)	NO_x, ppmv @ 3% O_2	NO_x, lb/MMBtu	CO, ppmv
116-1A	18-Jun-93	476	None	787	3.9	313	0.427	54
116-1B	18-Jun-93	472	None	805	3.8	301	0.410	262
117-1A	19-Jun-93	303	B	311	3.9	237	0.323	72
117-1B	19-Jun-93	299	B	297	5.7	237	0.323	26
118-1A	20-Jun-93	302	B	321	4.3	233	0.317	37
118-1B	20-Jun-93	298	B	308	4.3	235	0.321	40
119-1A	21-Jun-93	400	B	427	4.5	305	0.416	106
119-1B	21-Jun-93	400	B	409	5.1	315	0.429	118
120-1A	22-Jun-93	401	B	421	4.5	309	0.422	85
120-1B	22-Jun-93	401	B	424	4.6	309	0.422	91
Verification Tests–Phase 3b								
123-1	09-Aug-93	301	B	304	4.4	261	0.355	8
123-2	10-Aug-93	298	B	318	5.3	292	0.398	7
123-3	10-Aug-93	304	B	311	3.8	245	0.334	13
123-4	10-Aug-93	304	B	312	4.3	259	0.354	9
123-5	10-Aug-93	304	B&D	316	4.4	265	0.361	8
124-1	10-Aug-93	384	B	307	4.5	313	0.427	124
125-1	24-Aug-93	397	B	319	5.1	326	0.445	28
125-2	25-Aug-93	393	B	283	3.8	265	0.361	217
125-3	25-Aug-93	393	B	300	4.5	299	0.408	59
125-4	25-Aug-93	394	B	417	4.7	286	0.390	73
125-5	25-Aug-93	393	B	230	4.6	307	0.419	83
126-1	26-Aug-93	480	None	870	4.1	305	0.417	54

Table A-2

Stack Gas Short-Term Test Results

Test No.	Date	Load, MW	MOOS	O_2, vol% (dry)	NO_x, ppmv @3% O2	NOx, lb/MMBtu	CO, ppmv	CO, lb/MMBtu	SO_2, ppmv @ 3% O_2	SO_2, lb/MMBtu	THC, ppmv	THC, lb/MMBtu
Diagnostic Tests–Phase 3a												
58-1	09-Jul-91	477	None	7.1	512	0.70	6	0.005	1249	2.37	5	0.0021
58-2	09-Jul-91	475	None	6.5	483	0.66	6	0.005	1223	2.32	4	0.0018
58-3	09-Jul-91	473	None	5.5	421	0.57	61	0.051	1247	2.37	3	0.0015
59-1	10-Jul-91	471	None	7.3	485	0.66	5	0.004	1240	2.35	13	0.0063
59-2	10-Jul-91	473	None	5.8	440	0.60	7	0.006	1241	2.35	15	0.0070
59-3	10-Jul-91	475	None	5.8	420	0.57	16	0.013	1255	2.38	18	0.0086
59-4	10-Jul-91	474	None	5.4	400	0.54	124	0.103	1286	2.44	18	0.0083
59-5	10-Jul-91	474	None	6.3	452	0.62	16	0.013	1239	2.35	21	0.0097
60-1	11-Jul-91	393	None	7.1	411	0.56	5	0.004	1315	2.50	9	0.0044
60-2	11-Jul-91	398	None	6.3	374	0.51	9	0.007	1317	2.50	12	0.0059
60-3	11-Jul-91	397	None	6.0	357	0.49	111	0.092	1313	2.49	15	0.0070
60-4	11-Jul-91	502	None	6.5	510	0.69	7	0.005	1225	2.32	12	0.0055
61-1	12-Jul-91	392	None	7.1	400	0.54	1	0.001	1195	2.27	2	0.0010
61-2	12-Jul-91	392	None	6.4	375	0.51	1	0.001	1205	2.29	2	0.0010
61-3	12-Jul-91	390	None	5.7	338	0.46	79	0.065	1214	2.30	3	0.0012
61-4	12-Jul-91	498	None	6.4	483	0.66	3	0.002	1169	2.22	3	0.0014
62-1	13-Jul-91	289	E	9.2	457	0.62	3	0.002	1148	2.18	1	0.0005
62-2	13-Jul-91	291	E	8.1	421	0.57	4	0.003	1142	2.17	1	0.0005
62-3	13-Jul-91	290	E	7.3	397	0.54	6	0.005	1148	2.18	1	0.0005
62-5	13-Jul-91	474	None	6.9	479	0.65	5	0.004	1149	2.18	2	0.0010
63-1	14-Jul-91	302	B&E	8.1	362	0.49	8	0.006	1251	2.37	1	0.0005
63-2	14-Jul-91	305	E	8.0	426	0.58	6	0.005	1217	2.31	1	0.0005
63-3	14-Jul-91	303	E	7.3	403	0.55	18	0.015	1225	2.32	1	0.0005
64-1	15-Jul-91	467	None	7.1	496	0.68	3	0.002	1250	2.37	2	0.0007

Table A-2 (Continued)

Test No.	Date	Load, MW	MOOS	O_2, vol% (dry)	NO_x, ppmv @3% O2	NOx, lb/MMBtu	CO, ppmv	CO, lb/MMBtu	SO_2, ppmv @ 3% O_2	SO_2, lb/MMBtu	THC, ppmv	THC, lb/MMBtu
64-2	15-Jul-91	470	None	5.9	427	0.58	37	0.031	1278	2.42	2	0.0010
67-1	18-Jul-91	472	None	6.7	446	0.61	10	0.008	1232	2.34	1	0.0005
67-2	18-Jul-91	471	None	6.2	424	0.58	106	0.087	1250	2.37	1	0.0005
67-3	18-Jul-91	470	None	6.1	427	0.58	14	0.011	1236	2.34	1	0.0005
67-4	18-Jul-91	485	None	6.1	430	0.59	7	0.006	1237	2.35	1	0.0005
68-1	19-Jul-91	460	None	6.2	442	0.60	13	0.010	1210	2.30	1	0.0005
69-1	20-Jul-91	473	None	5.9	419	0.57	10	0.008	1235	2.34	1	0.0005
69-2	21-Jul-91	469	None	5.9	445	0.61	8	0.006	1247	2.37	1	0.0005
77-1	16-Nov-91	180	B&C	10.8	411	0.56	4	0.003	1119	2.12	1	0.0005
77-2	16-Nov-91	180	B&C	10.6	399	0.54	4	0.003	1067	2.02	1	0.0005
77-3	16-Nov-91	182	B&C	9.9	416	0.57	4	0.003	1066	2.02	1	0.0005
77-4	16-Nov-91	185	B&C	8.9	439	0.60	4	0.003	1089	2.07	1	0.0005
78-1	17-Nov-91	181	B&E	10.5	549	0.75	3	0.002	1062	2.02	1	0.0005
78-2	17-Nov-91	183	B&E	9.6	529	0.72	4	0.003	1046	1.98	1	0.0005
78-3	17-Nov-91	180	B&E	8.5	511	0.70	4	0.003	1068	2.03	1	0.0005
79-1	18-Nov-91	305	B&E	9.1	479	0.65	5	0.004	1288	2.44	1	0.0005
79-2	18-Nov-91	305	B&E	8.4	430	0.59	7	0.006	1309	2.48	1	0.0005
79-3	18-Nov-91	305	B&E	7.7	390	0.53	51	0.043	1319	2.50	1	0.0005
80-1	19-Nov-91	310	E&F	7.3	330	0.45	154	0.127	1260	2.39	1	0.0005
80-2	19-Nov-91	306	E&F	8.5	405	0.55	7	0.005	1222	2.32	1	0.0005
80-3	19-Nov-91	310	E&F	8.3	334	0.46	10	0.008	1244	2.36	1	0.0005
81-1	14-Jan-92	302	B&E	7.9	370	0.50	22	0.018	1353	2.57	1	0.0005
81-2	14-Jan-92	299	B&E	9.0	436	0.59	6	0.005	1328	2.52	1	0.0005
81-3	14-Jan-92	301	B&E	9.6	447	0.61	6	0.005	1327	2.52	1	0.0005

Table A-2 (Continued)

Test No.	Date	Load, MW	MOOS	O_2, vol% (dry)	NO_x, ppmv @3% O2	NOx, lb/MMBtu	CO, ppmv	CO, lb/MMBtu	SO_2, ppmv @ 3% O_2	SO_2, lb/MMBtu	THC, ppmv	THC, lb/MMBtu
82-1	15-Jan-92	395	None	6.8	397	0.54	25	0.021	1362	2.58	0	0.0000
82-2	15-Jan-92	395	None	7.4	423	0.58	2	0.001	1346	2.55	0	0.0000
82-3	15-Jan-92	295	None	8.1	462	0.63	0	0.000	1341	2.54	0	0.0000
Performance Tests—Phase 3a												
65-1	16-Jul-91	470	None	6.3	459	0.63	7	0.006	1149	2.18	2	0.0010
66-1	17-Jul-91	475	None	6.3	453	0.62	8	0.006	1246	2.36	1	0.0005
66-2	17-Jul-91	474	None	6.5	464	0.63	9	0.007	1267	2.40	1	0.0005
70-1	22-Jul-91	479	None	5.9	488	0.67	8	0.007	1188	2.25	1	0.0006
70-2	22-Jul-91	470	None	6.0	480	0.65	16	0.013	1173	2.23	2	0.0009
71-1	23-Jul-91	473	None	6.0	479	0.65	6	0.005	1214	2.30	1	0.0005
71-2	23-Jul-91	465	None	5.9	490	0.67	7	0.006	1166	2.21	2	0.0007
72-1	24-Jul-91	477	None	6.1	471	0.64	15	0.012	1271	2.41	2	0.0008
73-1	26-Jul-91	388	None	6.5	399	0.54	4	0.003	1247	2.37	1	0.0006
73-2	26-Jul-91	389	None	6.5	403	0.55	4	0.003	1243	2.36	1	0.0005
74-1	27-Jul-91	403	None	6.0	396	0.54	6	0.005	1128	2.14	0	0.0000
74-2	27-Jul-91	405	None	5.8	406	0.55	6	0.005	1097	2.08	0	0.0000
75-1	28-Jul-91	299	E	6.6	338	0.46	5	0.004	1025	1.94	1	0.0005
76-1	28-Jul-91	298	E	6.7	342	0.47	6	0.005	1016	1.93	1	0.0005

Table A-2 (Continued)

Test No.	Date	Load, MW	MOOS	OFA Flow, klb/hr	O_2, vol% (dry)	NO_x, ppmv @ 3% O_2	NO_x, lb/MMBtu	CO, ppmv	CO, lb/MMBtu	SO_2, ppmv @ 3% O_2	SO_2, lb/MMBtu	THC, ppmv	THC, lb/MMBtu
Diagnostic Tests--Phase 3b													
101-1	06-May-93	449	None	600	5.8	327	0.445	16	0.013	1100	2.09	0	0.0000
101-2	06-May-93	452	None	455	5.8	344	0.469	56	0.046	1075	2.04	1	0.0005
101-3	06-May-93	446	None	300	5.6	368	0.502	21	0.017	1131	2.15	1	0.0004
102-1	07-May-93	394	None	400	6.5	337	0.459	5	0.004	1143	2.17	0	0.0000
102-2	07-May-93	397	None	400	5.5	287	0.392	21	0.017	1151	2.18	0	0.0000
102-3	07-May-93	397	None	400	5.2	252	0.343	74	0.061	1161	2.20	0	0.0000
102-4	07-May-93	479	None	763	5.3	287	0.391	82	0.068	1158	2.20	1	0.0005
103-1	08-May-93	407	E	310	6.2	345	0.471	8	0.007	1123	2.13	0	0.0000
103-2	08-May-93	402	B	320	6.8	338	0.461	26	0.021	1099	2.09	0	0.0000
103-3	08-May-93	398	B	300	6.1	310	0.421	20	0.016	1114	2.11	1	0.0002
103-4	08-May-93	399	B	303	5.5	258	0.352	85	0.070	1170	2.22	0	0.0000
104-1	09-May-93	305	D&F	305	7.4	244	0.333	4	0.003	1120	2.13	0	0.0000
104-2	09-May-93	295	D&F	295	6.1	201	0.275	8	0.006	1138	2.16	0	0.0000
105-1	10-May-93	395	F	300	6.0	258	0.352	69	0.057	1182	2.24	1	0.0005
105-2	10-May-93	396	F	344	6.9	312	0.424	13	0.011	1138	2.16	1	0.0005
106-1	08-Jun-93	450	None	595	6.4	273	0.371	154	0.128	1486	2.82	1	0.0005
106-2	08-Jun-93	477	None	794	6.6	290	0.397	107	0.089	1433	2.72	1	0.0005
106-3	08-Jun-93	468	None	829	7.1	324	0.442	14	0.012	1479	2.81	1	0.0003
107-1	09-Jun-93	465	None	813	6.8	368	0.502	13	0.011	1440	2.73	0	0.0000
108-1	10-Jun-93	463	None	824	6.8	288	0.393	22	0.019	1414	2.68	0	0.0000
108-2	10-Jun-93	449	None	792	6.6	273	0.371	35	0.029	1465	2.78	0	0.0000
108-3	10-Jun-93	472	None	802	5.9	254	0.346	208	0.173	1458	2.77	0	0.0000
109-1	11-Jun-93	470	None	797	6.5	280	0.382	56	0.047	1528	2.90	0	0.0000
109-2	11-Jun-93	470	None	952	6.4	270	0.367	142	0.118	1539	2.92	0	0.0000
109-3	11-Jun-93	474	None	611	6.2	290	0.395	162	0.134	1503	2.85	0	0.0000

Table A-2 (Continued)

Test No.	Date	Load, MW	MOOS	OFA Flow, klb/hr	O_2, vol% (dry)	NO_x, ppmv @ 3% O_2	NO_x, lb/MMBtu	CO, ppmv	CO, lb/MMBtu	SO_2, ppmv @ 3% O_2	SO_2, lb/MMBtu	THC, ppmv	THC, lb/MMBtu
110-1	12-Jun-93	302	E	314	8.1	296	0.403	4	0.003	1452	2.76	0	0.0000
110-2	12-Jun-93	305	B&E	250	7.6	235	0.320	31	0.026	1440	2.73	0	0.0000
110-3	12-Jun-93	305	B&E	326	8.3	268	0.365	6	0.005	1430	2.71	0	0.0000
110-4	12-Jun-93	302	B&E	315	8.9	307	0.419	4	0.003	1394	2.65	0	0.0000
110-5	12-Jun-93	394	B	327	8.1	359	0.489	8	0.006	1376	2.61	0	0.0000
110-6	12-Jun-93	391	B	313	7.1	292	0.397	37	0.030	1434	2.72	0	0.0000
110-7	12-Jun-93	391	B	403	7.0	270	0.369	39	0.032	1435	2.72	0	0.0000
111-1	13-Jun-93	293	B&D	310	8.8	295	0.401	4	0.003	1459	2.77	0	0.0000
111-2	13-Jun-93	295	B&D	317	7.9	250	0.341	7	0.006	1496	2.84	0	0.0000
111-3	13-Jun-93	292	B&D	306	7.3	228	0.311	18	0.015	1515	2.88	0	0.0000
112-1	14-Jun-93	400	None	396	7.0	315	0.430	49	0.041	1548	2.94	0	0.0000
112-3	14-Jun-93	404	None	416	7.3	337	0.460	19	0.015	1526	2.90	0	0.0000
113-1	15-Jun-93	476	None	799	6.5	296	0.404	113	0.094	1444	2.74	0	0.0000
113-2	15-Jun-93	474	None	585	6.2	310	0.422	178	0.148	1436	2.73	0	0.0000
113-3	15-Jun-93	474	None	276	6.2	337	0.459	252	0.209	1435	2.72	0	0.0000
114-1	16-Jun-93	179	B,D&E	94	9.5	306	0.416	6	0.005	1233	2.34	0	0.0000
114-2	16-Jun-93	186	B,D&E	93	8.5	276	0.376	8	0.006	1213	2.30	0	0.0000
114-3	16-Jun-93	183	B,D&E	90	7.8	254	0.347	10	0.008	1216	2.31	0	0.0000
121-1	24-Jun-93	483	None	954	6.3	301	0.411	36	0.030	1134	2.15	0	0.0000
121-2	24-Jun-93	482	None	791	6.4	305	0.416	38	0.031	1128	2.14	0	0.0000
121-3	24-Jun-93	481	None	603	6.2	300	0.409	203	0.168	1091	2.07	0	0.0000
121-4	24-Jun-93	495	None	777	6.3	306	0.418	27	0.022	1104	2.10	0	0.0000
122-1	25-Jun-93	401	None	409	6.7	272	0.371	33	0.027	1160	2.20	0	0.0000
122-2	26-Jun-93	402	None	275	6.7	300	0.410	26	0.021	1170	2.22	0	0.0000
122-3	27-Jun-93	397	None	516	6.8	259	0.352	30	0.024	1199	2.28	0	0.0000

Table A-2 (Continued)

Test No.	Date	Load, MW	MOOS	OFA Flow, klb/hr	O_2, vol% (dry)	NO_x, ppmv @ 3% O_2	NO_x, lb/MMBtu	CO, ppmv	CO, lb/MMBtu	SO_2, ppmv @ 3% O_2	SO_2, lb/MMBtu	THC, ppmv	THC, lb/MMBtu
122-4	28-Jun-93	396	None	510	7.2	287	0.392	13	0.011	1171	2.22	0	0.0000
122-5	29-Jun-93	395	None	401	7.1	299	0.407	6	0.005	1168	2.22	0	0.0000
122-6	30-Jun-93	392	None	395	5.9	232	0.318	159	0.132	1192	2.26	0	0.0000
Performance Tests--Phase 3b													
115-1A	17-Jun-93	480	None	790	6.6	316	0.431	28	0.023	1316	2.50	0	0.0000
115-1B	17-Jun-93	467	None	784	6.7	321	0.438	16	0.013	1341	2.55	0	0.0000
115-1C	17-Jun-93	462	None	774	6.6	313	0.427	22	0.018	1368	2.60	0	0.0000
116-1A	18-Jun-93	476	None	787	6.5	309	0.422	42	0.035	1450	2.75	0	0.0000
116-1B	18-Jun-93	472	None	805	6.4	300	0.410	228	0.190	1396	2.65	0	0.0000
117-1A	19-Jun-93	303	B	311	6.9	237	0.323	40	0.033	1428	2.71	0	0.0000
117-1B	19-Jun-93	299	B	297	7.1	240	0.327	20	0.017	1405	2.67	0	0.0000
118-1A	20-Jun-93	302	B	321	7.1	230	0.313	28	0.023	1407	2.67	0	0.0000
118-1B	20-Jun-93	298	B	308	7.2	231	0.314	21	0.017	1322	2.51	0	0.0000
119-1A	21-Jun-93	400	B	427	7.2	304	0.416	95	0.079	1229	2.33	0	0.0000
119-1B	21-Jun-93	400	B	409	7.2	310	0.422	91	0.076	1227	2.33	0	0.0000
120-1A	22-Jun-93	401	B	421	7.2	304	0.414	65	0.054	1202	2.28	0	0.0000
120-1B	22-Jun-93	401	B	424	7.4	304	0.414	40	0.033	1176	2.23	0	0.0000
Verification Tests--Phase 3b													
123-1	09-Aug-93	301	B	304	7.5	264	0.360	6	0.005	1378	2.62	0	0.0000
123-2	10-Aug-93	298	B	318	8.1	294	0.400	3	0.002	1351	2.56	0	0.0000
123-3	10-Aug-93	304	B	311	7.0	246	0.335	7	0.006	1366	2.59	0	0.0000
123-4	10-Aug-93	304	B	312	7.4	261	0.355	5	0.004	1371	2.60	0	0.0000
123-5	10-Aug-93	304	B&D	316	7.5	266	0.362	6	0.005	1344	2.55	0	0.0000
124-1	10-Aug-93	384	B	307	7.3	315	0.429	103	0.085	1308	2.48	0	0.0000

Table A-2 (Continued)

Test No.	Date	Load, MW	MOOS	OFA Flow, klb/hr	O_2, vol% (dry)	NO_x, ppmv @ 3% O_2	NO_x, lb/MMBtu	CO, ppmv	CO, lb/MMBtu	SO_2, ppmv @ 3% O_2	SO_2, lb/MMBtu	THC, ppmv	THC, lb/MMBtu
125-1	24-Aug-93	397	B	319	7.9	330	0.450	18	0.015	1434	2.72	0	0.0000
125-2	25-Aug-93	393	B	283	6.8	269	0.366	125	0.103	1489	2.83	0	0.0000
125-3	25-Aug-93	393	B	300	7.4	306	0.417	55	0.045	1495	2.84	0	0.0000
125-4	25-Aug-93	394	B	417	7.4	286	0.390	78	0.064	1435	2.72	0	0.0000
125-5	25-Aug-93	393	B	230	7.3	310	0.423	68	0.056	1502	2.85	0	0.0000
126-1	26-Aug-93	480	None	870	6.8	310	0.423	46	0.038	1619	3.07	0	0.0000

Table A-6

Preheater Outlet In-Situ Ash Resistivity

Test	Date	Load, MW	Duct	APH Gas Temp, °F	Dust Layer, mm	Resistivity, ohm-cm Spark Method	Resistivity, ohm-cm V-I Method
Phase 3a							
65	07/16/91	480	West	281	0.73	8.4×10^{9}	5.7×10^{10}
				283	0.24	1.0×10^{11}	1.8×10^{11}
				284	0.19	1.6×10^{9}	3.3×10^{10}
				328	0.49	5.8×10^{10}	1.6×10^{11}
66	07/17/91	480	East	297	0.32	1.0×10^{11}	4.3×10^{10}
				306	0.77	4.8×10^{10}	4.2×10^{10}
				304	0.86	6.6×10^{9}	5.3×10^{10}
70	07/22/91	480	East	289	1.32	9.5×10^{9}	2.8×10^{9}
				296	0.92	2.8×10^{10}	3.0×10^{10}
				296	1.24	2.2×10^{10}	4.6×10^{10}
				297	1.14	1.5×10^{10}	7.4×10^{10}
71	07/23/91	480	West	285	1.62	1.0×10^{10}	4.5×10^{10}
				289	1.21	1.3×10^{10}	6.6×10^{10}
				291	1.1	1.5×10^{10}	7.5×10^{10}
72	07/24/91	480	East	289	22.54	8.6×10^{9}	2.3×10^{10}
				295	2	1.5×10^{10}	2.7×10^{10}
				294	1.39	4.1×10^{9}	2.7×10^{10}
73	07/26/91	400	East	279	1.76	4.0×10^{9}	2.9×10^{10}
				279	2.02	8.7×10^{9}	9.5×10^{9}
				280	2	1.6×10^{9}	2.5×10^{10}
74	07/27/91	400	West	280	1.57	2.8×10^{9}	3.5×10^{10}
				282	1.31	3.6×10^{9}	3.7×10^{10}
				283	1.38	$7.0 \quad 10^{9}$	2.6×10^{10}
				285	1.24	3.4×10^{9}	5.2×10^{10}
75	07/28/91	300	West	271	1.73	6.3×10^{9}	2.9×10^{10}
				272	1.63	6.1×10^{9}	3.5×10^{10}
				273	1.69	6.9×10^{9}	9.1×10^{9}
				275	1.91	7.8×10^{9}	2.1×10^{10}

Table A-6 (Continued)

Test	Date	Load, MW	Duct	APH Gas Temp, °F	Dust Layer, mm	Resistivity, ohm-cm	
						Spark Method	V-I Method
Phase 3b							
115[a]	06/17/93	470	West	329	2.75	3.0×10^{11}	2.9×10^{11}
				330	0.51	3.1×10^{11}	6.1×10^{10}
				334	0.31		1.7×10^{11}
				335	0.73	1.6×10^{11}	7.5×10^{10}
116	06/18/93	472	East	307	0.47	1.2×10^{10}	9.0×10^{10}
				308	0.98		3.6×10^{10}
				311	0.69		4.7×10^{10}
				308	1.27	4.4×10^{10}	4.1×10^{10}
117	06/19/93	296	East	284	1.52	5.2×10^{10}	1.8×10^{10}
				286	0.62		4.2×10^{10}
				287	1.55	4.8×10^{10}	2.7×10^{10}
				287	1.59	3.8×10^{10}	3.1×10^{10}
118	06/20/93	302	West	292	1.21	2.2×10^{10}	2.9×10^{10}
				295	0.98	2.9×10^{10}	2.5×10^{10}
				297	1.03	5.3×10^{10}	4.3×10^{10}
119	06/21/22-93	396	West	316	1.54	1.8×10^{10}	2.5×10^{10}
				316	1.37	1.1×10^{10}	2.9×10^{10}
				316	1.42	1.3×10^{10}	2.4×10^{10}
120	06/22-23/93	398	East	294	1.51	1.4×10^{10}	1.2×10^{10}
				293	1.25	1.5×10^{10}	7.0×10^{9}
				293	1.23	1.2×10^{10}	2.0×10^{10}

[a]The data from this test were not used in calculating averages due to a suspected probe malfunction.

Table A-7

Coal Feed Proximate/Ultimate Analyses

Test #	Date	Time	H_2O, wt%	C, wt%	H, wt%	N, wt%	Cl, wt%	S, wt%	Ash, wt%	O, wt%	HHV, BTU/lb
Diagnostic Tests--Phase 3a											
58-1	07/09/91	-	6.75	71.89	4.63	1.42	0.01	1.38	9.41	4.52	12,691
58-3	07/09/91	-	6.50	72.76	4.64	1.35	0.01	1.65	8.56	4.54	12,869
59-1	07/10/91	-	5.31	73.06	4.72	1.34	0.01	1.62	9.37	4.57	12,930
59-4	07/10/91	-	6.38	72.47	4.62	1.38	0.01	1.62	9.25	4.29	12,832
77-2	11/16/91	-	4.64	72.91	4.76	1.35	0.05	1.58	10.02	4.73	12,924
78-2	11/17/91	-	5.27	71.81	4.62	1.33	0.12	1.60	10.41	4.95	12,791
79-2	11/18/91	0640	4.95	73.18	4.71	1.39	0.08	1.99	9.53	4.25	13,000
Performance Tests--Phase 3a											
65-1	07/17/91	0830	6.85	71.18	4.62	1.34	0.01	1.42	9.67	4.93	12,613
65-1	07/17/91	1300	14.90	63.98	4.13	1.24	0.02	1.30	10.25	4.20	11,364
65-1	07/17/91	1700	4.55	73.11	4.72	1.45	0.02	1.66	9.95	4.55	12,991
66-1	07/17/91	-	4.91	73.13	4.74	1.42	0.02	1.53	9.39	4.88	13,015
66-1	07/17/91	1630	4.62	73.54	4.74	1.38	0.02	1.66	9.31	4.75	13,094
66-1	07/17/91	1630	4.68	72.93	4.57	1.44	0.03	1.71	9.37	5.30	13,058
66-1	07/17/91	1649	3.59	74.71	4.79	1.47	0.02	1.69	9.28	4.47	13,259
70-1	07/22/91	0830	4.15	74.47	4.80	1.42	0.02	1.54	9.30	4.32	13,220
70-1	07/22/91	1230	4.94	73.88	4.71	1.40	0.02	1.56	9.11	4.40	13,092
70-1	07/22/91	1430	5.54	73.29	4.73	1.44	0.02	1.62	8.97	4.40	13,041

Table A-7 (Continued)

Test #	Date	Time	H_2O, wt%	C, wt%	H, wt%	N, wt%	Cl, wt%	S, wt%	Ash, wt%	O, wt%	HHV, BTU/lb
71-1	07/23/91	0830	4.76	73.71	4.70	1.36	0.02	1.67	9.28	4.52	13,084
71-1	07/23/91	1130	4.51	73.96	4.72	1.37	0.01	1.58	9.46	4.41	13,105
71-2	07/23/91	1500	4.53	73.94	4.77	1.42	0.01	1.77	9.07	4.50	13,138
72-1	07/24/91	1100	5.23	73.10	4.75	1.35	0.01	1.41	9.12	5.05	12,928
72-2	07/24/91	1300	6.25	71.41	4.59	1.28	0.01	1.43	9.76	5.28	12,577
72-2	07/24/91	1600	6.00	72.66	4.65	1.37	0.01	1.42	8.87	5.02	12,833
72-2	07/24/91	1600	6.36	71.64	4.39	1.35	0.01	1.42	9.48	5.36	12,714
73-1	07/26/91	0200	5.41	73.50	4.74	1.44	0.01	1.58	8.89	4.45	13,042
73-1	07/26/91	0600	5.79	71.72	4.67	1.37	0.01	1.59	9.72	4.96	12,719
73-2	07/26/91	0700	5.94	70.56	4.57	1.38	0.01	1.38	10.59	5.21	12,517
74-1	07/27/91	0800	4.93	72.76	4.74	1.45	0.01	1.64	10.03	4.45	12,893
74-1	07/27/91	1230	5.19	72.31	4.73	1.40	0.01	1.57	9.93	4.86	12,892
74-2	07/27/91	1400	5.96	72.29	4.68	1.36	0.01	1.48	9.74	4.49	12,854
75-1	07/28/91	0640	6.38	72.48	4.65	1.36	0.01	1.40	9.02	4.70	12,775
75-1	07/28/91	1050	6.34	72.36	4.65	1.44	0.01	1.47	9.15	4.59	12,771
76-1	07/28/91	1340	6.29	72.81	4.65	1.41	0.01	1.44	8.89	4.51	12,819
76-1	07/28/91	1630	5.74	72.99	4.73	1.43	0.01	1.50	9.16	4.44	12,938
76-1	07/28/91	1630	4.87	72.29	4.50	1.39	0.01	1.47	9.83	5.65	13,035
76-1	07/28/91	1720	5.70	72.58	4.96	1.46	0.01	1.49	9.21	4.87	12,824

Table A-7 (Continued)

Test #	Date	Time	H_2O, wt%	C, wt%	H, wt%	N, wt%	Cl, wt%	S, wt%	Ash, wt%	O, wt%	HHV, BTU/lb
Long-Term Tests--Phase 3a											
LT	08/27/91	1800	5.22	73.20	4.75	1.40	0.17	1.40	9.33	4.70	12,925
LT	08/28/91	-	4.66	72.89	4.73	1.44	0.18	1.44	10.25	4.60	12,919
LT	09/04/91	-	6.13	71.90	4.64	1.41	0.17	1.54	9.99	4.40	12,729
LT	11/05/91	-	5.40	72.18	4.64	1.39	0.14	1.56	10.11	4.72	12,764
LT	11/05/91	-	5.12	72.34	4.64	1.32	0.02	1.58	9.87	5.14	12,765
LT	11/06/91	-	3.96	72.96	4.79	1.28	0.02	1.57	10.57	4.87	12,934
LT	11/08/91	0730-0830	4.09	73.43	4.69	1.35	0.02	1.52	10.32	4.60	12,985
LT	11/08/91	0900-1000	4.00	73.12	4.70	1.32	0.02	1.69	10.68	4.49	12,930
LT	11/08/91	1015-1115	3.94	73.22	4.69	1.30	0.03	1.55	10.14	5.17	12,976
LT	11/20/91	-	4.13	73.64	4.81	1.28	0.02	1.58	10.07	4.50	13,011
LT	11/20/91	-	3.67	73.82	4.76	1.31	0.03	1.67	9.82	4.96	13,131
LT	11/20/91	-	4.42	72.98	4.75	1.34	0.02	1.75	10.12	4.65	12,947
LT	12/04/91	-	6.56	71.44	4.58	1.35	0.02	1.54	9.87	4.66	12,637
LT	12/11/91	-	6.65	70.99	4.59	1.32	0.02	1.63	9.92	4.89	12,613
LT	12/11/91	0430-0530	7.02	71.57	4.53	1.36	0.02	1.62	9.76	4.44	12,600
Diagnostic Tests--Phase 3b											
106	06/08/93	-	6.58	69.10	4.59	1.45	0.04	1.70	10.17	6.41	12,208
107	06/09/93	-	5.65	69.79	4.66	1.48	0.04	1.89	10.92	5.61	12,263
108	06/10/93	-	6.53	68.99	4.57	1.43	0.06	1.69	9.85	6.94	12,323
108	06/10/93	-	7.02	68.62	4.57	1.42	0.03	1.79	10.27	6.30	12,013
109	06/11/93	-	6.69	69.11	4.58	1.44	0.06	1.80	10.26	6.11	12,240

Table A-7 (Continued)

Test #	Date	Time	H_2O, wt%	C, wt%	H, wt%	N, wt%	Cl, wt%	S, wt%	Ash, wt%	O, wt%	HHV, BTU/lb
109	06/11/93	-	6.15	69.23	4.64	1.47	0.06	1.87	9.81	6.83	12,220
110	06/12/93	-	6.03	69.54	4.60	1.48	0.06	1.84	10.02	6.50	12,350
110	06/12/93	-	6.79	68.36	4.59	1.44	0.06	1.73	10.32	6.78	12,102
111	06/13/93	-	6.68	69.41	4.62	1.40	0.06	1.77	10.19	5.93	12,246
111	06/13/93	-	7.69	67.75	4.54	1.39	0.02	1.86	10.52	6.25	11,956
112	06/14/93	-	7.40	68.88	4.52	1.44	0.02	1.83	10.18	5.76	12,130
112	06/14/93	-	8.25	67.25	4.54	1.36	0.06	1.82	10.21	6.57	11,790
113	06/15/93	-	7.44	68.57	4.50	1.39	0.05	1.83	10.62	5.66	12,055
113	06/15/93	-	5.40	73.18	4.66	1.33	0.02	1.47	8.33	5.62	12,966
114	06/16/93	-	5.19	74.03	4.72	1.34	0.02	1.54	7.86	5.33	13,128
121	06/24/93	-	9.76	68.37	4.40	1.32	0.04	1.55	8.90	5.70	12,022
121-2	06/24/93	-	4.81	72.68	4.79	1.40	0.05	1.50	8.74	6.08	12,964
122	06/25/93	-	7.34	71.30	4.74	1.32	0.03	1.59	9.01	4.70	12,642
122-2	06/25/93	-	5.71	72.47	4.76	1.39	0.05	1.53	9.07	5.07	12,859
Performance Tests--Phase 3b											
115	06/17/93	-	6.19	70.37	4.61	1.42	0.04	1.75	9.63	6.03	12,495
115A	06/17/93	-	6.16	72.22	4.67	1.32	0.02	1.58	8.69	5.36	12,780
115B	06/17/93	-	5.62	71.46	4.72	1.35	0.03	1.64	8.97	6.25	12,765
115C	06/17/93	-	6.36	71.48	4.64	1.40	0.06	1.67	9.05	5.40	12,610
116	06/18/93	-	6.87	68.76	4.61	1.46	0.06	1.80	10.04	6.46	12,093
116A	06/18/93	-	6.81	69.92	4.63	1.34	0.03	1.69	9.74	5.87	12,368
116A	06/18/93	-	7.34	69.51	4.52	1.34	0.06	1.70	9.70	5.89	12,297

Table A-7 (Continued)

Test #	Date	Time	H_2O, wt%	C, wt%	H, wt%	N, wt%	Cl, wt%	S, wt%	Ash, wt%	O, wt%	HHV, BTU/lb
116B	06/18/93	-	7.49	69.08	4.60	1.34	0.08	1.79	9.88	5.83	12,199
116C	06/18/93	-	6.71	70.73	4.60	1.40	0.06	1.82	9.86	4.88	12,358
117	06/19/93	-	8.25	67.78	4.53	1.39	0.03	1.82	9.87	6.37	11,976
117A	06/19/93	-	7.10	69.95	4.66	1.38	0.05	1.72	9.93	5.25	12,327
117B	06/19/93	-	6.82	69.33	4.64	1.41	0.05	1.71	10.20	5.89	12,272
117C	06/19/93	-	7.04	69.38	4.61	1.40	0.03	1.72	10.06	5.79	12,187
118	06/20/93	-	7.76	68.53	4.57	1.41	0.02	1.93	10.25	5.56	11,984
118A	06/20/93	-	6.59	69.05	4.66	1.42	0.02	1.96	10.20	6.12	12,287
118B	06/20/93	-	6.76	69.69	4.62	1.49	0.02	1.64	9.52	6.28	12,334
118C	06/20/93	-	7.08	69.46	4.65	1.43	0.03	1.75	9.92	5.71	12,212
119	06/21/93	-	5.41	73.24	4.73	1.40	0.03	1.51	8.87	4.83	12,882
119	06/22/93	-	5.93	71.94	4.67	1.39	0.03	1.57	9.40	5.10	12,667
119A	06/21/93	-	6.27	71.13	4.68	1.37	0.05	1.56	9.49	5.51	12,497
119B	06/21/93	-	5.14	72.93	4.71	1.41	0.07	1.51	8.99	5.31	12,843
119C	06/21/93	-	5.68	72.35	4.76	1.44	0.07	1.57	8.99	5.21	12,712
119C	06/21/93	-	5.93	71.98	4.70	1.43	0.06	1.61	9.11	5.24	12,801
120	06/23/93	-	5.42	72.23	4.64	1.38	0.06	1.65	9.27	5.41	12,716
120A	06/22/93	-	5.95	71.57	4.64	1.36	0.04	1.54	9.18	5.76	12,730
120B	06/23/93	-	5.64	73.52	4.76	1.44	0.03	1.51	8.93	4.21	12,915

Table A-7 (Continued)

Test #	Date	Time	H_2O, wt%	C, wt%	H, wt%	N, wt%	Cl, wt%	S, wt%	Ash, wt%	O, wt%	HHV, BTU/lb
Long-Term Tests--Phase 3b											
LT	06/26/93	-	5.60	72.21	4.70	1.34	0.03	1.56	9.69	4.90	12,799
LT	06/27/93	-	5.42	72.57	4.72	1.35	0.01	1.64	9.30	5.00	12,830
LT	06/28/93	-	5.10	73.19	4.79	1.39	0.03	1.70	9.11	4.73	12,959
LT	06/29/93	-	5.57	71.37	4.67	1.41	0.04	1.76	10.63	4.59	12,657
LT	06/30/93	-	8.84	67.23	4.42	1.37	0.03	1.71	10.69	5.73	11,885
LT	07/03/93	-	8.63	67.35	4.50	1.32	0.01	1.96	10.36	5.88	11,876
LT	07/01/93	-	8.93	66.78	4.38	1.34	0.04	2.01	10.56	5.99	11,709
LT	07/02/93	-	9.18	66.06	4.33	1.34	0.04	2.05	10.71	6.32	11,560
LT	07/03/93	-	6.19	69.82	4.53	1.35	0.02	1.68	10.08	6.35	12,210
LT	07/04/93	-	8.01	66.61	4.39	1.40	0.03	1.95	10.76	6.88	11,704
LT	07/05/93	-	9.06	66.30	4.34	1.35	0.03	1.96	9.99	6.99	11,698
LT	07/06/93	-	7.46	67.67	4.41	1.39	0.03	1.92	10.96	6.19	11,900
LT	07/07/93	-	7.95	66.15	4.46	1.35	0.03	2.16	11.33	6.60	11,688
LT	07/08/93	-	6.70	68.81	4.53	1.34	0.02	2.03	11.14	5.44	12,176
LT	07/09/93	-	3.75	72.81	4.80	1.37	0.01	1.73	10.54	5.00	12,903
LT	07/10/93	-	5.65	70.37	4.66	1.34	0.02	1.84	10.60	5.55	12,384
LT	07/11/93	-	4.12	71.79	4.77	1.36	0.01	1.78	11.19	5.00	12,715
LT	07/12/93	-	6.03	69.76	4.66	1.39	0.04	1.89	10.68	5.58	12,298
LT	07/13/93	-	4.53	71.69	4.73	1.36	0.02	1.68	10.71	5.31	12,746
LT	07/14/93	-	5.44	71.21	4.74	1.34	0.02	1.75	10.50	5.02	12,583
LT	07/15/93	-	8.14	66.20	4.47	1.33	0.03	2.09	10.79	6.97	11,619

Table A-7 (Continued)

Test #	Date	Time	H_2O, wt%	C, wt%	H, wt%	N, wt%	Cl, wt%	S, wt%	Ash, wt%	O, wt%	HHV, BTU/lb
LT	07/16/93	-	5.48	71.55	4.69	1.33	0.02	1.78	10.27	4.90	12,679
LT	07/17/93	-	4.76	72.53	4.72	1.35	0.01	1.81	9.92	4.90	12,885
LT	07/18/93	-	5.28	71.54	4.66	1.35	0.01	1.95	9.82	5.39	12,659
LT	07/19/93	-	5.95	70.44	4.57	1.40	0.01	1.78	10.56	5.30	12,476
LT	07/20/93	-	6.12	70.45	4.48	1.36	0.02	1.71	10.85	5.03	12,457
LT	07/21/93	-	5.28	71.77	4.71	1.33	0.02	1.76	9.78	5.37	12,794
LT	07/22/93	-	7.44	67.33	4.42	1.31	0.03	2.05	11.05	6.41	11,987
LT	07/23/93	-	6.25	69.11	4.62	1.33	0.03	2.21	11.00	5.48	12,282
LT	07/24/93	-	4.57	71.96	4.74	1.36	0.02	2.09	9.82	5.46	12,759
LT	07/25/93	-	5.93	72.35	4.64	1.38	0.01	1.35	9.67	4.68	12,815
LT	07/26/93	-	6.40	71.73	4.49	1.36	0.01	1.47	10.39	4.17	12,633
LT	07/27/93	-	5.34	71.96	4.56	1.36	0.01	1.45	10.90	4.42	12,670
LT	07/28/93	-	5.03	72.32	4.65	1.35	0.02	1.67	10.22	4.76	12,725
LT	07/29/93	-	5.83	72.23	4.46	1.31	0.01	1.60	9.52	5.05	12,792
LT	07/30/93	-	5.28	72.47	4.50	1.34	0.02	1.76	10.00	4.65	12,779
LT	07/31/93	-	5.55	72.31	4.68	1.28	0.02	2.03	9.80	4.34	12,823
Verification Tests--Phase 3b											
123	08/09/93	-	6.56	71.21	4.56	1.31	0.02	1.66	10.36	4.34	12,536
125	08/25/93	-	7.51	68.99	4.50	1.31	0.02	1.81	10.78	5.09	12,153
126	08/26/93	-	8.36	67.69	4.43	1.31	0.03	1.84	10.71	5.66	11,852

Table A-8

Bottom Ash LOI Data

Test No.	Date	Load, MWe	O_2, vol%	Average LOI, wt%
Phase 3a				
65-1	07/16/91	470	4.0	1.92
66-1	07/17/91	475	3.8	1.04
71-1	07/23/91	473	3.5	2.01
72-1	07/24/91	477	3.4	2.38
73-1	07/26/91	388	4.1	1.80
74-1	07/27/91	403	3.8	1.74
75-1	07/28/91	299	4.3	1.72
76-1	07/28/91	298	4.5	2.33
Phase 3b				
115-1	06/17/93	470	3.8	0.71
116-1	06/18/93	472	3.9	0.13
117-1	06/19/93	296	3.9	1.05
118-1	06/20/93	302	4.2	0.03
119-1	06/21/93	396	4.4	0.33
120-1	06/23/93	398	4.5	0.93

Table A-9

ESP Fly Ash: LOI Analyses

Test No.	Date	Load, MWe	Economizer O_2, vol%	ESP Inlet (A-Side)			ESP Outlet (B-Side)		
				East	West	Average	East	West	Average
Phase 3a									
65-1	16-Jul-91	470	4.0	3.44	5.91	4.68	11.61	8.65	10.13
66-1	17-Jul-91	475	3.8	12.11	4.11	8.11	7.20	9.55	8.38
70-1	23-Jul-91	479	3.3	14.28	5.75	10.02	6.48	8.07	7.28
71-1	23-Jul-91	473	3.5	12.24	4.64	8.44	5.10	6.47	5.79
72-1	24-Jul-91	477	3.4	5.89	4.92	5.41	4.26	4.42	4.34
73-1	26-Jul-91	388	4.1	9.15	3.07	6.11	4.31	9.70	7.01
74-1	27-Jul-91	403	3.8	8.35	2.87	5.61	3.92	7.68	5.80
75-1	28-Jul-91	299	4.3	22.25	10.93	16.59	5.63	9.51	7.57
76-1	28-Jul-91	298	4.5	7.76	3.78	5.77	5.61	13.63	9.62
Phase 3b									
115-1C	06/17/93	462	3.7	10.55	5.35	7.95	6.36	10.54	8.45
116-1B	06/18/93	472	3.8	8.59	5.28	6.94	5.04	8.86	6.95
117-1B	06/19/93	299	5.7	6.15	4.42	5.29	5.03	6.84	5.94
118-1B	06/20/93	298	4.3	5.48	5.72	5.60	5.63	6.77	6.20
120-1B	06/23/93	401	4.6	7.83	10.96	9.40	6.44	10.80	8.62

Table A-10

CEGRIT Fly Ash LOI Data

				LOI, wt%	
Test No.	Date	Load, MW	Economizer O_2, vol%	East	West
Diagnostic Tests--Phase 3a					
58-1	07/09/91	477	4.6	--	2.76
58-2	07/09/91	475	4.1	--	3.66
58-3	07/09/91	473	2.9	1.24	5.43
59-1	07/10/91	471	5	2.37	3.37
59-3	07/10/91	475	3.1	1.24	4.89
59-4	07/10/91	474	2.6	--	5.16
77-1	11/16/91	180	8.7	3.63	0.86
77-2	11/16/91	180	8.5	2.22	1.14
77-3	11/16/91	182	7.4	1.85	1.08
77-4	11/16/91	185	6.4	2.22	2.23
78-1	11/17/91	181	8.3	1.35	0.97
78-2	11/17/91	183	7.2	1.86	0.88
79-1	11/18/91	305	7.1	1.59	1.50
79-2	11/18/91	305	6.1	2.79	1.98
79-3	11/18/91	305	5.3	3.84	2.48
80-1	11/18/91	310	4.8	4.78	4.57
80-2	11/18/91	306	6.3	4.30	2.46
80-3	11/18/91	310	6.2	3.78	3.27
Performance Tests--Phase 3a					
65-1	07/16/91	470	4	--	5.68
70-1	07/22/91	479	3.3	--	4.56
71-1A	07/23/91	473	3.5	--	4.79
71-1B	07/23/91	473	3.5	--	4.10
72-1	07/24/91	477	3.4	3.04	5.22
72-1	07/24/91	477	3.4	--	6.42
73-1	07/26/91	388	4.1	2.43	4.82
73-2	07/26/91	389	4.1	2.26	4.97
74-1	07/27/91	403	3.8	2.37	6.09
74-2	07/27/91	405	3.6	2.30	5.19
75-1	07/28/91	299	4.3	2.76	5.82
76-1	07/28/91	298	4.5	2.35	5.01

Table A-10 (Continued)

Test No.	Date	Load, MW	Economizer O_2, vol%	LOI, wt% East	LOI, wt% West
Long-Term Tests–Phase 3a					
LT	08/27/91			6.30	5.23
LT	08/28/91			4.28	3.98
LT	08/30/91			2.79	3.78
LT	09/03/91			2.01	2.95
LT	09/04/91			3.67	7.29
LT	09/04/91			3.86	6.08
LT	09/05/91			3.15	8.13
LT	09/05/91			2.72	6.90
LT	09/06/91			5.34	4.80
LT	09/06/91			5.21	3.22
LT	09/16/91			6.58	6.08
Performance Tests–Phase 3b					
115A	06/17/93	480	3.9	2.15	2.40
115B	06/17/93	467	4.0	1.39	5.09
115C	06/17/93	462	3.7	2.35	3.74
116A	06/18/93	476	3.9	1.57	3.20
116B	06/18/93	472	3.8	2.21	4.66
117A	06/19/93	303	3.9	2.16	3.33
117B	06/19/93	299	5.7	1.97	3.65
118A	06/20/93	302	4.3	1.94	2.92
118B	06/20/93	298	4.3	2.11	3.36
119	06/21/93	400	4.5	2.58	5.76
120	06/22/93	401	4.5	2.69	5.30

Table A-11

Long-Term Stack Gas Monitoring: Daily Averages

Sequential Day	Date	Average Load, MW	O_2, vol%	NO_x, lb/MMBtu	SO_2, lb/MMBtu	CO ppmv @ 3% O_2	CO lb/MMBtu	THC ppmv @ 3% O_2	THC lb/MMBtu (as CH4)
Phase 3a									
1	07-Aug-91	405.2	7.78	0.59	2.00	11.47	0.0095	0.323	0.00015
2	08-Aug-91	400.1	7.57	0.55	2.07	16.37	0.0136	0.334	0.00016
3	09-Aug-91	402.6	7.07	0.58	2.07	14.30	0.0119	0.027	0.00001
14	20-Aug-91	328.3	7.73	0.53	2.06	11.34	0.0094	6.029	0.00286
15	21-Aug-91	356.1	8.01	0.61	2.04	10.27	0.0085	3.017	0.00143
16	22-Aug-91	345.1	8.06	0.58	2.00	10.31	0.0085	2.589	0.00123
17	23-Aug-91	336.1	8.18	0.57	2.00	11.52	0.0096	1.860	0.00088
25	31-Aug-91	308.3	8.57	0.52	2.18	3.14	0.0026	1.476	0.00070
26	01-Sep-91	335.6	8.54	0.56	2.22	6.04	0.0050	1.480	0.00070
27	02-Sep-91	242.5	9.27	0.53	2.24	4.69	0.0039	1.543	0.00073
28	03-Sep-91	338.0	8.15	0.63	2.22	6.20	0.0051	1.424	0.00068
29	04-Sep-91	404.1	7.39	0.63	2.19	5.92	0.0049	0.982	0.00047
30	05-Sep-91	376.2	8.00	0.60	2.21	5.43	0.0045	0.698	0.00033
33	08-Sep-91	253.7	9.14	0.55	2.09	7.14	0.0059	0.000	0.00000
34	09-Sep-91	238.8	8.93	0.43	2.19	5.80	0.0048	0.632	0.00030
35	10-Sep-91	232.5	8.98	0.38	2.25	7.16	0.0059	0.235	0.00011
36	11-Sep-91	233.0	8.80	0.41	2.34	9.08	0.0075	0.194	0.00009
37	12-Sep-91	267.0	8.07	0.41	2.35	11.62	0.0096	0.138	0.00007
38	13-Sep-91	272.1	8.04	0.44	2.35	10.80	0.0090	0.207	0.00010
39	14-Sep-91	265.3	8.53	0.47	2.34	9.95	0.0083	0.284	0.00013

Table A-11 (Continued)

Sequential Day	Date	Average Load, MW	O_2, vol%	NOx, lb/MMBtu	SO_2, lb/MMBtu	CO ppmv @ 3% O_2	CO lb/MMBtu	THC ppmv @ 3% O_2	THC lb/MMBtu (as CH4)
40	15-Sep-91	270.6	8.50	0.47	2.28	10.67	0.0088	0.402	0.00019
41	16-Sep-91	277.7	7.98	0.45	2.32	8.65	0.0072	0.202	0.00010
42	17-Sep-91	280.3	8.02	0.46	2.37	6.79	0.0056	0.161	0.00008
43	18-Sep-91	282.2	8.42	0.41	2.36	16.64	0.0138	0.063	0.00003
44	19-Sep-91	278.1	8.54	0.48	2.27	14.57	0.0121	0.041	0.00002
45	20-Sep-91	266.0	9.11	0.53	2.26	9.80	0.0081	0.040	0.00002
46	21-Sep-91	269.1	8.83	0.52	2.26	14.61	0.0121	0.053	0.00003
47	22-Sep-91	267.7	8.68	0.54	2.29	13.42	0.0111	0.045	0.00002
48	23-Sep-91	300.7	7.97	0.43	2.36	10.95	0.0091	0.042	0.00002
49	24-Sep-91	287.5	8.28	0.42	2.40	14.02	0.0116	0.052	0.00002
55	30-Sep-91	387.6	7.44	0.59	2.43	11.06	0.0092	0.000	0.00000
56	01-Oct-91	337.4	8.32	0.54	2.39	10.46	0.0087	0.037	0.00002
57	02-Oct-91	353.5	8.05	0.51	2.31	10.95	0.0091	0.197	0.00009
58	03-Oct-91	343.8	8.07	0.52	2.22	8.87	0.0074	0.047	0.00002
59	04-Oct-91	275.3	8.48	0.47	2.31	10.54	0.0087	0.037	0.00002
60	05-Oct-91	264.1	8.10	0.48	2.37	15.24	0.0126	0.030	0.00001
61	06-Oct-91	234.6	8.41	0.58	2.48	13.53	0.0112	0.033	0.00002
64	09-Oct-91	400.1	7.38	0.63	2.52	8.64	0.0072	0.000	0.00000
65	10-Oct-91	404.0	7.40	0.61	2.49	4.71	0.0039	0.000	0.00000
66	11-Oct-91	394.8	7.64	0.63	2.44	5.38	0.0045	0.000	0.00000
68	13-Oct-91	393.7	6.99	0.73	2.24	6.81	0.0056	1.264	0.00060
69	14-Oct-91	270.3	8.17	0.54	2.34	9.14	0.0076	1.402	0.00067
70	15-Oct-91	268.5	8.54	0.48	2.37	7.81	0.0065	1.444	0.00069

Table A-11 (Continued)

Sequential Day	Date	Average Load, MW	O_2, vol%	NOx, lb/MMBtu	SO_2, lb/MMBtu	CO ppmv @ 3% O_2	CO lb/MMBtu	THC ppmv @ 3% O_2	THC lb/MMBtu (as CH4)
71	16-Oct-91	266.2	8.27	0.49	2.35	6.47	0.0054	1.413	0.00067
72	17-Oct-91	270.0	8.44	0.51	2.41	5.12	0.0042	1.432	0.00068
73	18-Oct-91	271.2	9.33	0.55	2.43	7.47	0.0062	1.550	0.00074
74	19-Oct-91	277.1	9.35	0.56	2.38	5.30	0.0044	1.550	0.00074
82	27-Oct-91	259.3	8.29	0.60	2.40	0.00	0.0000	0.000	0.00000
83	28-Oct-91	265.9	8.85	0.58	2.32	0.00	0.0000	0.007	0.00000
84	29-Oct-91	268.5	9.54	0.57	2.23	0.00	0.0000	0.216	0.00010
86	31-Oct-91	270.2	7.88	0.51	2.24	6.67	0.0055	0.007	0.00000
87	01-Nov-91	276.5	7.63	0.49	2.34	6.12	0.0051	2.456	0.00117
88	02-Nov-91	284.5	8.34	0.48	2.45	6.21	0.0051	4.485	0.00213
89	03-Nov-91	276.5	8.61	0.50	2.42	0.90	0.0007	0.000	0.00000
90	04-Nov-91	280.1	8.77	0.48	2.38	0.78	0.0006	0.000	0.00000
91	05-Nov-91	297.6	8.55	0.48	2.33	0.65	0.0005	0.000	0.00000
92	06-Nov-91	284.9	8.74	0.49	2.16	1.91	0.0016	0.000	0.00000
93	07-Nov-91	277.2	8.64	0.52	2.13	0.25	0.0002	0.000	0.00000
94	08-Nov-91	279.5	9.12	0.55	2.20	0.14	0.0001	0.000	0.00000
95	09-Nov-91	296.8	8.74	0.42	2.25	0.00	0.0000	0.000	0.00000
98	12-Nov-91	262.8	9.17	0.44	1.94	17.65	0.0146	0.764	0.00036
99	13-Nov-91	277.6	8.96	0.48	2.15	23.56	0.0195	0.750	0.00036
100	14-Nov-91	278.6	8.77	0.45	2.19	23.48	0.0195	0.681	0.00032
101	15-Nov-91	271.3	8.90	0.43	2.15	11.32	0.0094	0.542	0.00026
105	19-Nov-91	362.8	7.69	0.61	2.38	18.94	0.0157	0.680	0.00032
106	20-Nov-91	395.8	7.20	0.61	2.29	17.63	0.0146	0.654	0.00031

Table A-11 (Continued)

Sequential Day	Date	Average Load, MW	O_2, vol%	NOx, lb/MMBtu	SO_2, lb/MMBtu	CO ppmv @ 3% O_2	CO lb/MMBtu	THC ppmv @ 3% O_2	THC lb/MMBtu (as CH4)
107	21-Nov-91	385.0	7.36	0.60	2.21	14.15	0.0117	0.661	0.00031
108	22-Nov-91	306.5	8.42	0.60	2.16	11.57	0.0096	0.719	0.00034
109	23-Nov-91	215.2	9.48	0.64	2.11	14.34	0.0119	0.715	0.00034
110	24-Nov-91	251.5	9.69	0.68	2.08	15.10	0.0125	0.804	0.00038
111	25-Nov-91	280.0	9.41	0.64	2.10	4.18	0.0035	0.280	0.00013
119	03-Dec-91	321.9	7.95	0.52	2.30	7.58	0.0063	0.392	0.00019
120	04-Dec-91	344.4	7.79	0.52	2.37	10.03	0.0083	-0.026	-0.00001
126	10-Dec-91	387.0	7.71	0.63	2.45	8.48	0.0070	1.872	0.00089
127	11-Dec-91	441.5	6.97	0.62	2.40	5.77	0.0048	1.290	0.00061
128	12-Dec-91	306.5	8.24	0.62	2.31	1.53	0.0013	1.419	0.00067
129	13-Dec-91	296.6	8.53	0.56	2.30	0.57	0.0005	1.453	0.00069
130	14-Dec-91	236.4	9.22	0.60	2.33	0.75	0.0006	1.433	0.00068
131	15-Dec-91	251.7	9.17	0.63	2.41	1.46	0.0012	1.140	0.00054
133	17-Dec-91	325.5	7.88	0.58	2.27	12.72	0.0105	0.461	0.00022
134	18-Dec-91	322.9	8.52	0.64	2.32	9.25	0.0077	0.477	0.00023
Phase 3b									
1	11-May-93	345.5	6.61	0.35	2.23	54.62	0.0453	0.293	0.00014
2	12-May-93	329.9	6.52	0.32	2.18	16.01	0.0133	0.021	0.00001
8	18-May-93	391.3	6.39	0.38	2.16	15.63	0.0130	1.186	0.00056
9	19-May-93	386.7	6.33	0.41	2.06	12.51	0.0104	0.050	0.00002
10	20-May-93	379.2	6.22	0.40	2.07	14.31	0.0119	0.000	0.00000
11	21-May-93	369.0	6.63	0.38	2.14	14.49	0.0120	0.002	0.00000
14	24-May-93	198.3	10.49	0.39	2.41	9.01	0.0075	0.000	0.00000

Table A-11 (Continued)

Sequential Day	Date	Average Load, MW	O_2, vol%	NOx, lb/MMBtu	SO_2, lb/MMBtu	CO ppmv @ 3% O_2	CO lb/MMBtu	THC ppmv @ 3% O_2	THC lb/MMBtu (as CH4)
15	25-May-93	239.8	9.72	0.34	2.45	20.21	0.0168	0.000	0.00000
16	26-May-93	195.0	10.36	0.34	2.41	15.47	0.0128	0.000	0.00000
17	27-May-93	199.3	10.79	0.36	2.41	11.33	0.0094	0.002	0.00000
18	28-May-93	202.0	10.42	0.35	2.45	10.80	0.0090	0.000	0.00000
20	30-May-93	267.6	9.28	0.40	2.31	59.29	0.0492	2.157	0.00102
21	31-May-93	185.8	10.74	0.57	2.23	47.79	0.0396	1.764	0.00084
22	01-Jun-93	186.9	10.72	0.58	2.34	14.30	0.0119	1.160	0.00055
23	02-Jun-93	190.2	11.43	0.56	2.45	13.96	0.0116	1.752	0.00083
24	03-Jun-93	327.6	8.31	0.48	2.51	78.79	0.0653	0.436	0.00021
26	05-Jun-93	315.7	9.06	0.48	2.59	13.16	0.0109	0.023	0.00001
27	06-Jun-93	327.6	8.73	0.45	2.79	79.12	0.0656	0.000	0.00000
28	07-Jun-93	304.2	9.61	0.42	2.70	31.45	0.0261	0.413	0.00020
42	21-Jun-93	240.0	9.20	0.40	2.30	10.75	0.0089	0.000	0.00000
44	23-Jun-93	329.8	8.20	0.44	2.32	32.13	0.0266	0.000	0.00000
49	28-Jun-93	296.8	8.97	0.40	2.32	98.15	0.0814	0.000	0.00000
50	29-Jun-93	240.7	10.24	0.43	2.35	36.80	0.0305	0.000	0.00000
51	30-Jun-93	308.6	9.16	0.41	2.35	53.54	0.0444	0.001	0.00000
52	01-Jul-93	328.1	8.23	0.34	2.64	110.21	0.0914	0.130	0.00006
53	02-Jul-93	330.2	7.53	0.37	2.92	76.65	0.0636	0.000	0.00000
58	07-Jul-93	329.7	7.92	0.40	3.07	22.12	0.0183	0.000	0.00000
59	08-Jul-93	343.6	7.47	0.40	3.24	127.05	0.1053	0.000	0.00000
60	09-Jul-93	349.6	7.81	0.39	2.67	100.92	0.0837	0.003	0.00000
61	10-Jul-93	336.0	7.46	0.36	2.61	76.92	0.0638	0.000	0.00000

Table A-11 (Continued)

Sequential Day	Date	Average Load, MW	O_2, vol%	NOx, lb/MMBtu	SO_2, lb/MMBtu	CO		THC	
						ppmv @ 3% O_2	lb/MMBtu	ppmv @ 3% O_2	lb/MMBtu (as CH4)
62	11-Jul-93	365.7	7.16	0.35	2.83	144.13	0.1195	0.000	0.00000
63	12-Jul-93	342.2	7.31	0.36	2.58	97.76	0.0811	0.014	0.00001
64	13-Jul-93	328.1	8.14	0.38	2.60	38.90	0.0323	0.023	0.00001
65	14-Jul-93	369.8	7.84	0.43	2.50	125.32	0.1039	0.169	0.00008
66	15-Jul-93	342.9	8.01	0.40	2.58	77.81	0.0645	0.102	0.00005
67	16-Jul-93	361.3	7.89	0.37	2.98	102.85	0.0853	0.036	0.00002
68	17-Jul-93	372.6	6.86	0.36	2.80	57.79	0.0479	0.000	0.00000
69	18-Jul-93	337.0	8.11	0.43	2.78	5.78	0.0048	0.000	0.00000
70	19-Jul-93	370.6	7.78	0.40	2.77	32.40	0.0269	0.000	0.00000
71	20-Jul-93	360.1	7.87	0.41	2.20	17.80	0.0148	0.000	0.00000
72	21-Jul-93	377.4	7.66	0.39	2.55	63.38	0.0526	0.283	0.00013
73	22-Jul-93	368.9	7.73	0.40	2.70	134.48	0.1115	0.278	0.00013
74	23-Jul-93	344.3	8.04	0.43	3.16	126.68	0.1050	0.278	0.00013
75	24-Jul-93	381.2	7.60	0.40	2.97	99.91	0.0828	0.179	0.00008
78	27-Jul-93	338.8	7.86	0.41	2.16	34.86	0.0289	0.005	0.00000
79	28-Jul-93	362.3	7.39	0.38	2.41	116.64	0.0967	0.005	0.00000
80	29-Jul-93	344.5	8.09	0.42	2.44	40.58	0.0337	0.000	0.00000
87	05-Aug-93	306.1	8.34	0.41	2.64	74.86	0.0621	0.000	0.00000
88	06-Aug-93	187.6	10.25	0.43	2.63	3.26	0.0027	0.000	0.00000
94	12-Aug-93	255.5	8.23	0.36	2.64	33.35	0.0276	0.000	0.00000
95	13-Aug-93	220.9	9.98	0.39	2.44	15.22	0.0126	0.000	0.00000

[a]Note: Only days with at least 18 hours of valid monitoring data are included.