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180 MWe DEMONSTRATION OF ADVANCED TANGENTIALLY-FIRED COMBUSTION TECHNIQUES FOR THE REDUCTION OF NITROGEN OXIDE (NO_x) EMISSIONS FROM COAL-FIRED BOILERS

Plant Lansing Smith

Phase III and Final
Environmental Monitoring Program Report

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EXECUTIVE SUMMARY

This report summarizes the results obtained during environmental monitoring activities conducted during the third phase of testing for the U.S. Department of Energy's Innovative Clean Coal Technology (ICCT) Program demonstration entitled "180 MWe Demonstration of Advanced Tangentially-Fired Combustion Techniques for the Reduction of Nitrogen Oxide (NO_x) Emissions from Coal-Fired Boilers." This project is being conducted at Gulf Power Company's Plant Lansing Smith Unit 2, near Panama City, Florida.

The primary goal of this project is to characterize the performance of low NO_x combustion equipment through the collection and analysis of both long-term emissions data and short-term characterization data. During each test phase, diagnostic, performance, long-term, and verification tests are performed. The advanced combustion techniques included in this demonstration project are being tested in a stepwise manner using the following phased approach:

Phase I:	Baseline testing on the "as-found" Unit 2 boiler;
Phase II:	Low NO_x Concentric Firing System (LNCFS) Level II (Separated Overfire Air Ports) testing;
Phase IIIa:	LNCFS Level III (Separated Overfire Air Ports and Close Coupled Overfire Air Ports) testing; and
Phase IIIb:	LNCFS Level I (Close Coupled Overfire Air Ports) testing.

EMP activities consist of sampling and analytical activities performed during testing periods for each phase; compliance monitoring is also performed on gaseous and aqueous streams. Energy Technology Consultants, Inc. is 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 is responsible to Southern Company Services, Inc. for the preparation of the EMP reports.

During Phase IIIa, a total of 48 diagnostic, 8 performance, and 11 verification tests were performed. Statistically valid long-term testing was conducted for 49 days. In Phase IIIb, 41 diagnostic, 8 performance, and 9 verification tests were performed. Sixty-five days of statistically valid long-term testing were conducted. With few exceptions, all of the sampling and analytical methods used during the testing were specified and approved in the Environmental Monitoring Plan that was prepared for this project. Minor changes in the specified methods for a few parameters were implemented, but the modifications should not affect the results presented in this report.

EMP monitoring conducted during Phase IIIa and IIIb testing periods showed the following:

- Based on an analysis of the long-term monitoring data, LNCFS Level III operation reduced NO_x emissions from Unit 2 by an average of 45% at higher load levels (135 to 200 MW), while average reductions of about 37% were achieved during both LNCFS Levels I and II operation. The reduction in NO_x emissions produced during LNCFS Levels II and III testing was less at lower unit loads.

- LNCFS Level III operation resulted in higher levels of fly ash carbon and loss on ignition (LOI) compared to either baseline or LNCFS Level II tests at all loads. The LOI appeared to consist primarily of carbon.

- The average carbon monoxide emissions from Unit 2 were low, although they were roughly twice as high during LNCFS Level III testing than during the baseline operation (approximately 20 ppm versus 10 ppm corrected to 5% oxygen). The CO emissions during LNCFS Level II testing were approximately the same as for Level III, while Level I emissions were comparable to the baseline.

- Most of the values obtained for total hydrocarbon emissions were low and in the same range during all test phases, 0.5 to 1.5 ppmv (corrected to 3% oxygen).

- Although there was appreciable scatter in the data, sulfur dioxide emissions were comparable for all test phases, consistent with the fact that similar coal sulfur content was measured during all three test phases.

- None of the LNCFS configurations appeared to have any appreciable impact on the fraction of sulfur dioxide converted to SO_3 relative to baseline operation.

- No exceedances of permit limits for aqueous streams were observed during Phase III or any of the previous test phases.

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1.0 INTRODUCTION

As an Innovative Clean Coal Technology (ICCT) Program demonstration, the project entitled "180 MWe Demonstration of Advanced Tangentially-Fired Combustion Techniques for the Reduction of Nitrogen Oxide (NO_x) Emissions from Coal-Fired Boilers" is 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. and submitted to the U.S. Department of Energy (DOE) on December 27, 1990. A revised EMP, submitted on March 31, 1993 and subsequently approved by DOE, incorporated a number of changes to the 1990 version. The EMP includes supplemental and compliance monitoring of several 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 IIIa and IIIb (LNCFS Levels III and I, respectively), and compares these results to those obtained during the previous phases of the project.

1.1 Project Description

Southern Company Services (SCS) signed a Cooperative Agreement with DOE for this ICCT Round II project on September 20, 1990. In this project, a number of retrofit NO_x-reduction techniques were tested on Unit 2 at Gulf Power Company's Plant Lansing Smith (Plant Smith), near Panama City, Florida. Emissions and performance were characterized for this tangentially-fired boiler while operating in the following configurations:

- Baseline ("as-found") configuration--Phase I;
- Retrofitted Low NO_x Concentric Firing System (LNCFS) Level II (Separated Overfire Air Ports) and simulated Low NO_x Bulk Furnace Staging (LNBFS)--Phase II;

- Retrofitted LNCFS Level III (Separated Overfire Air Ports and Close Coupled Overfire Air Ports)--Phase IIIa; and

- Simulated LNCFS Level I (Close Coupled Overfire Air Ports)--Phase IIIb.

The major objectives of the project were to:

- Demonstrate the performance of four NO_x-controlling combustion technologies (i.e., LNCFS Levels I, II, and III and LNBFS);

- Determine the short-term NO_x reduction capabilities for each of the operating configurations;

- Determine the dynamic long-term NO_x emission characteristics of the three levels of LNCFS operation using statistical techniques;

- Evaluate cost-effectiveness of the low NO_x technologies tested (i.e., cost per ton of NO_x removed); and

- Determine the effects of the low NO_x combustion technologies on other combustion parameters [e.g., carbon monoxide (CO) production, carbon carry-over, particulate characteristics].

Each phase of the project involved three distinct testing periods: short-term characterization, long-term characterization, and short-term verification. The short-term characterization testing establishes the impacts of selected parameters on NO_x emissions and establishes the influence of the operating mode on other combustion parameters. The long-term characterization, which occurs over 50-80 days of continuous testing, establishes the dynamic response of the NO_x emissions while the unit is operated under normal system dispatch conditions. The short-term verification testing is conducted to determine whether any fundamental changes in the NO_x emission characteristics have occurred during the long-term test period.

The EMP activities consist of a specific set of sampling and analytical activities performed during testing periods for each phase; compliance monitoring of gaseous and aqueous streams is also included. Energy Technology Consultants, Inc. (ETEC) prepares the phase reports which summarize 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 environmental letter reports "180 MW Demonstration of Advanced Tangentially-Fired Combustion Techniques for the Reduction of Nitrogen Oxide (NO_x) Emissions from Coal-Fired Boilers," for Phases IIIa and IIIb, dated July 22, 1993 and August 8, 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 the execution of the project. Energy Technology Consultants, Inc. has responsibility for the on-site testing and analysis of the data for all phases of the project. Spectrum Systems, Inc. (Spectrum) provides a full-time on-site instrument technician who is responsible for the operation and maintenance of the data acquisition system (DAS), which is housed within the instrument control room. Southern Research Institute (SoRI) is responsible for the flue gas particulate measurements during the performance testing portion of the short-term characterization tests. Flame Refractories, Inc. (Flame) is responsible for measuring fuel/air input parameters and furnace output temperatures during the performance testing portion of the short-term characterization tests. W. S. Pitts, Inc. (WSPC) is responsible for the analysis of 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.

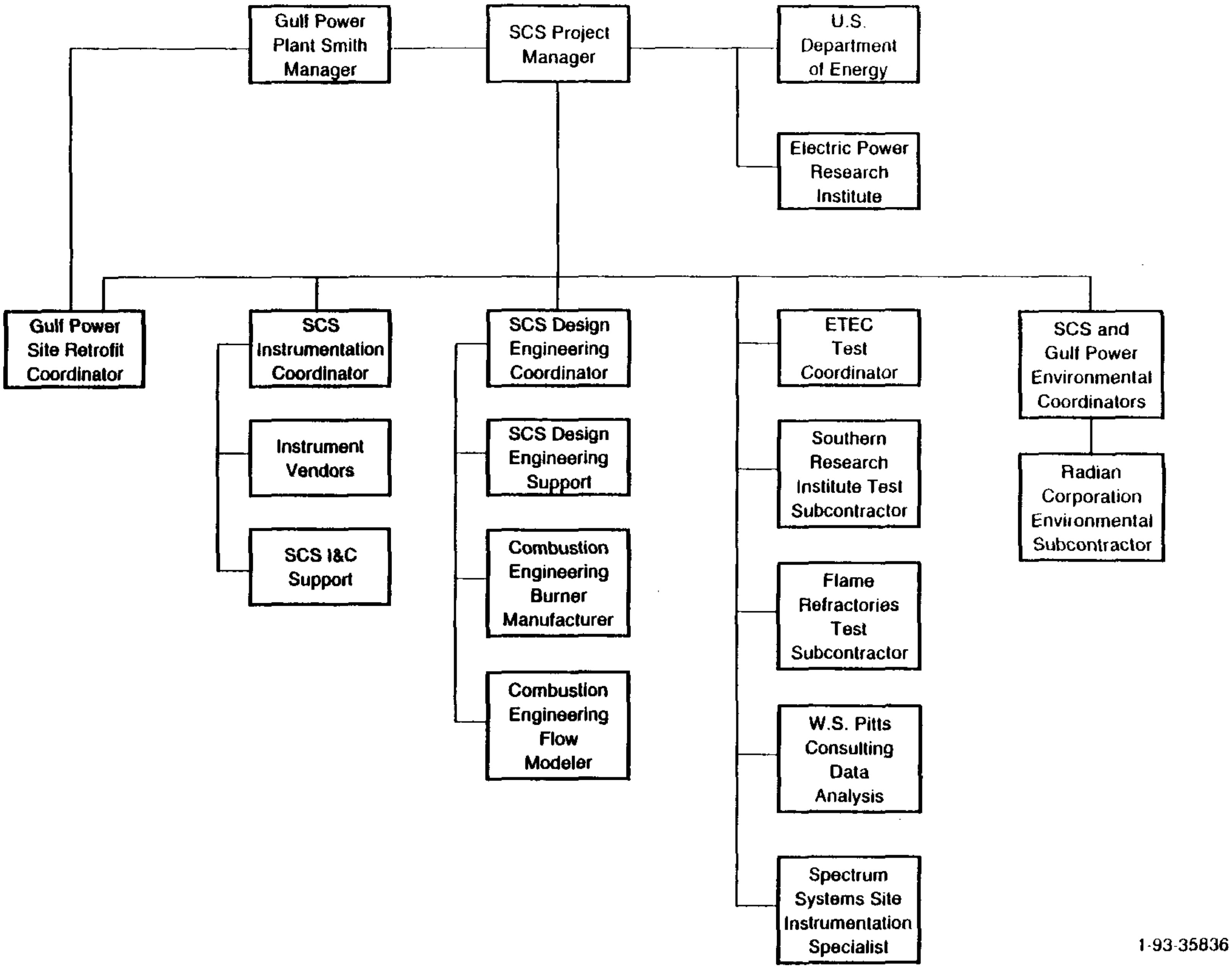

Figure 1-1. Plant Lansing Smith Project Organization

1.3 Unit Description

Unit 2 at Plant Smith is an ABB CES (Asea Brown Boveri Combustion Engineering Services) tangentially-fired boiler rated at 180 MWe. Five mills provide pulverized eastern bituminous coal for delivery to five burner elevations.

Unit 2 is a balanced draft unit with two forced draft fans and three induced draft fans. The unit is equipped with both a hot-side and a cold-side electrostatic precipitator (ESP). The flue gases exit the economizer into the hot-side ESP and through two Ljungstrom air preheaters. The flue gases then flow into the cold-side ESP, through the induced draft fans, and out the stack. Figure 1-2 is a simplified schematic flow diagram of Unit 2 showing the locations of the EMP sampling points.

1.4 Report Organization

The remainder of this report is organized as follows:

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

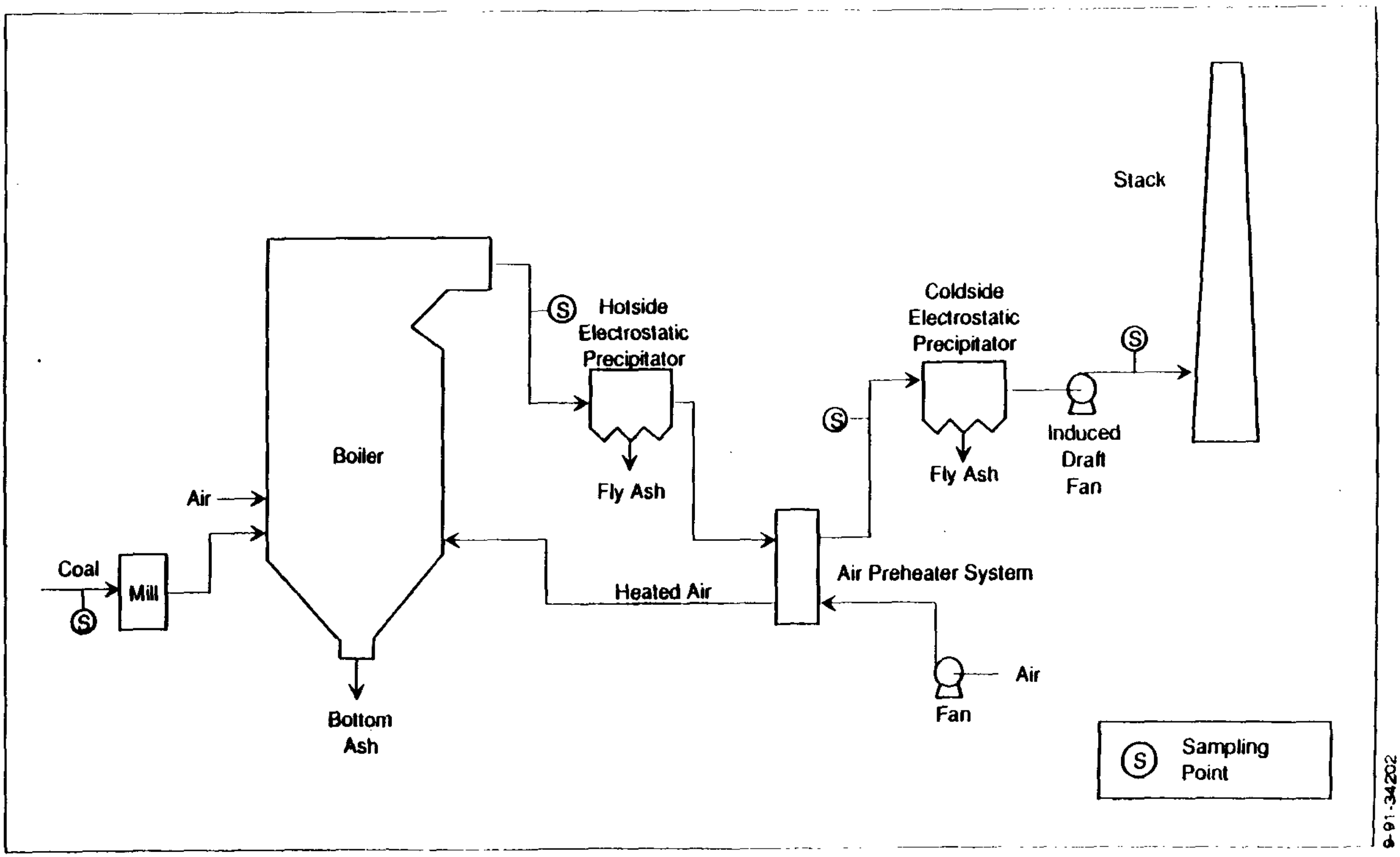

Figure 1-2. Schematic Flow Diagram of Unit 2 at Plant Smith

Appendices A, B, and C present summary tables of the data for the gaseous, aqueous, and solid streams monitored as part of the EMP, respectively.

2.0 TECHNOLOGY DESCRIPTION AND PHASE III EMP MONITORING

2.1 Technology Description

ABB CES supplied their low NO_x concentric firing system (LNCFS) for retrofit into the four existing corner wall penetrations of the original five tier burner configuration on Unit 2. The LNCFS is offered in the following three configurations:

- Level I, which includes close coupled overfire air (CCOFA) and clustered coal nozzles;
- Level II, which includes separated overfire air (SOFA); and
- Level III, which incorporates all of these technologies.

In addition to these three levels of LNCFS technology, the testing program included an evaluation of a low NO_x bulk firing system (LNBFS) concept. LNCFS Level II and the LNBFS concept were tested during Phase II, while LNCFS Levels III and I were investigated during Phases IIIa and IIIb, respectively. Phase I consisted of baseline tests with the "as found" unit. Figure 2-1 provides a schematic view of the burner register and SOFA configurations that were involved during the testing under each of the three project phases. The same burner and SOFA configurations were retrofitted to all four corners of Unit 2.

The concept of overfire air was included in all four levels of NO_x reduction technology demonstrated in this project. In LNCFS Levels I and III a close coupled overfire air (CCOFA) system was integrated directly into the windbox. Compared to the baseline configuration, the CCOFA was arranged by exchanging the highest coal nozzle with the air nozzle immediately below it, as shown in Figure 2-1. This configuration provided the NO_x reduction advantages of an overfire air system without major pressure part modifications to the boiler.

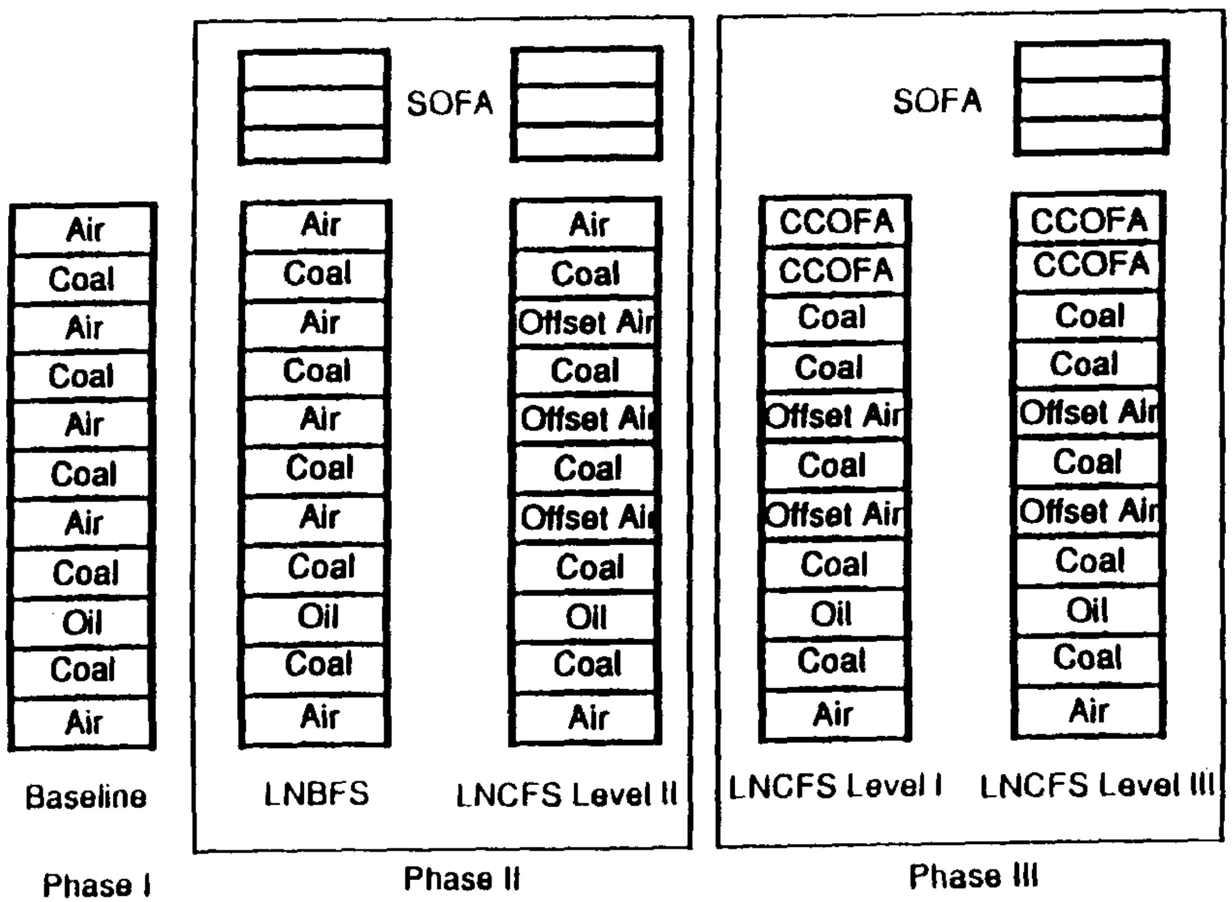

Figure 2-1. Burner Registers and Overfire Air Configurations During the Various Test Phases at Plant Smith

In LNBFS and LNCFS Levels II and III, a separated overfire air (SOFA) system was used. The air supply ductwork for the SOFA was taken off the secondary air duct and routed to the corners of the furnace above the existing windbox. Because the SOFA ports were already in place, LNCFS Level I was simulated by closing the dampers of all of the SOFA ports.

LNBFS operation was simulated with the LNCFS Level II hardware by zeroing the auxiliary air yaws and SOFA yaws, while maintaining the burner damper, auxiliary air dampers, and SOFA dampers at the LNCFS Level II settings. (Yaw refers to the adjustable horizontal offsets of the offset air nozzles from the burners.)

2.2 Phase III EMP Monitoring

Phases IIIa (LNCFS Level III) and IIIb (LNCFS Level I) each consisted of three test elements: short-term characterization, long-term characterization, and short-term verification.

Short-term characterization tests were performed to characterize the NO_x emissions under a number of selected boiler operating conditions of unit load, excess oxygen, mill pattern, and mill bias. The short-term characterization testing is divided into two elements: diagnostic tests and performance tests. Diagnostic tests are used to establish gaseous emission trends; these tests last from one to three hours each. Performance testing is used to establish boiler efficiency and steaming capability (ability to meet design steam temperatures), gaseous and particulate emissions, and mill performance. Each performance test lasts from 10 to 12 hours. All of the short-term characterization tests are conducted with the unit in a fixed configuration while it is off system load dispatch to ensure steady boiler operation. The primary operating parameters varied during these tests include boiler load, excess oxygen, mill pattern, and mill bias. The emphasis of the EMP is on the gaseous and particulate emissions monitoring during these tests, as well as on the coal feed sampling. During Phase IIIa, a total of 48 diagnostic tests and 8 performance tests were conducted. During Phase IIIb, a total of 41 diagnostic tests and 8 performance tests were conducted.

Long-term testing was conducted under normal system load dispatch control. Long-term testing provides emission and operational results that are subsequently subjected to statistical analyses to obtain a true representation of the emissions from the unit. This testing includes most of the variables that can affect NO_x emissions from a boiler during normal operation, including such parameters as coal variability, mill-in-service patterns, mill bias ranges, excess oxygen excursions, equipment conditions, and weather-related factors. Data were recorded continuously over each of the long-term testing periods, which lasted a total of 80 days during Phase IIIa and 89 days during Phase IIIb.

Following the long-term testing period, verification testing was conducted to determine whether changes in the condition of the unit and/or the coal feed had occurred that might have an impact on the interpretation of the long-term test data. Verification tests are conducted in a manner similar to the diagnostic tests; four or five basic test configurations are tested during this effort. A total of 11 verification tests were conducted during Phase IIIa; 9 tests were conducted during Phase IIIb.

Table 2-1 provides a summary of the tests performed during Phase III. For each series of tests, the table shows the dates, the 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 test element.

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

Table 2-1

Phase III (LNCFS Level III and Level I) Operation Summary

Test Element	Dates	Days of Testing	Number of Tests
Phase IIIa (LNCFS Level III):			
Diagnostic Tests	12/05/91 - 12/11/91; 01/12/92 - 01/13/92	9	48
Performance Tests	12/12/91 - 12/15/92; 12/17/91 - 12/20/91	8	8
Long-Term Testing	12/21/91 - 03/09/92	49 [1]	NA
Verification Tests	03/10/92 - 03/11/92	2	11
Phase IIIb (LNCFS Level I):			
Diagnostic Tests	05/14/92 - 05/20/92; 05/29/93 - 06/02/93	12	41
Performance Tests	06/08/92; 06/10/92 - 06/16/92; 06/19/92 - 06/20/92	10	8
Long-Term Testing	06/03/92 - 08/30/92	65 [2]	NA
Verification Tests	09/15/92 - 09/18/92	4	9

[1] 49 days of statistically significant testing; 80 days total or 11 weeks of operation.

[2] 65 days of statistically significant testing; 89 days total or 13 weeks of operation.

NA = Not applicable.

Table 2-2

Gaseous Streams: Integrated Monitoring Schedule [1,2,3,4]

Parameter	Economizer Outlet Gas			Preheater Outlet Gas			Stack Inlet Gas				
	KVB ECEM			KVB ECEM			KVB ECEM			Opacity Monitor	Other
	D/V	P	L	D/V	P	L	D/V	P	L	L	L
Opacity										C [c]	
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		
Total Hydrocarbons							a	a	C		
SO_3/SO_2		4/T									
Particulate Matter:											
Loading		3/T									A [c]
Size Distribution		3/T									
Carbon Content, %		d									
Loss on Ignition (LOI)		d									
Resistivity		3/T									

[1]Monitoring Test Element:
- D = Diagnostic tests; 1-3 hours each
- V = Verification tests; similar to diagnostic tests
- P = Performance tests; 10-12 hours each
- L = Long-term monitoring

[2]Monitoring Frequency:
- a = At least 2 averages per numbered test; each average is based on 12 measurements.
- b = At least 10 averages per numbered test; each average is based on 12 measurements.
- d = Daily composites of solids from the loading measurement.
- n/T = Sampled a minimum of n times during each test.
- C = Continuous
- A = Annual

[3]Monitoring Type: [c] = Compliance parameter; all others are supplemental.

[4]Notes on CEMs:

KVB ECEM (Extractive Continuous Emissions Monitor) is used for the economizer outlet gas, preheater outlet gas, and continuous stack gas monitoring. Except for the stack inlet gas monitor probe, all lines for the KVB ECEM lead to individual flow control valves through bubblers. Opacity is measured in the combined stack gas flow of Units 1 and 2 using a dedicated CEM.

Table 2-3

Aqueous Streams: Integrated Monitoring Schedule[1,2]

Parameter	Ash Pond Discharge
Total Suspended Solids	1/W [c]
pH	1/W [c]
Oil and Grease	1/2W [c]

Parameter	Groundwater[3]
Total Dissolved Solids	1/Q [c]
pH	1/Q [c]
Specific Conductivity	1/Q [c]
Chloride	1/Q [c]
Sulfate	1/Q [c]
Radioactivity:	
Gross Alpha	2/Y [c]
Gross Beta	2/Y [c]
Total Metals:	
Aluminum	1/Q [c]
Cadmium	1/Q [c]
Chromium	1/Q [c]
Iron	1/Q [c]
Manganese	1/Q [c]
Nickel	1/Q [c]

[1]Monitoring frequency:
- 1/W = One sample per week;
- 1/2W = One sample every two weeks;
- 1/Q = One sample per quarter; and
- 2/Y = Two samples per year.

[2]Monitoring type: [c] = Compliance monitoring.

[3]Eight groundwater monitoring wells are to be sampled. The locations and sampling frequencies, as approved by the Florida Department of Environmental Regulation (DER), are shown in Gulf Power Company's Monitoring Compliance Plan.

Table 2-4

Solid Streams: Integrated Monitoring Schedule[1,2,3]

Parameter	Coal Feed[4]		
	D/V	P	L
Ultimate and Proximate Analyses[5]	1/D [s]	3/D [s]	1/W [s]
Chlorine	1/D [s]	3/D [s]	1/W [s]

[1]Monitoring frequency: n/D = Minimum of n samples per day; and
n/W = Minimum of n samples per week.

[2]Monitoring type: [s] = Supplemental monitoring.

[3]Monitoring test elements: D = Diagnostic tests;
V = Verification tests;
P = Performance tests; and
L = Long-term monitoring.

[4]The coal feed sample is a composite from all operating mills.

[5]Analyses include carbon, hydrogen, nitrogen, sulfur, moisture, ash, and oxygen (by difference).

3.0 SAMPLING AND ANALYTICAL METHODS

The sampling and analytical methods specified in the Environmental Monitoring Plan and used during Phase III are summarized in Tables 3-1 through 3-3. The sample volumes, containers, preservation conditions, and holding times for the aqueous and solid stream samples, as specified in the EMP, are summarized in Tables 3-4 and 3-5. The ETEC phase reports contain additional details of the sampling and analytical methods used for the monitoring.

3.1 Gaseous Streams

The KVB Extractive Continuous Emissions Monitor (ECEM) was used to provide quantitative analyses for NO_x, SO_2 (sulfur dioxide), CO, O_2 (oxygen), and total hydrocarbons. SoRI was responsible for the sulfur and solids emissions testing, which included measurement of the particulate matter loading, size distribution, ash resistivity, carbon content, and loss on ignition (LOI). The EMP-specified analytical and sampling methods were followed during the Phase III gaseous monitoring.

3.2 Aqueous Streams

The groundwater analyses performed during Phase III followed the EMP-specified analytical methods, with two exceptions. ASTM Method D1943-81 and ASTM Method 1890-81 are the analytical methods specified in the EMP for measuring gross alpha and gross beta, respectively. During testing, EPA Method 903.1 was used to determine the radioactivity of the groundwater. This EPA method is approved for NPDES work.

For the sulfate measurement, EPA Method 375.4 was used (equivalent to ASTM D516-82), which is approved for NPDES work. However, ASTM Method

Table 3-1

Sampling and Analytical Methods: Gaseous Streams

Parameter	Sampling Method	Analytical Method/ Instrument	Monitored Streams[1]
Opacity	--	Opacity Meter	s
SO_2	ECEM[2]	UV Spectrophotometer	s
CO	ECEM	Fuji CO Analyzer	s,e,p
NO_x	ECEM	TECO Chemiluminescence	s,e,p
O_2	ECEM	Thermox O_2 Analyzer	s,e,p
SO_3	Cheney-Homolya Controlled Condensation	Barium-Thorin Titration	e
Total Hydrocarbons	ECEM	Beckman FID	s
Particulate Matter:			
Loading	EPA Method 17	Gravimetry	s,e
Size Distribution	Inertial Separation	Cascade Impactors, Gravimetry	e
Carbon Content	EPA Method 17 Catch	Ignition, Differential Conductivity	e
Resistivity	EPA Method 17 Catch	Laboratory Resistivity	e

[1]Stream identification: s = Stack inlet gas;
e = Economizer outlet gas; and
p = Air preheater outlet.

[2]ECEM = Extractive continuous emissions monitor system.

Table 3-2

Sampling and Analytical Methods: Aqueous Streams

Parameter	Sampling Method	Analytical Method[1]	Monitored Streams[2]
Total Suspended Solids	Grab	Filtration/Drying/Gravimetry - EPA 160.2	a
Total Dissolved Solids	Grab	Filtration/Evaporation/Gravimetry - EPA 160.1	g
pH	Grab	Electrometry - EPA 150.1	a,g
Oil and Grease	Grab	Freon Extraction/Gravimetry - EPA 413.1	a
Specific Conductivity	Grab	Conductivity Meter - EPA 120.1	g
Chloride	Grab	Titration - EPA 325.3	g
Sulfate	Grab	Ion Chromatography - ASTM D4327-84	g
Gross Alpha	Grab	Proportional Counter - ASTM D1943-81	g
Gross Beta	Grab	Proportional Counter - ASTM D1890-81	g
Total Metals[3]	Grab	Dissolution, ICAPES - EPA 200.7	g
Cadmium	Grab	Dissolution, AA - EPA 213.2	g

[1] Analytical methods: AA = Atomic absorption; and
ICAPES = Inductively coupled argon plasma emissions spectroscopy.

[2] Stream identification: a = Ash pond discharge; and
g = Groundwater.

[3] Includes aluminum, chromium, iron, manganese, and nickel.

Table 3-3

Sampling and Analytical Methods: Solid Streams

Parameter	Sampling Method	Analytical Method	Monitored Streams[1]
Ultimate and Proximate Analyses[2]	Grab/Composite	Combustion/Gravimetry/Titration - ASTM D3176	f
Chlorine	Grab/Composite	Combustion/Absorption/Titration - ASTM D2361	f

[1] Stream identification: f = Coal feed.

[2] Analyses include carbon, hydrogen, nitrogen, sulfur, moisture and ash. Oxygen is determined by difference.

Table 3-4

Sample Information: Aqueous Streams

Parameter	Sample Volume Required (mL)	Container Type[1]	Preservation	Holding Time (Days)
Total Suspended Solids	100	P,G	Cool, 4 °C	7
Total Dissolved Solids	100	P,G	Cool, 4 °C	7
pH	25	P,G	None	Analyze Immediately
Oil and Grease	1,000	G (Amber)	H_2SO_4 to pH <2; Cool, 4 °C	28
Specific Conductance	100	P,G	Cool, 4 °C	28
Chloride	50	P,G	None Required	28
Sulfate	50	P,G	Cool, 4 °C	28
Radioactivity (Gross Alpha, Gross Beta)	1,000	P,G	HNO_3 to pH <2	14
Total Metals (Aluminum, Cadmium, Chromium, Iron, Manganese, Nickel)	100	P,G	HNO_3 to pH <2	180

[1] P = plastic; G = glass.

Table 3-5

Sample Information: Solid Streams

Parameter	Sample Weight (g)	Container Type	Preservation	Holding Time (Days)
Ultimate and Proximate Analyses and Chlorine	1,000	Plastic Bag	Eliminate air and seal	--[1]

[1] The general holding time for solids held in the absence of air or other conditions which would promote oxidation is 180 days.

D4327-84 was specified in the EMP. These changes from the EMP-specified methods are not expected to affect the results for these parameters.

3.3 Solid Streams

Coal samples were obtained by plant personnel. The specified analytical and sampling methods were used for the coal analyses.

4.0 GASEOUS STREAM MONITORING RESULTS

This section presents the results of the gaseous stream monitoring performed during Phase III at Plant Smith. These results are also compared to those obtained during Phases I (Baseline) and II (LNCFS Level II) monitoring. Three streams were monitored as specified by the EMP: preheater outlet gas, economizer outlet gas, and stack inlet gas. The parameters selected for monitoring and their monitoring frequencies are presented in Table 2-2.

Table 4-1 presents the actual and planned gaseous stream monitoring during Phases IIIa and IIIb. As shown in this table, most of the planned EMP monitoring was performed during this testing phase. In some cases more than the planned amount of monitoring was actually conducted. Monitoring of the preheater outlet gas was not conducted as originally planned, especially during the diagnostic and verification test periods. However, sufficient data were obtained from which to develop analyses and draw conclusions.

Appendix A contains all of the short-term results in tabular form. The daily averages obtained during long-term testing of the stack inlet gas are also listed.

The following sections present the results of Phase III testing for gaseous streams, primarily in graphical form. These results are also compared to those from the previous testing phases. Section 4.1 presents the short-term monitoring results for the economizer outlet gas, including NO_x emissions, SO_3/SO_2 ratio, and particulate data. The short-term test results for SO_2, CO, and THC in the stack inlet gas stream are presented in Section 4.2. The long-term monitoring results for the stack inlet gas are presented in Section 4.3. Section 4.4 presents the results of compliance monitoring performed during the Phase III testing periods.

Table 4-1

Gaseous Streams: Actual and Planned Monitoring [1]
Phase IIIa: LNCFS Level III

Parameter	Economizer Outlet Gas			Preheater Outlet Gas			Stack Inlet Gas				
	KVB ECEM			KVB ECEM			KVB ECEM				Opacity Monitor
	D	P	V	D	P	V	D	P	L	V	L
Opacity											C/C
SO_2							119/96 [2]	73/16 [3]	C/C [4]	3/22 [5]	
CO	133/96	87/80 [6]	27/22	4/96	31/80	0/22	119/96	73/16	C/C	3/22	
NO_x	133/96	87/80	27/22	4/96	31/80	0/22	119/96	73/16	C/C	3/22	
O_2	133/96	87/80	27/22	4/96	31/80	0/22	119/96	73/16	C/C	3/22	
THC							119/96	73/16	C/C	3/22	
SO_3/SO_2		32/32 [7]									
Particulate Matter:											
Loading		15/24 [8]									
Size Distribution		15/24 [8]									
Carbon Content		5/8 [9]									
Loss on Ignition (LOI)		5/8 [9]									
Resistivity		7/24 [8]									

D = Diagnostic tests.
V = Verification tests.
P = Performance tests.
L = Long-term monitoring.
C = Continuous.
ECEM = Extractive continuous emissions monitor.
THC = Total hydrocarbons.

Table 4-1 (Continued)

Gaseous Streams: Actual and Planned Monitoring [1]
Phase IIIb: LNCFS Level I

Parameter	Economizer Outlet Gas			Preheater Outlet Gas			Stack Inlet Gas				
	KVB ECEM			KVB ECEM			KVB ECEM				Opacity Monitor
	D	P	V	D	P	V	D	P	L	V	L
Opacity											C/C
SO_2							80/82 [2]	86/16 [3]	C/C [4]	24/18 [5]	
CO	284/82	76/80 [6]	33/18	0/82	119/80	0/18	80/82	82/16	C/C	24/18	
NO_x	283/82	76/80	33/18	0/82	119/80	0/18	80/82	86/16	C/C	24/18	
O_2	284/82	76/80	33/18	0/82	119/80	0/18	80/82	86/16	C/C	24/18	
THC							80/82	86/16	C/C	24/18	
SO_3/SO_2		28/32 [7]									
Particulate Matter:											
Loading		12/24 [8]									
Size Distribution		12/24 [8]									
Carbon Content		4/8 [9]									
Loss on Ignition (LOI)		4/8 [9]									
Resistivity		12/24 [8]									

D = Diagnostic tests.
V = Verification tests.
P = Performance tests.
L = Long-term monitoring.
C = Continuous.
ECEM = Extractive continuous emissions monitor.
THC = Total hydrocarbons.

Table 4-1 (Continued)

[1]*Example:* 2/3 = *two samples collected; three samples planned.*

[2]Two samples are planned per numbered test. Diagnostic testing consisted of 48 tests during Phase IIIa and 41 tests during Phase IIIb.

[3]For the stack inlet gas, two samples are planned per test for each performance test. Eight performance tests were conducted during Phases IIIa and IIIb.

[4]The ECEM was essentially measuring the levels of these constituents continuously.

[5]During verification testing, two samples are planned per test; 11 verification tests were conducted during Phase IIIa; 9 were conducted during Phase IIIb.

[6]For the preheater and economizer outlet gas streams during performance testing, ten samples are planned per numbered test for each stream.

[7]Four samples per performance test.

[8]Three samples per performance test.

[9]Daily composites of ash samples are planned during performance testing; eight days of performance testing were conducted during Phases IIIa and IIIb.

4.1 Short-Term Test Results for the Economizer Outlet Gas

This section presents the short-term gas monitoring results for NO_x, SO_3/SO_2 ratio, and several particulate matter parameters measured in the economizer outlet gas.

4.1.1 Nitrogen Oxides Emissions

Figures 4-1 through 4-5 present the average NO_x emission rates as a function of oxygen levels in the economizer outlet gas for each of the five nominal operating load levels at which testing was performed (i.e., 200, 180, 135, 115, and 70 MW). Since consistent results were obtained during diagnostic, performance, and verification tests at each load level during each testing phase, they have not been displayed separately.

As expected, for each load level the NO_x emission rate increased as the oxygen level increased. Data obtained at the highest operating load level, 200 MW, were insufficient to permit much comparison of the test results obtained using different NO_x reduction configurations. Compared to baseline operation, all of the retrofit NO_x reduction configurations produced reductions in NO_x emissions at 180, 135, and 115 MW. Differences in NO_x emission rates among the different LNCFS levels were not pronounced in most cases. At the lowest operating load level, 70 MW, all of the observed NO_x emission rates were in the same range as those measured in the baseline configuration. 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 data are presented in Section 4.3.

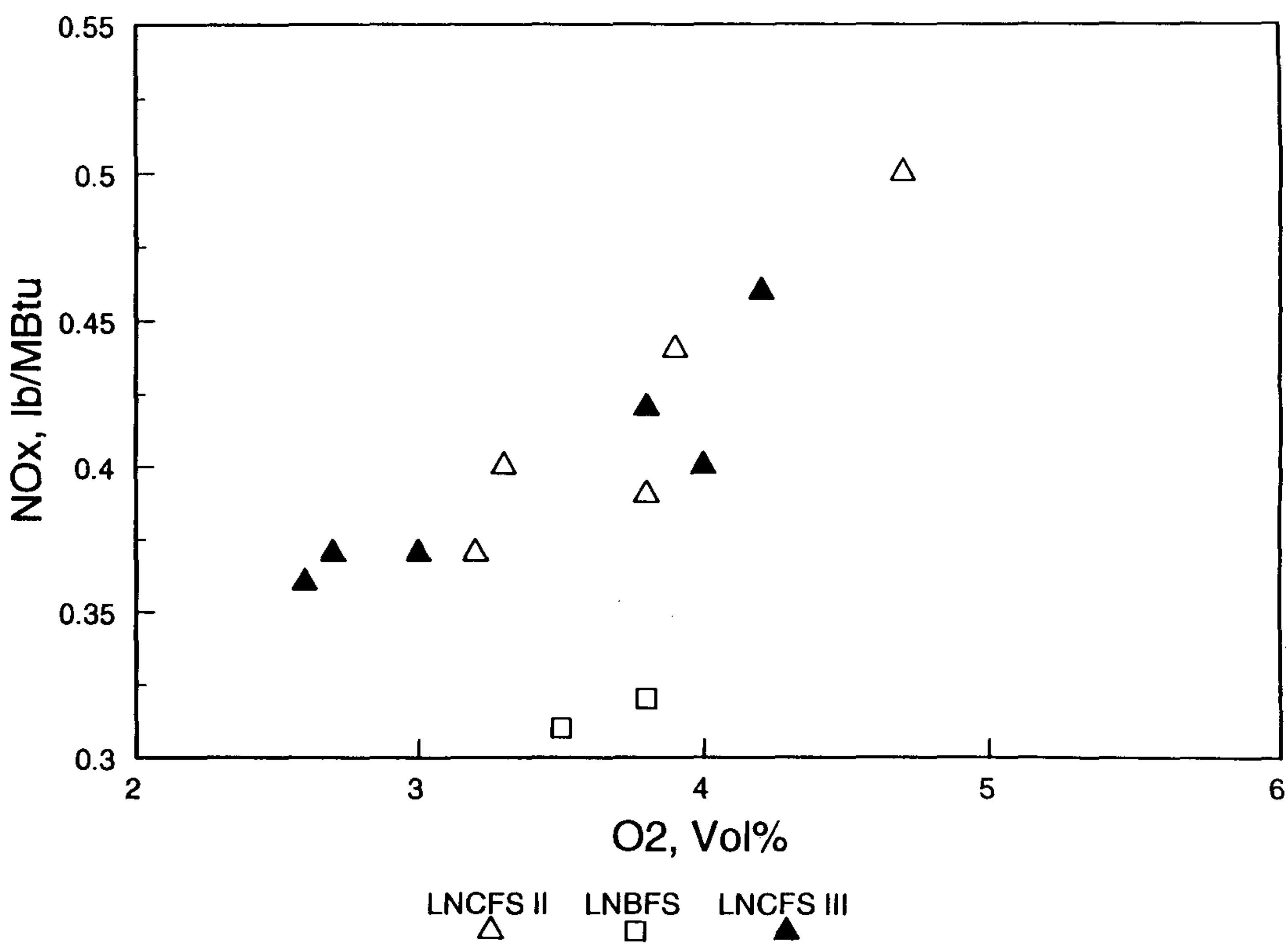

Figure 4-1. Short-Term Economizer Outlet Gas NO_x Concentration Versus Oxygen Concentration at 200 MW: All Test Phases

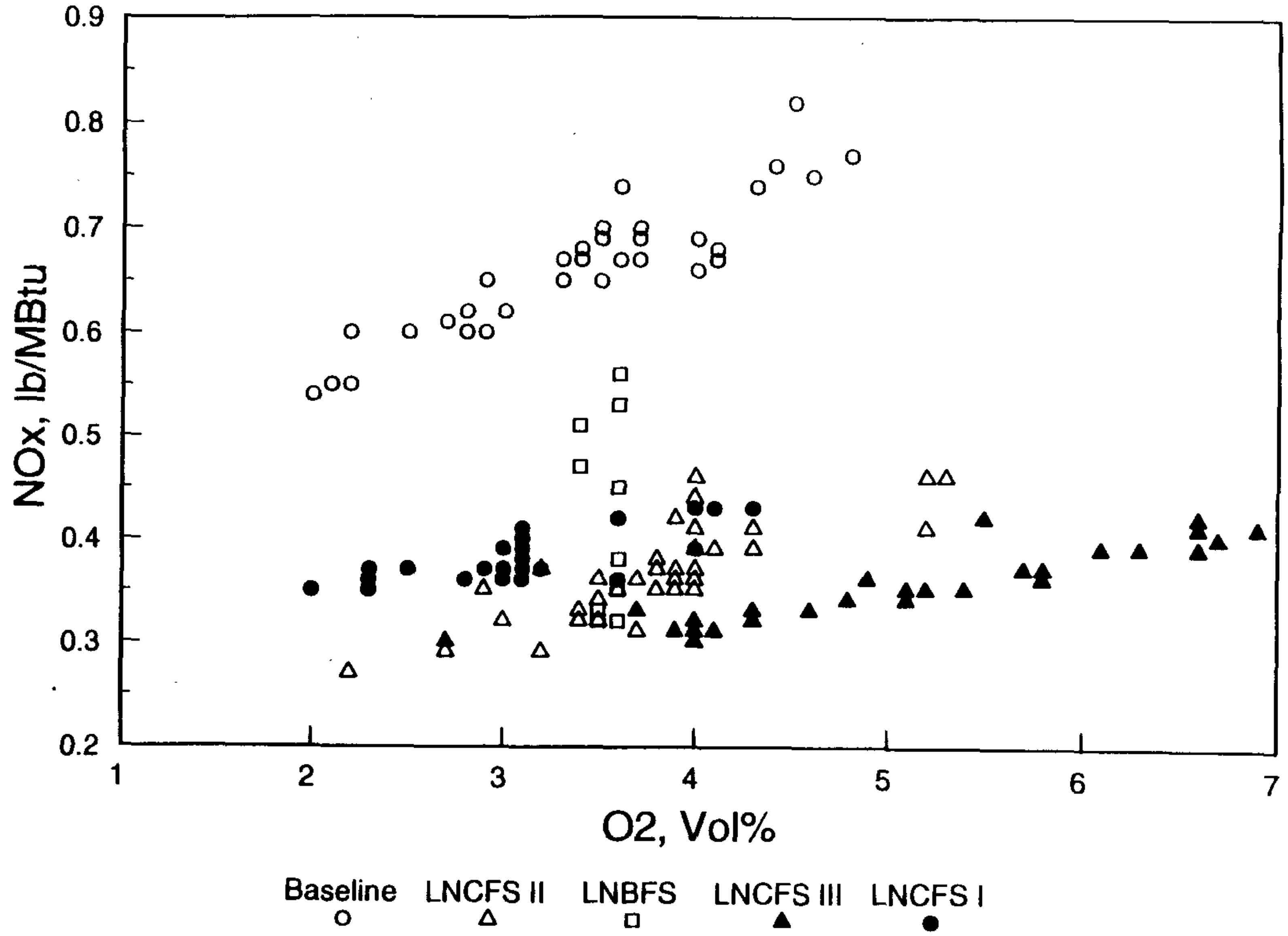

Figure 4-2. Short-Term Economizer Outlet Gas NO_x Concentration Versus Oxygen Concentration at 180 MW: All Test Phases

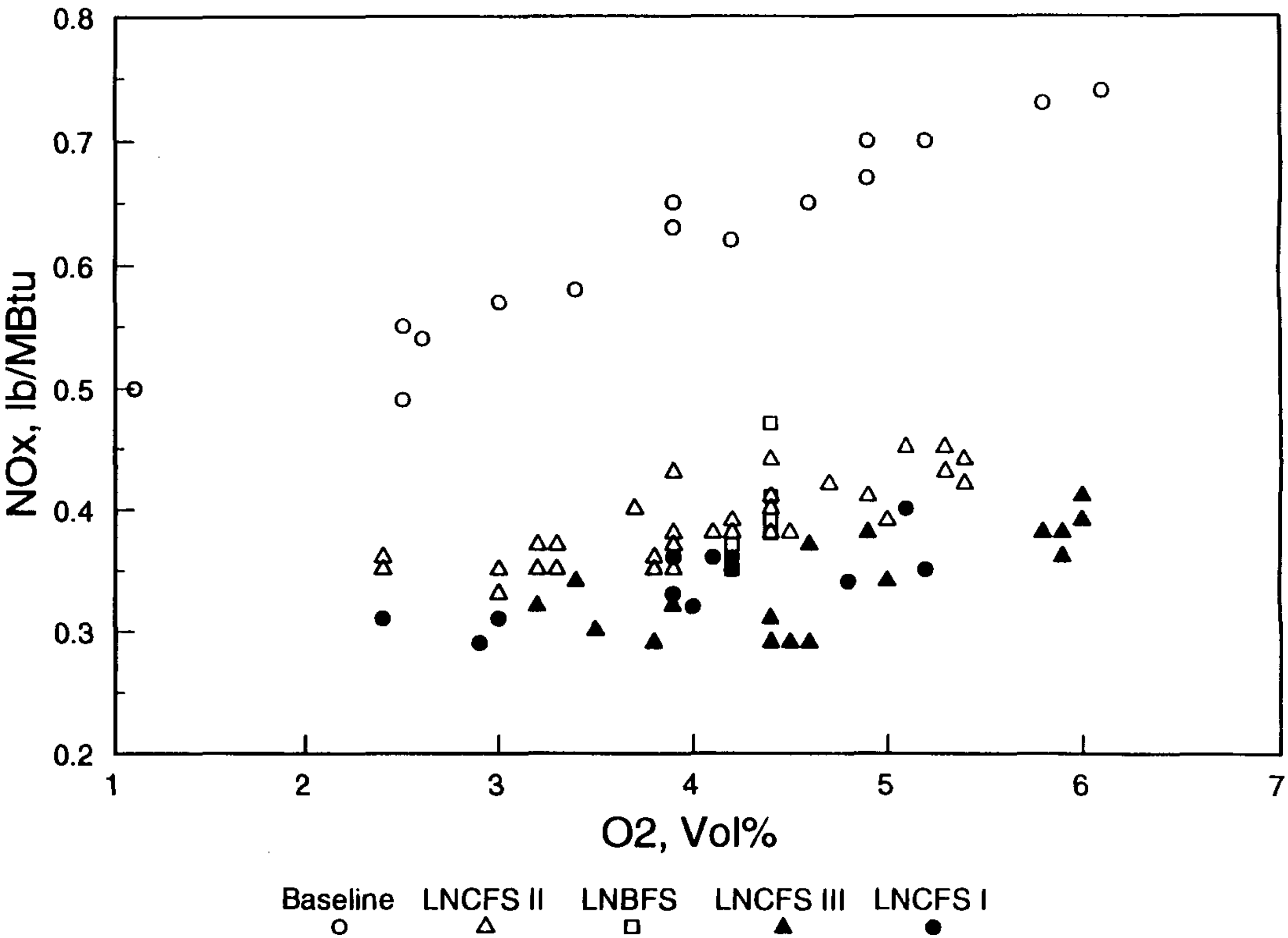

Figure 4-3. Short-Term Economizer Outlet Gas NO_x Concentration Versus Oxygen Concentration at 135 MW: All Test Phases

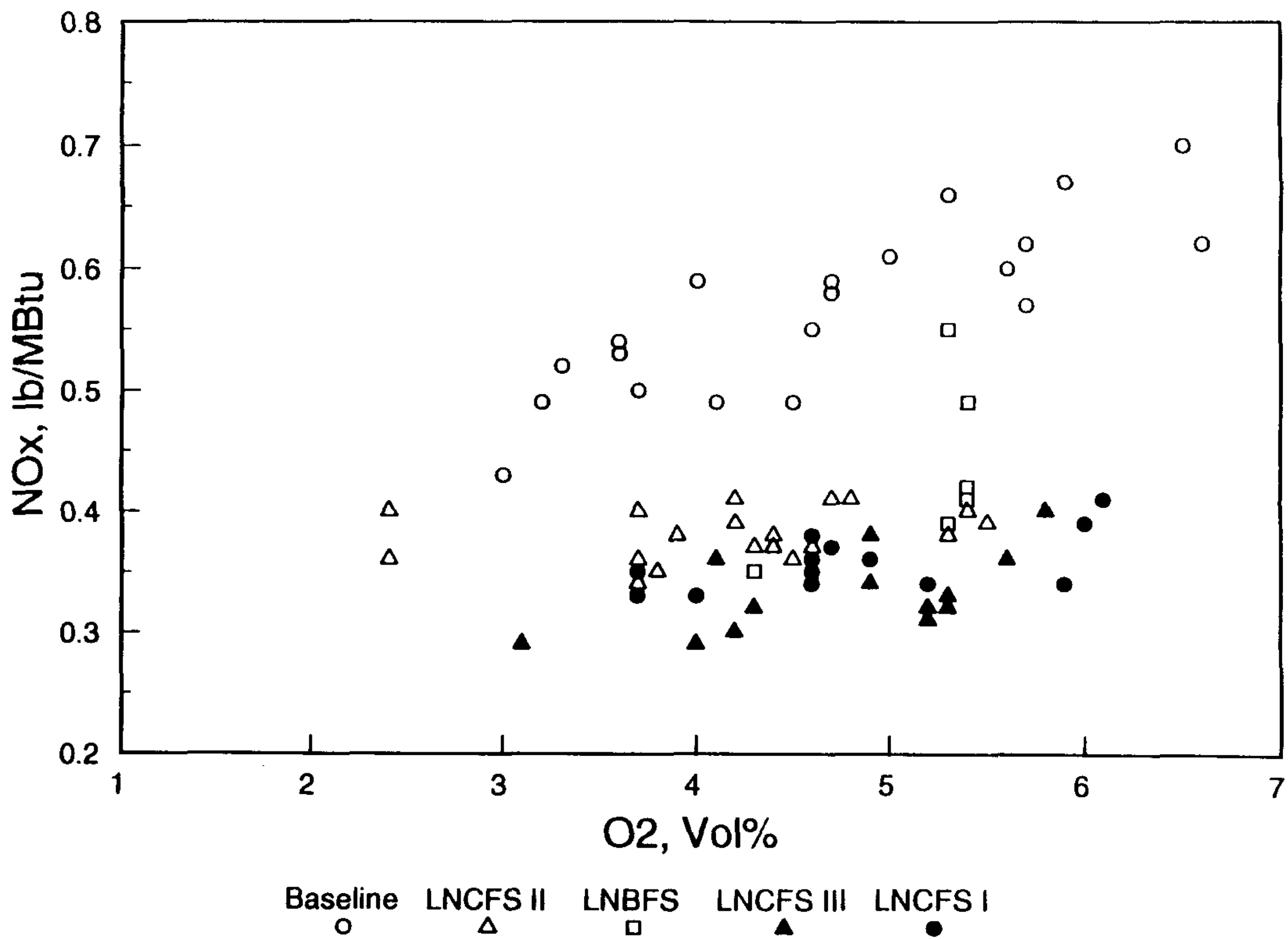

Figure 4-4. Short-Term Economizer Outlet Gas NO_x Concentration Versus Oxygen Concentration at 115 MW: All Test Phases

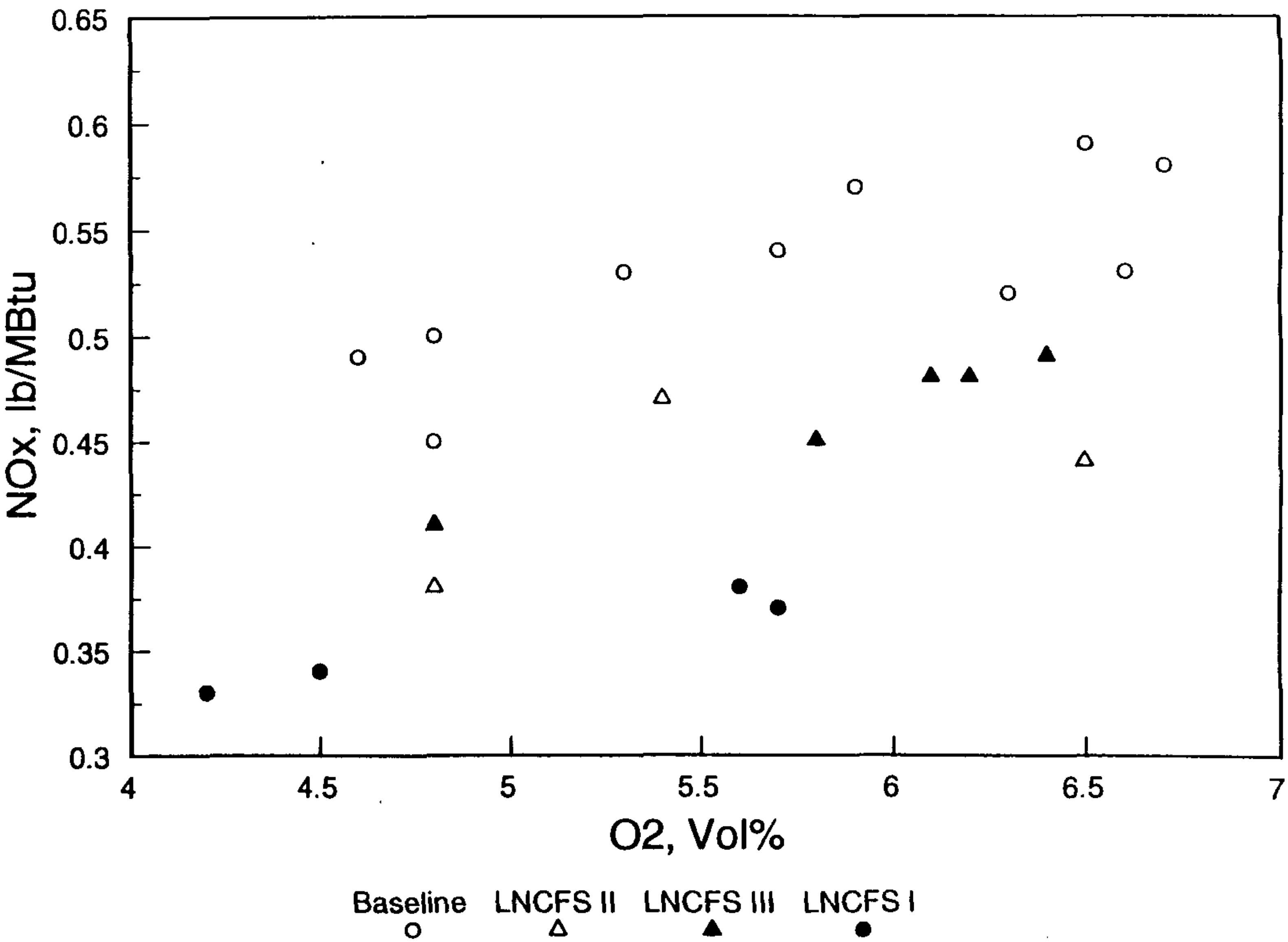

Figure 4-5. Short-Term Economizer Outlet Gas NO_x Concentration Versus Oxygen Concentration at 70 MW: All Test Phases

4.1.2 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 (SO_3). 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 SO_3 can have a beneficial impact on the operation of electrostatic precipitators.

The average ratios of SO_3 to SO_2 concentrations measured at each load level are shown in Figure 4-6 for all three test phases. For the Phase IIIa and IIIb tests, the 95% confidence intervals are included. Based on the available data, it does not appear that the NO_x-reduction retrofits tested during this program affected the amount of SO_3 formed, relative to baseline operation. As expected, the amount of excess oxygen had the biggest impact on SO_3 formation.

4.1.3 Particulate Loading

Particulate loading was measured in the economizer outlet gas. The average loadings measured at 115, 135, 180, and 200 MW are shown in Figure 4-7 for all test phases. No clear and consistent trends were observed in particulate loading as a function of the level of NO_x control technology employed.

4.1.4 Particle Size Distribution

Figure 4-8 shows the size distribution of the particulate matter in the preheater outlet gas measured for the 180 MW tests during baseline, LNCFS Level II, and LNCFS Level III testing. As shown in this figure, only minor differences were observed in the particle size distributions. Similar results were obtained at other load levels.

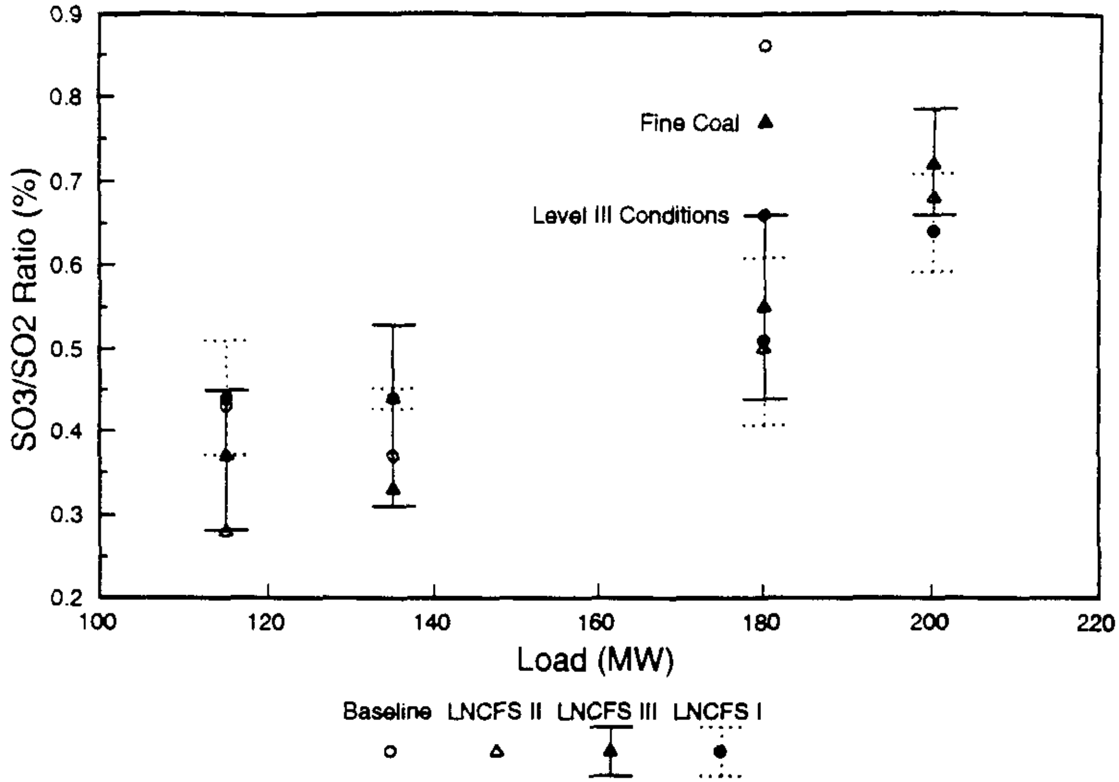

Figure 4-6. Economizer Outlet Gas SO_3/SO_2 Ratio Versus Load: All Test Phases

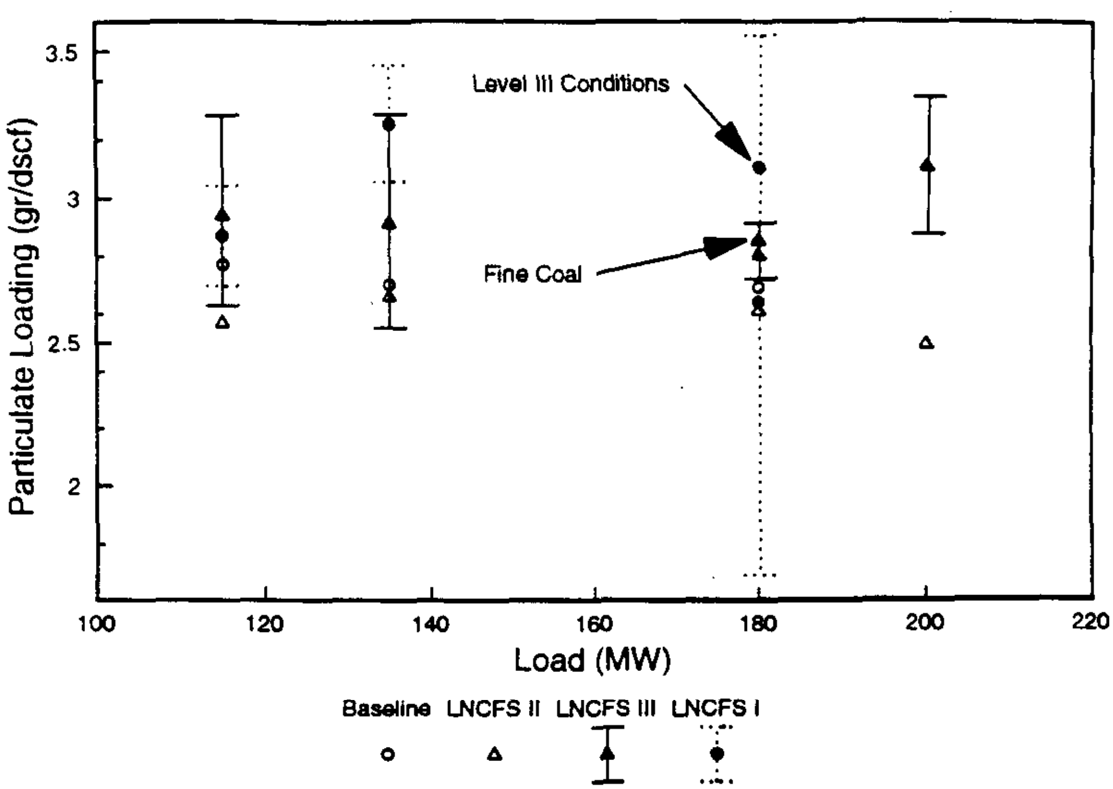

Figure 4-7. Economizer Outlet Gas Particulate Loading Versus Load: All Test Phases

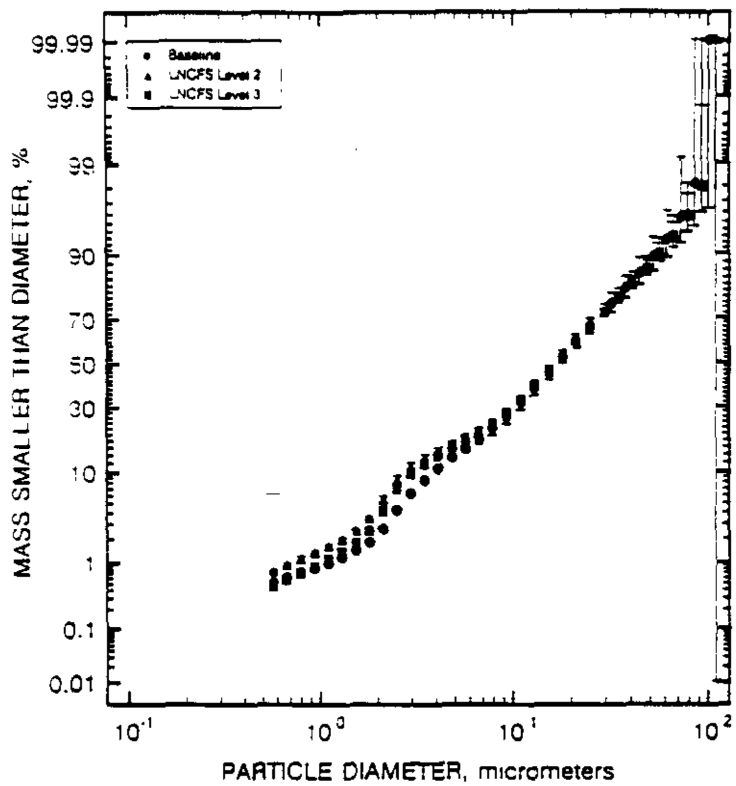

Figure 4-8. Particle Size Distributions at 180 MW: Baseline, LNCFS Level II and Level III

4.1.5 Carbon and LOI Content

Samples of the particulates collected in the economizer outlet gas by the mass loading trains were analyzed for carbon content and loss on ignition (LOI); these parameters are indicators of combustion efficiency during the test period. The results, shown in Figures 4-9 and 4-10, show that the carbon content and LOI were higher during the LNCFS Level III tests than for either the baseline or LNCFS Level II tests at all boiler loads. No clear trends were found for the LNCFS Level I data. The measured LOI clearly consisted primarily of carbon, as shown in Figure 4-11.

4.1.6 Particulate Matter Resistivity

The resistivity of the particulate matter entering an ESP is an important variable that may impact particulate removal efficiency. Because of the high temperatures present at the hot-side ESP outlet and the low particulate matter loadings at the cold-side ESP inlet, in-situ resistivity measurements could not be made. Instead, laboratory resistivity measurements were made in simulated environments. The results are shown in Figure 4-12 for tests performed at the hot-side ESP temperatures. Higher resistivities were observed at each level of LNCFS testing relative to baseline, but the differences were not great, and all of the values obtained were sufficiently low such that ESP performance should not be greatly affected.

4.2 Short-Term Results for the Stack Inlet Gas

Because bubblers were used as flow meters in sampling the economizer outlet and preheater outlet gas streams, the data for SO_2, CO, and THC obtained from these streams are suspected to be biased low. This section presents the results obtained for these species in the stack inlet gas. In all cases, the data were corrected to a 3% oxygen concentration.

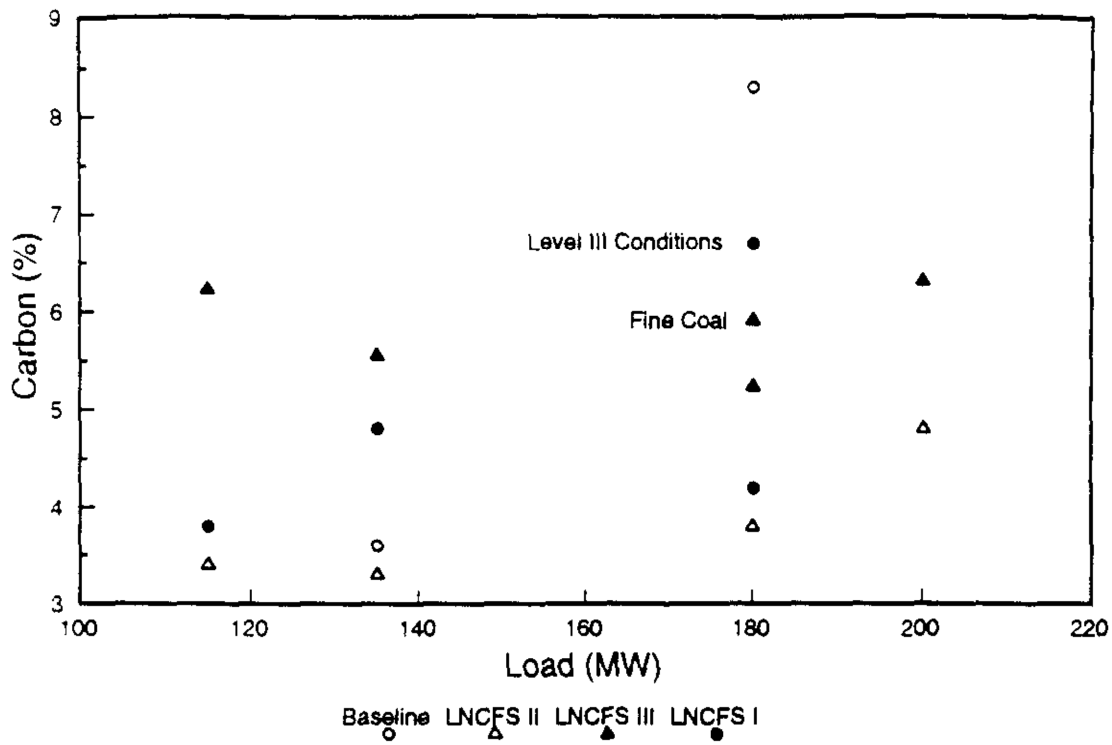

Figure 4-9. Carbon Content of Economizer Outlet Gas Particulates Versus Load: All Test Phases

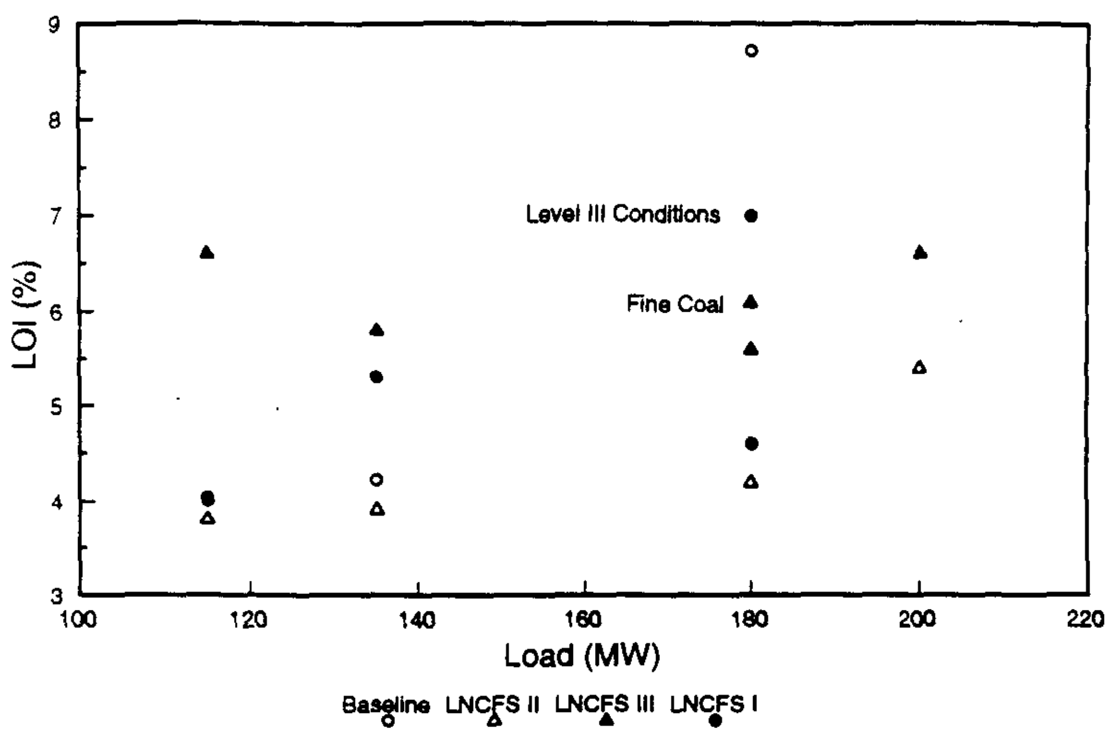

Figure 4-10. LOI Measurements of Economizer Outlet Gas Particulates Versus Load: All Test Phases

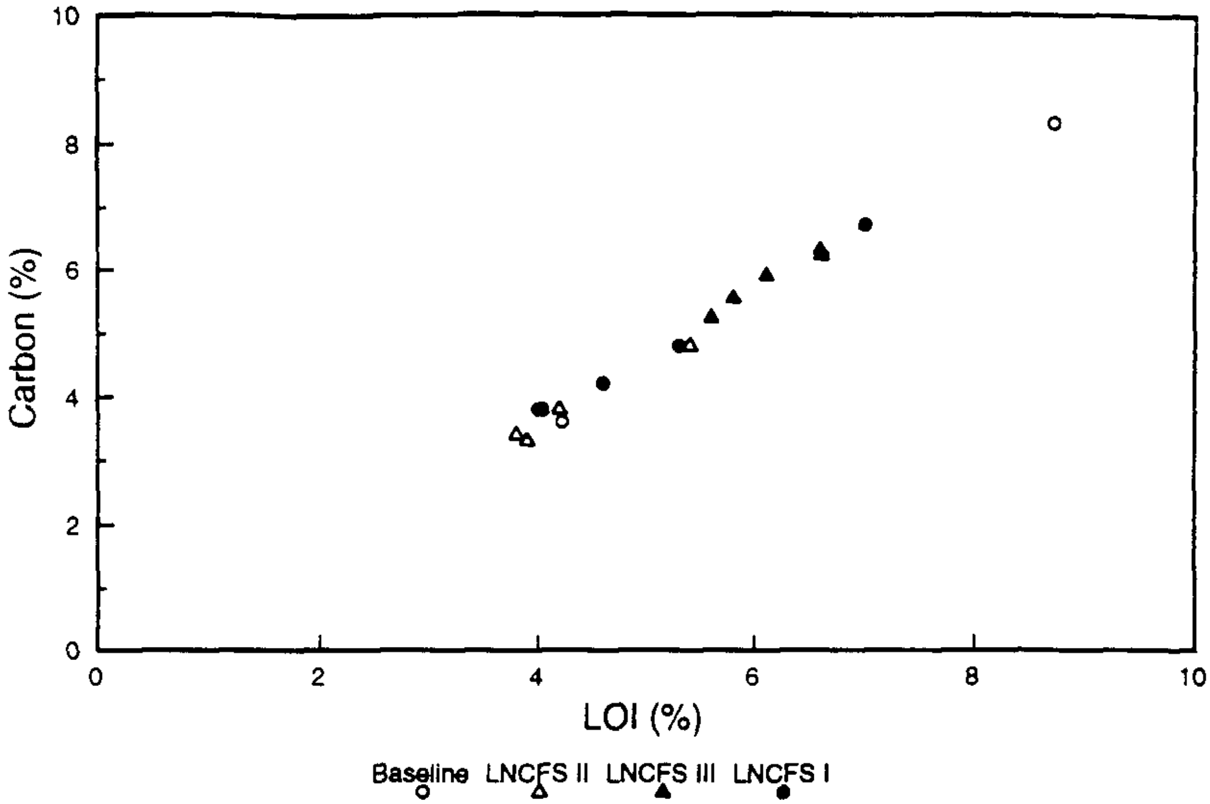

Figure 4-11. Relationship Between Carbon Content and LOI of Economizer Outlet Gas Particulates: All Test Phases

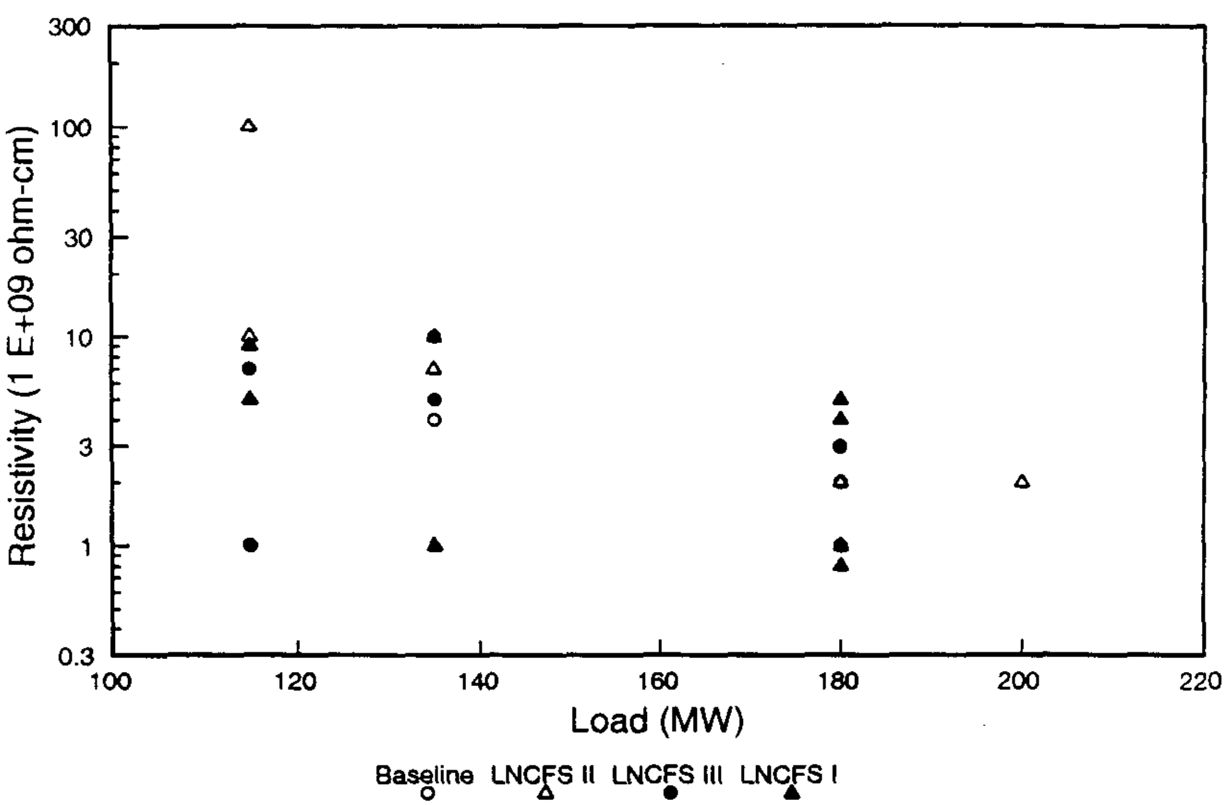

Figure 4-12. Laboratory Resistivity Measurements of Economizer Outlet Gas Particulates: All Test Phases

4.2.1 Sulfur Dioxide Emissions

Figure 4-13 presents the stack inlet gas SO_2 concentrations (corrected to 3% O_2) measured during the short-term tests as a function of unit load. As expected, no relationships were indicated between stack gas SO_2 concentration and operating load or the oxygen concentration. Although the SO_2 concentration in the stack gas is expected to be a function of coal sulfur content, the data showed considerable variability even over short time periods, and it is, therefore, not possible to determine a relationship. The data for each of the test phases are in the same general ranges as expected, given the similarities in coal sulfur content from one phase to the next.

4.2.2 Carbon Monoxide Emissions

The short-term stack gas CO concentration data are presented in Figure 4-14. Many of the measured concentrations were in the same range for each test configuration, although there was considerable scatter in the data within each of the test phases.

4.2.3 Total Hydrocarbon Emissions

The data for THC concentration are shown in Figure 4-15. As with CO, no relationships were found between THC concentration and load or oxygen concentration using the short-term data. In most cases, THC concentrations between 0.5 and 1.5 ppmv were generally measured except during baseline testing, when considerably more data scatter was observed than during the subsequent testing phases.

4.3 Long-Term Monitoring Results

Long-term monitoring consisted of continuous measurements of operating parameters while Unit 2 was under system load dispatch control. Unit load and

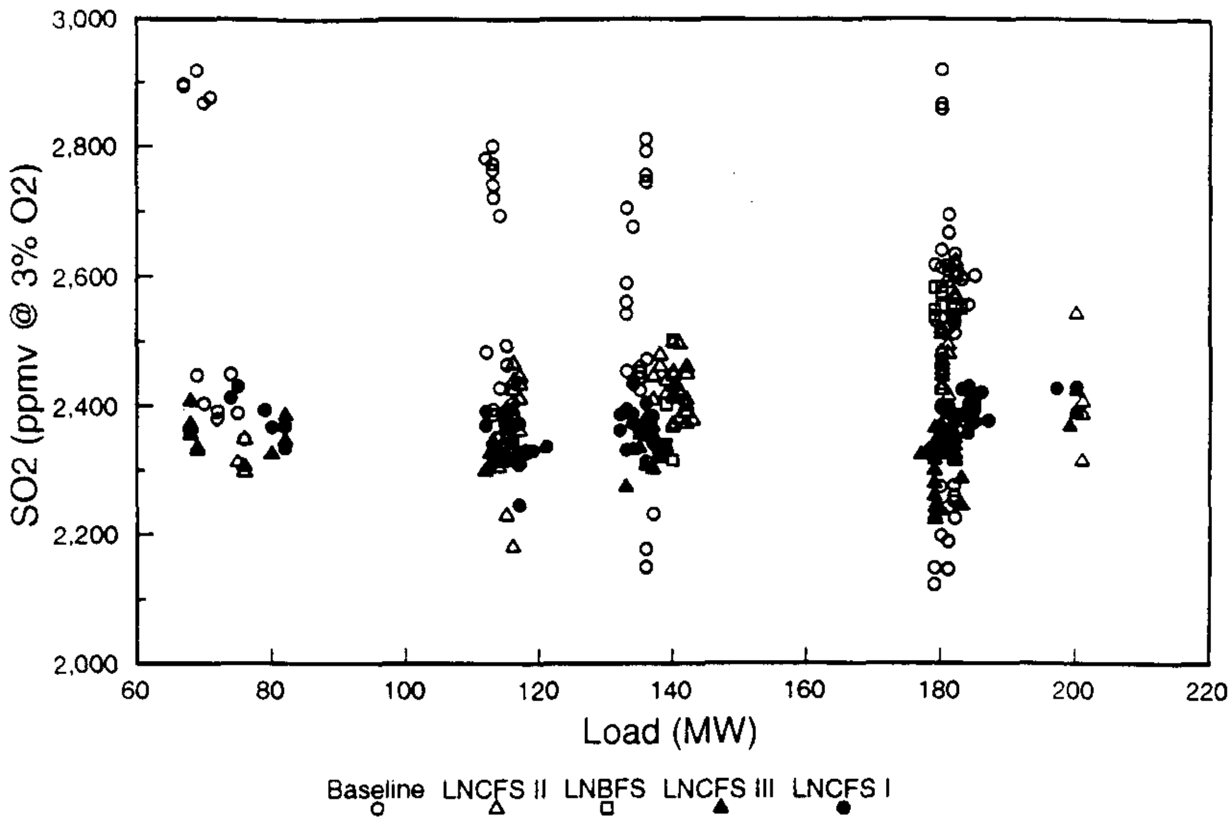

Figure 4-13. Short-Term Stack Inlet Gas SO_2 Concentration Versus Load: All Test Phases

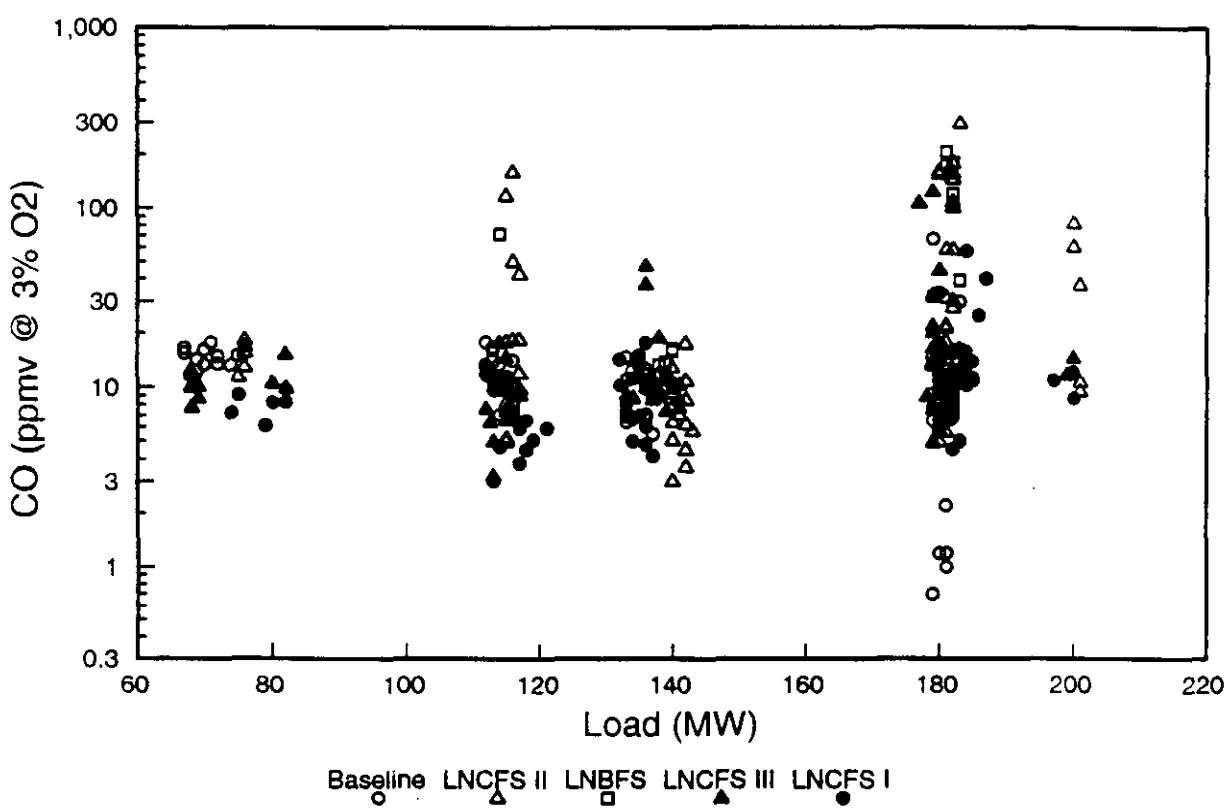

Figure 4-14. Short-Term Stack Inlet Gas CO Concentration Versus Load: All Test Phases

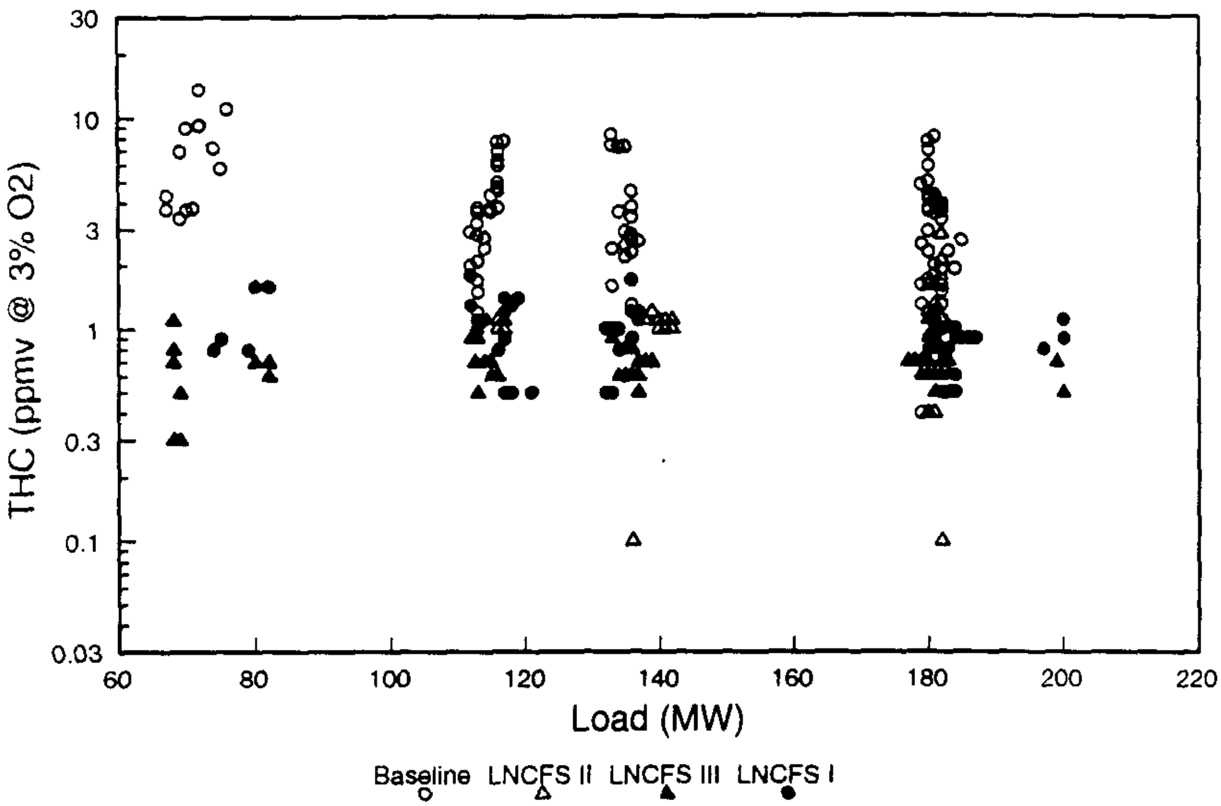

Figure 4-15. Short-Term Stack Inlet Gas THC Concentration Versus Load: All Test Phases

concentrations of O_2, NO_x, SO_2, CO, and THC were measured and the 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 lost due to CEM outages. In these cases, data were treated using an adaptation of EPA's NSPS guidelines for determining what quantity of data is sufficient for computing an hourly average for emission monitoring purposes. Only those days with at least 18 hours of valid hourly data were used in computing daily average emissions.

Five-minute average data were used to evaluate the relationship between NO_x concentration and load and between NO_x and O_2 levels in the stack gas at various load levels. Hourly average emission analyses, 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 each long-term monitoring period. The ETEC phase reports focus on the NO_x emission results. This EMP report summarizes the emission trends for NO_x, but also presents the emission trends for SO_2, CO, and THC, based on the daily average data.

4.3.1 Nitrogen Oxides Emissions

Long-term daily average NO_x emissions for all three project phases are plotted versus load in Figure 4-16. The data clearly show that NO_x emissions were reduced at each level of LNCFS operation relative to Unit 2 baseline operation. Differences in NO_x emission levels between the various levels of LNCFS operation cannot be clearly determined from this figure. A statistical analysis of the five-minute average data shows the differences more distinctly. Figure 4-17 shows the average NO_x emissions (in pounds per million Btu) for baseline operation and each level of LNCFS operation. At higher loads (135 MW to 200 MW), LNCFS Level III control reduced baseline NO_x emissions by an average of about 45%, while Levels I and II resulted in

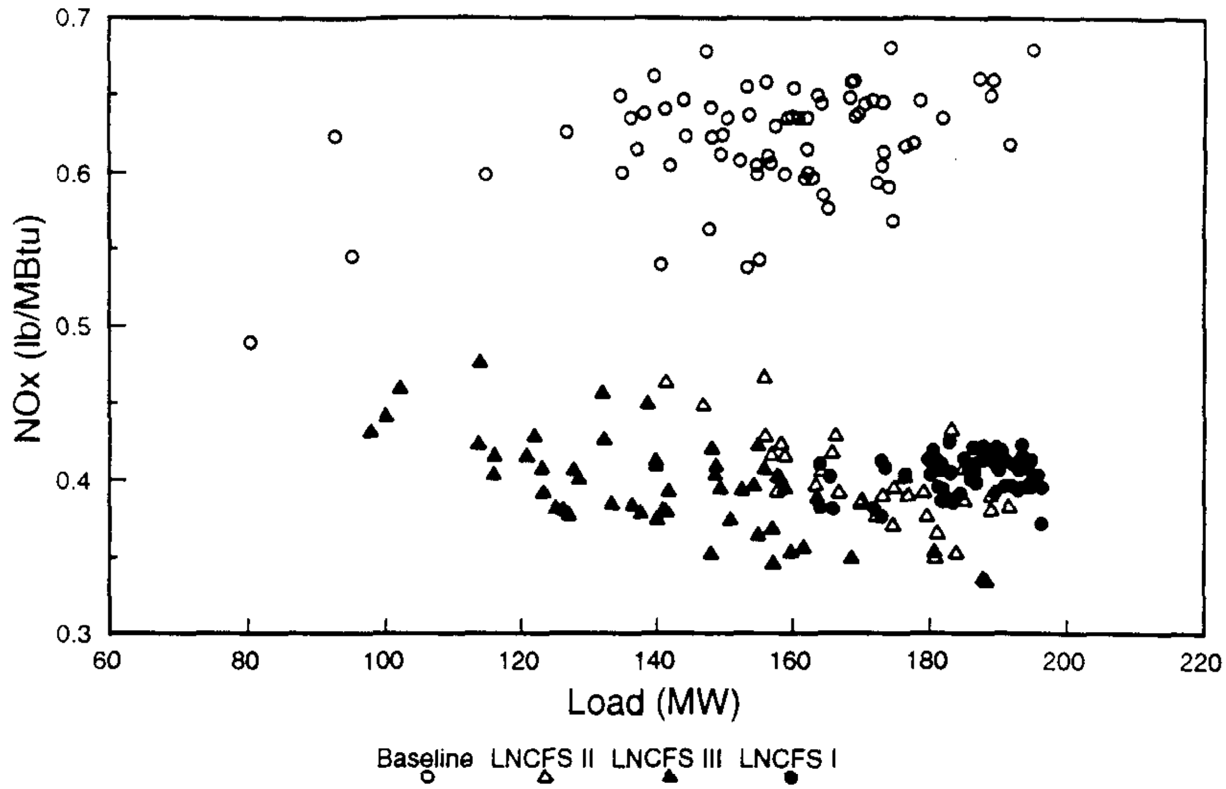

Figure 4-16. Long-Term Daily Average NO_x Emissions Versus Load: All Test Phases

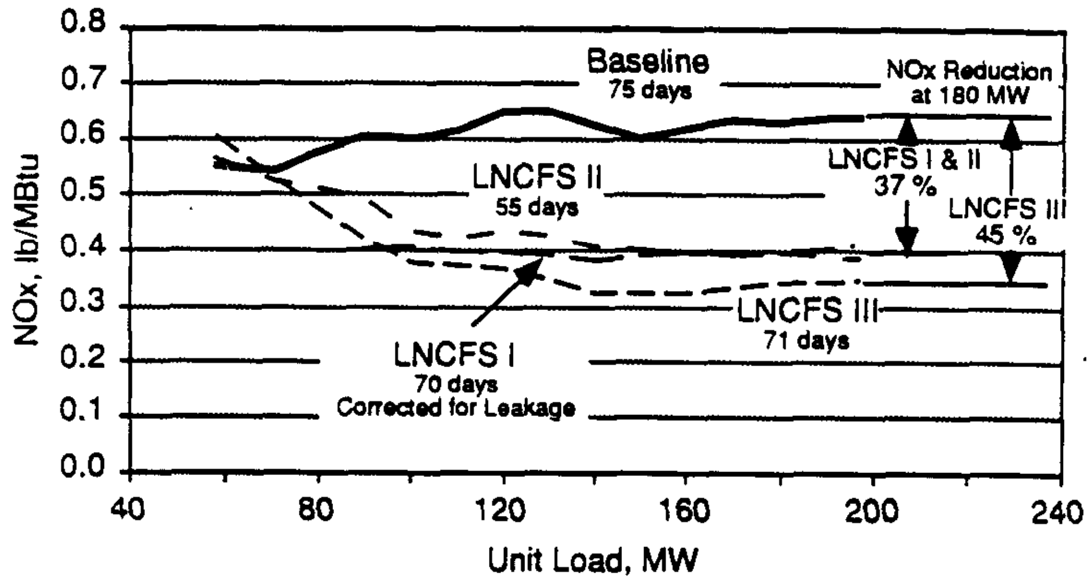

Figure 4-17. Average Long-Term NO_x Emissions Versus Load: All Test Phases

(Source: Third Quarter 1992 Technical Progress Report, prepared by Souther Company Services, Inc., cleared by DOE Patent Counsel on November 23, 1992.)

average reductions of 37%. The level of NO_x reduction produced at LNCFS Levels II and III decreased appreciably at lower unit loads.

4.3.2 Sulfur Dioxide Emissions

Daily average SO_2 emissions data for all three project phases are presented in Figure 4-18. Although there is appreciable scatter in the data, the SO_2 emissions observed during all three phases appear to fall in the same range (i.e., 4 to 5 pounds per million Btu), consistent with the similarities in coal sulfur content measured during all three phases. There did not appear to be any statistically significant differences among any of the test phases.

4.3.3 Carbon Monoxide Emissions

Average CO emissions data from the long-term testing periods of all three phases are presented in Figure 4-19. The average CO concentration in the stack inlet gas was roughly twice as high during LNCFS Level II and III testing compared to either the baseline or Level I (approximately 20 ppmv versus 10 ppmv). These concentrations correspond to emission rates of 0.02 and 0.01 pounds per million Btu, respectively. Some of the highest CO levels were measured during times when the average oxygen concentration, as shown in Figure 4-20, was highest. The reasons for this somewhat anomalous result are unknown. However, none of the CO levels observed were high enough to cause concern, and the average emission rates were all low.

4.3.4 Total Hydrocarbon Emissions

The long-term daily average THC emissions data are presented in Figure 4-21. For the most part, the levels obtained during all three phases varied from 0.5 to 1.5 ppmv (corrected to 3% O_2). This concentration range corresponds to an emission rate of approximately 0.00025 to 0.00075 pounds of THC (expressed as methane) per

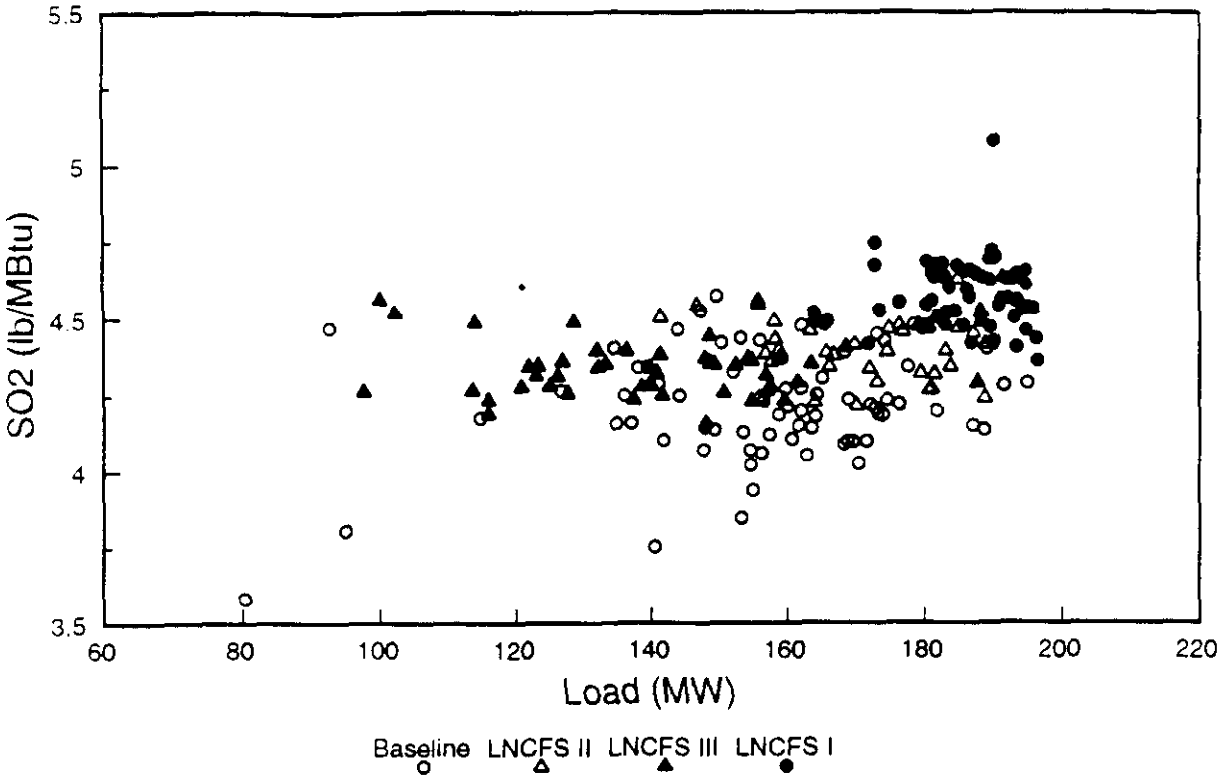

Figure 4-18. Long-Term Daily Average SO_2 Emissions Versus Load: All Test Phases

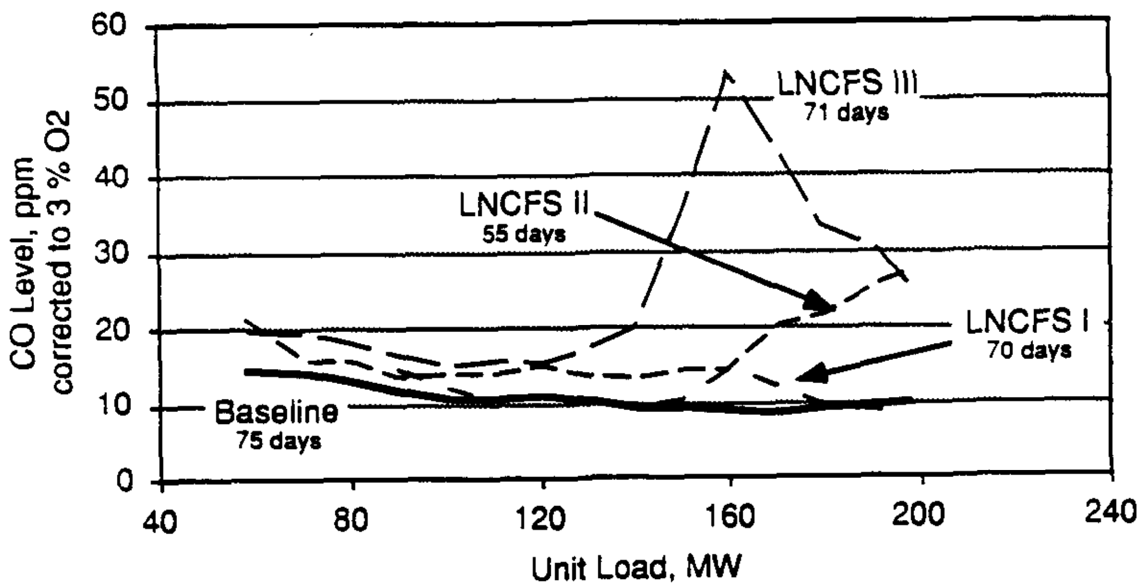

Figure 4-19. Long-Term Daily Average CO Emissions Versus Load: All Test Phases

(Source: Third Quarter 1992 Technical Progress Report, prepared by Souther Company Services, Inc., cleared by DOE Patent Counsel on November 23, 1992.)

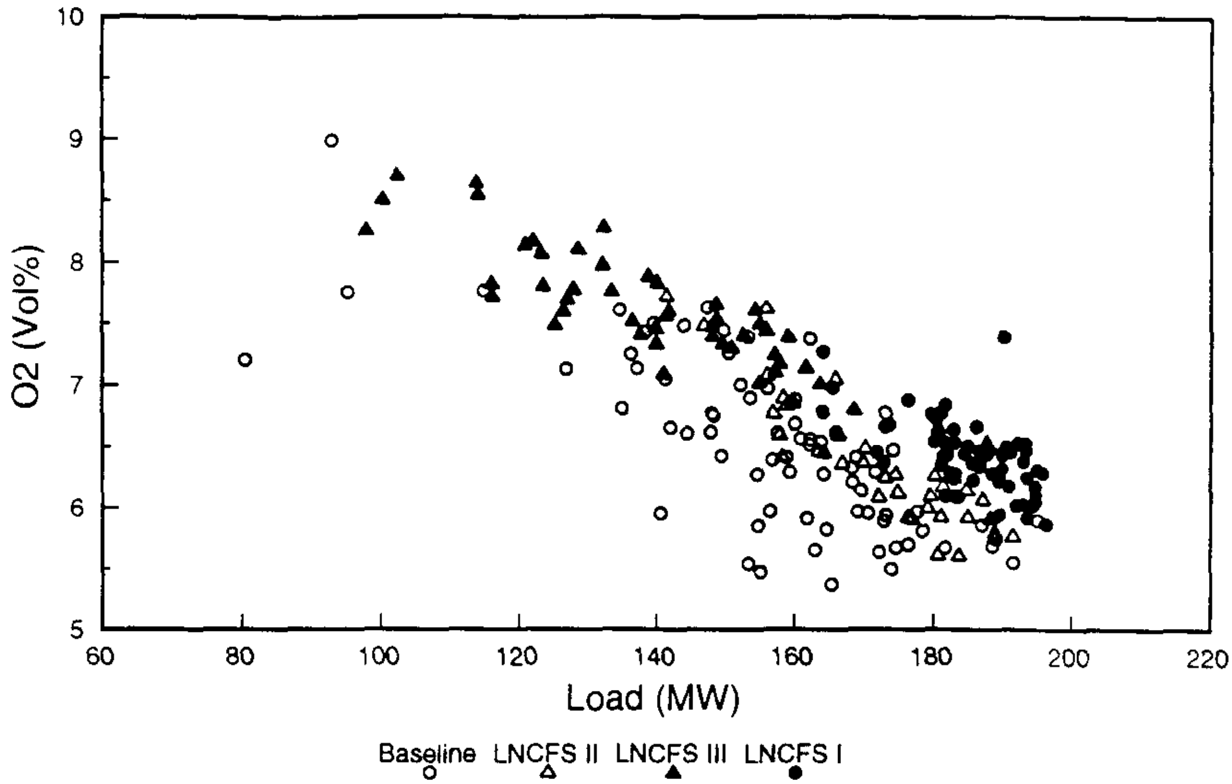

Figure 4-20. Long-Term Daily Average Oxygen Concentration Versus Load: All Test Phases

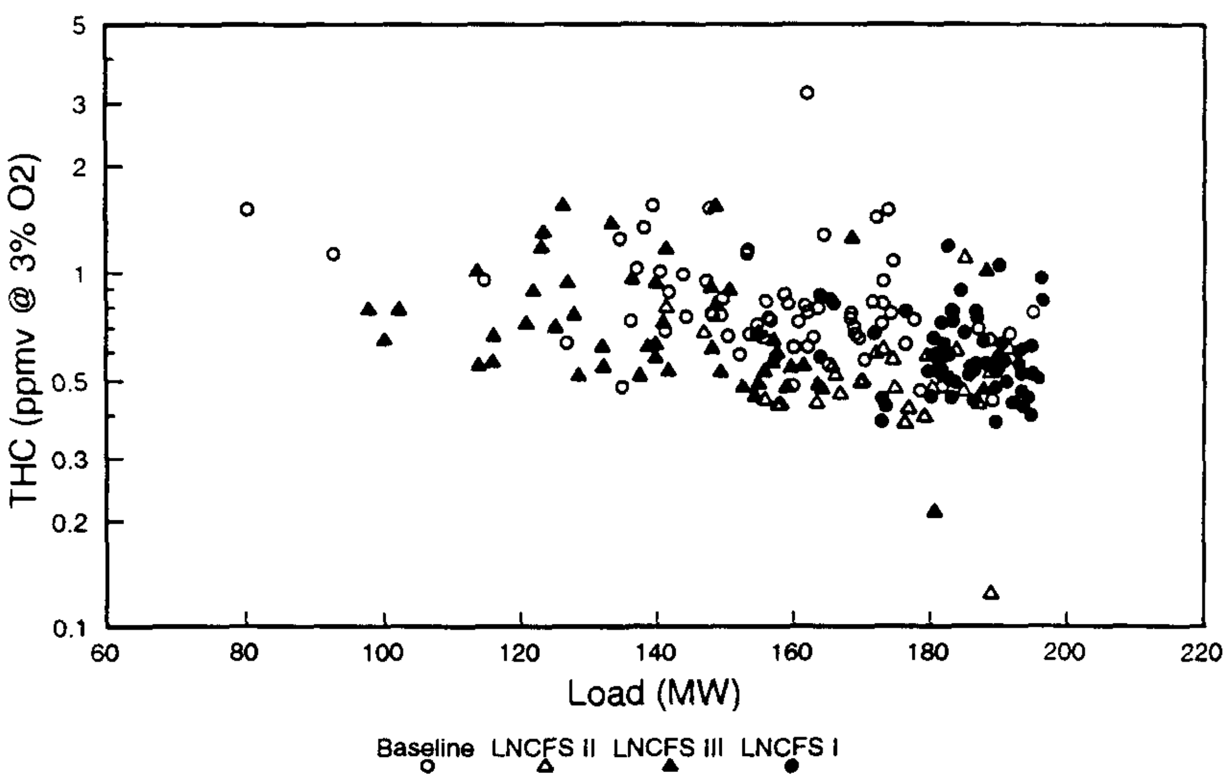

Figure 4-21. Long-Term Daily Average THC Emissions Versus Load: All Test Phases

million Btu. There did not appear to be statistically significant differences among test phases.

4.4 Compliance Monitoring

The only gaseous stream compliance parameter included in the EMP monitoring is opacity in the stack inlet gas; this parameter is monitored continuously using a dedicated opacity meter. The opacity monitoring results were taken from quarterly compliance reports submitted to the Florida Department of Environmental Regulation. Copies of these compliance reports are included in the applicable quarterly and annual EMP progress reports.

Table 4-2 presents the opacity exceedances for Unit 2 during the Phase III testing period, as well as the cause of each exceedance. The permit limit for Unit 2 is 40% opacity during any six-minute monitoring period.

As during the other monitoring phases, the number and length of exceedances of the 40% opacity limit were small compared to the total time of operation of Unit 2. For instance, there are a total of 240 six-minute averages per day. Most of the exceedances occurred during unit start up or shut down. A number of apparent exceedances were due to opacity monitor malfunction. Unit 2 did not exceed the excess opacity emissions allowed under Chapter 17-2.250 F.A.C.

Table 4-2

Summary of Excess Opacity Emissions During Phase III[1,2]

Date	Number of Six-Minute Averages with Excess Emissions	Opacity Exceedance[3] (%)	Cause of Exceedance[4]
10/25/91	5	12	D
10/26/91	1	15	D
11/12/91	7	9	U
11/14/91	2	13	U
12/02/91	3	15	S
12/03/91	17	31	M
12/04/91	1	24	M
01/13/92	3	23	M
02/14/92	14	13	D
02/17/92	6	24	U
04/08/92	17	26	M
04/17/92	4	13	D
04/29/92	6	9	U
05/05/92	3	13	D
05/06/92	4	16	U
05/07/92	2	22	U
05/10/92	25	22	M
05/26/92	7	28	M
05/28/92	56	24	M
06/08/92	27	44	M
06/16/92	19	19	D
06/17/92	1	3	U
06/18/92	5	19	U

Table 4-2 (Continued)

Date	Number of Six-Minute Averages with Excess Emissions	Opacity Exceedance[3] (%)	Cause of Exceedance[4]
07/10/92	2	17	M
07/11/92	11	11	E
07/12/92	5	8	D
07/13/92	7	29	U
09/01/92	28	19	U
09/03/92	9	21	U,D
09/04/92	10	30	U
09/05/92	1	35	D
09/07/92	3	35	U
09/08/92	11	32	U
09/23/92	5	9	D
09/27/92	7	2	D
09/28/92	6	16	U

[1] This summary was taken from the quarterly compliance reports submitted to the Florida Department of Environmental Regulation.

[2] The permit limit for opacity is 40% for Unit 2 based on a six-minute average. Unit 2 did not exceed the excess opacity emissions allowed under Chapter 17-2.250 F.A.C.

[3] The magnitude of the opacity emissions over the permit limit of 40 percent. For example, an exceedance of 2% means that the opacity was measured at 42 percent.

[4] Cause: D = Shut down;
E = Equipment malfunction;
M = Monitor malfunction;
S = Soot blow; and
U = Start up.

5.0 AQUEOUS STREAM MONITORING RESULTS

This section presents the results of aqueous stream monitoring performed during Phase III. Two aqueous streams have been designated for monitoring: ash pond discharge and groundwater. The parameters selected for monitoring are those required for compliance with Plant Smith'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 Phase III. The aqueous stream monitoring results were taken from quarterly compliance reports submitted by Gulf Power Company to the Florida Department of Environmental Regulation. These compliance reports have been included as appendices to the quarterly EMP progress reports prepared and submitted to DOE for this project.

Table 5-2 summarizes the results of the groundwater monitoring during Phase III. The average for each parameter is determined from the analyses of samples collected from the eight groundwater wells at Plant Smith. Appendix B contains the groundwater monitoring data for Phase III.

Table 5-3 shows the results of the ash pond discharge analyses. Since there were no discharges from the ash pond during May of 1992 no analyses were performed for that month. There were no exceedances of the permit limits during any of the discharge periods.

Table 5-1

Aqueous Streams: Actual and Planned Monitoring[1]

Parameter	Ash Pond Discharge
Total Suspended Solids	(a)
pH	(a)
Oil and Grease	(a)
Parameter	**Groundwater**
Total Dissolved Solids	32/32[2]
pH	32/32
Specific Conductivity	32/32
Chloride	32/32
Sulfate	32/32
Radioactivity:	
Gross Alpha	32/16
Gross Beta	24/16
Total Metals:	
Aluminum	32/32
Cadmium	32/32
Chromium	32/32
Iron	32/32
Manganese	32/32
Nickel	32/32

(a) Ash pond discharge was monitored as required and reported to the Florida Department of Environmental Regulation.

[1] Groundwater samples are supposed to be collected from eight monitoring wells at least one time per quarter. Phase III testing was conducted during the last quarter of 1991 and the first three quarters of 1992.

[2] Example: 2/3 = two samples collected; three sampled planned.

Table 5-2

Quarterly Groundwater Monitoring Results During Phase III

Fourth Quarter 1991						
Parameter	**Units**	**Average**	**Std. Dev.**	**Ranges**	**No. Values <DL/No. Values**	**Detection Limit**
Aluminum	mg/L	1.57	1.54	0.04-3.80	0/8	
Cadmium	mg/L	<0.0050	0	N/A	8/8	0.0050
Chloride	mg/L	1,156	1,874	15-5,600	0/8	
Chromium	mg/L	0.010	0.001	<0.010-0.012	6/8	0.010
Conductivity	umho/cm	4,036	5,649	76-17,000	0/8	
Iron	mg/L	4.3	4.3	0.4-13	0/8	
Manganese	mg/L	0.12	0.18	<0.010-0.55	2/8	0.010
Nickel	mg/L	0.062	0.011	0.039-0.071	0/8	
pH	S.U.	5.9	1.0	3.9-7.1	0/8	
Sulfate	mg/L	281	345	2.9-730	0/8	
Total Dissolved Solids	mg/L	2,292	3,272	49-9,800	0/8	
Gross Alpha	pCi/L	16.7	16.8	3.9-55	0/8	
Gross Beta	pCi/L	42.0	52.7	5.4-160	0/8	

First Quarter 1992						
Parameter	**Units**	**Average**	**Std. Dev.**	**Ranges**	**No. Values <DL/No. Values**	**Detection Limit**
Aluminum	mg/L	1.24	1.44	<0.05-4.40	2/8	0.050
Cadmium	mg/L	<0.0050	0	N/A	8/8	0.0050
Chloride	mg/L	1,295	2,216	7.7-6,600	0/8	
Chromium	mg/L	<0.01	0.00	N/A	8/8	0.010
Conductivity	umho/cm	3,806	5,353	64-16,000	0/8	
Iron	mg/L	3.40	4.06	0.49-13	0/8	
Manganese	mg/L	0.14	0.29	<0.01-0.86	2/8	0.010
Nickel	mg/L	<0.02	0.0	N/A	8/8	0.020
pH	S.U.	5.9	1.0	3.9-7.2	0/8	
Sulfate	mg/L	285	347	5.8-740	0/8	
Total Dissolved Solids	mg/L	2,259	3,339	50-10,000	0/8	
Gross Alpha	pCi/L	13.1	13.8	<1-43	0/8	1
Gross Beta	pCi/L	52.9	62.6	5.1-190	0/8	

Table 5-2 (Continued)

Second Quarter 1992						
Parameter	**Units**	**Average**	**Std. Dev.**	**Ranges**	**No. Values < DL/No. Values**	**Detection Limit**
Aluminum	mg/L	2.0	1.8	<0.05-5	2/8	0.050
Cadmium	mg/L	<0.0050	0.0	N/A	8/8	0.0050
Chloride	mg/L	1,211	1,876	12-5,600	0/8	
Chromium	mg/L	0.01	0.00	<0.01-0.015	7/8	0.010
Conductivity	umho/cm	4,143	5,694	70-17,000	0/8	
Iron	mg/L	4.72	4.87	0.58-15	0/8	
Manganese	mg/L	0.12	0.18	<0.01-0.54	1/8	0.010
Nickel	mg/L	<0.02	0.00	N/A	8/8	0.020
pH	S.U.	5.9	1.0	4.2-7.3	0/8	
Sulfate	mg/L	277	338	7-720	0/8	
Total Dissolved Solids	mg/L	2,208	2,940	62-8,800	0/8	
Gross Alpha	pCi/L	23	28	1.6-74	0/8	
Gross Beta	pCi/L	47	61	<1-180	0/8	1

Third Quarter 1992						
Parameter	**Units**	**Average**	**Std. Dev.**	**Ranges**	**No. Values < DL/No. Values**	**Detection Limit**
Aluminum	mg/L	6.5	14.8	<0.050-43	1/8	0.050
Cadmium	mg/L	<0.0050	0.0	N/A	8/8	0.0050
Chloride	mg/L	2,200	1,950	1,300-7,000	0/8	
Chromium	mg/L	0.012	0.005	<0.010-0.0250	6/8	0.010
Conductivity	umho/cm	3,076	4,640	60-14,000	0/8	
Iron	mg/L	5.2	5.7	0.78-16	0/8	
Manganese	mg/L	0.17	0.28	<0.010-0.82	1/8	0.010
Nickel	mg/L	<0.020	0	N/A	8/8	0.020
pH	S.U.	6.0	0.9	4.3-7.2	0/8	
Sulfate	mg/L	294	372	<1.0-800	1/8	1.0
Total Dissolved Solids	mg/L	2,263	3,303	73-10,000	0/8	
Gross Alpha	pCi/L	23.5	24.0	0.6-59	0/8	
Gross Beta	pCi/L	No data were obtained for this parameter during the 3rd Quarter				

Table 5-3

Results from Ash Pond Discharge Monitoring During Phase III

	TSS (mg/L)		pH		Oil & Grease (mg/L)	
Date	**Average**	**Maximum**	**Minimum**	**Maximum**	**Average**	**Maximum**
December 1991	1.7	2.7	7.6	8.0	<1.0	<1.0
January 1992	1.6	2.2	7.2	7.5	<1.0	<1.0
February 1992	2.4	3.0	7.3	8.1	<1.0	<1.0
March 1992	1.7	2.6	7.3	7.7	<1.0	<1.0
April 1992	1.9	2.0	7.9	8.0	<1.0	<1.0
May 1992	No discharge		No discharge		No discharge	
June 1992	4.0	6.6	7.5	7.8	<1.0	<1.0
July 1992	2.4	3.2	7.3	8.1	<1.0	<1.0
August 1992	1.7	2.0	7.6	8.3	<1.0	<1.0
September 1992	3.6	3.6	7.1	7.1	<1.0	<1.0
Permit Limits	30	100	6	11	15	20

TSS = Total suspended solids.

6.0 SOLID STREAM MONITORING RESULTS

The coal feed is the only solid stream sampled as part of the EMP. The coal is monitored to detect changes in composition that might impact the results obtained by the NO_x reduction technologies. This section summarizes the results of the coal analyses performed during Phase III. Appendix C presents the data for each sample obtained during this phase.

Table 6-1 presents the actual and planned coal feed monitoring. As shown in this table, most of the planned samples were collected. A statistical summary of the feed coal analyses during each of the Phase III test periods is given in Table 6-2. Figure 6-1 presents some of the ultimate analysis parameters in graphical form. The figure shows that the coal analyses were quite consistent over all of the Phase III test periods.

The results obtained during Phase III are also consistent with those from the previous phases. Table 6-3 presents a comparison of the 95% confidence intervals computed using the data from all three phases. Moisture content showed the greatest variability among the test phases. When the data are examined on a moisture-free bases, the values for the remaining parameters were found to be very consistent for all phases.

Table 6-1

Solid Streams: Actual and Planned Monitoring[1]

Parameter	D	P	L	V
Phase IIIa (LNCFS Level III):				
Ultimate and Proximate Analyses[2]	13/9	24/24	18/11	2/2
Chlorine	13/9	24/24	18/11	2/2
Phase IIIb (LNCFS Level I):				
Ultimate and Proximate Analyses	8/12	31/30	9/13	3/4
Chlorine	8/12	31/30	9/13	3/4

Monitoring test elements: D = Diagnostic tests;
P = Performance tests;
L = Long-term monitoring; and
V = Verification tests.

[1] 24/24 means 24 measurements taken/24 planned.

[2] Analyses include carbon, hydrogen, nitrogen, sulfur, ash and moisture. Oxygen is determined by difference.

Table 6-2

Results of the Coal Analyses (wt%)

Phase IIIa (LNCFS Level III)												
	Diagnostic Testing			Performance Testing			Long-Term Testing			Verification Testing		
Proximate & Ultimate Analyses	Avg	Std. Dev.	Range	Avg	Std. Dev.	Range	Avg	Std. Dev.	Range	Avg	Std. Dev.	Range
Carbon	67.67	0.79	65.49-68.50	67.24	0.52	66.31-68.10	66.53	0.91	64.12-68.40	66.31	0.16	66.15-66.46
Hydrogen	4.66	0.12	4.45-4.81	4.61	0.08	4.46-4.84	4.56	0.09	4.38-4.74	4.49	0.01	4.48-4.50
Nitrogen	1.47	0.02	1.44-1.52	1.42	0.05	1.32-1.50	1.43	0.05	1.34-1.53	1.43	0.00	1.43-1.43
Sulfur	2.83	0.18	2.59-3.24	2.79	0.09	2.62-3.02	2.78	0.11	2.61-3.11	2.74	0.03	2.71-2.76
Moisture	8.80	0.74	7.77-10.69	8.96	0.50	7.88-10.14	10.02	1.44	7.01-12.80	10.86	0.04	10.82-10.90
Ash	8.73	0.40	7.94-9.42	8.76	0.25	8.45-9.63	8.53	0.39	7.92-9.07	8.64	0.02	8.62-8.66
Oxygen	5.84	0.18	5.55-6.18	6.21	0.49	5.41-7.88	6.14	0.58	5.34-7.64	5.55	0.18	5.37-5.72
Chlorine	0.15	0.02	0.12-0.20	0.15	0.03	0.10 -0.25	0.13	0.03	0.07 -0.18	0.09	0.01	0.08-0.09

Phase IIIb (LNCFS Level I)												
	Diagnostic Testing			Performance Testing			Long-Term Testing			Verification Testing		
Proximate & Ultimate Analyses	Avg	Std. Dev.	Range	Avg	Std. Dev.	Range	Avg	Std. Dev.	Range	Avg	Std. Dev.	Range
Carbon	67.18	0.46	66.31-67.81	66.71	0.60	65.56-67.79	66.46	0.86	64.83-67.91	67.52	0.14	67.37-67.70
Hydrogen	4.47	0.10	4.28-4.55	4.42	0.21	3.89-4.80	4.40	0.15	4.21-4.71	4.41	0.04	4.36-4.46
Nitrogen	1.38	0.03	1.33-1.41	1.41	0.03	1.36-1.46	1.38	0.02	1.36-1.41	1.41	0.02	1.38-1.42
Sulfur	2.89	0.07	2.81-3.02	2.92	0.10	2.75-3.25	2.83	0.13	2.67-3.08	2.87	0.01	2.85-2.88
Moisture	9.22	0.64	8.49-10.39	9.51	0.74	7.61-10.86	9.64	1.05	7.52-11.26	9.11	0.00	9.10-9.11
Ash	8.57	0.22	8.21-9.01	8.63	0.23	8.25-9.41	8.88	0.27	8.43-9.35	8.52	0.14	8.33-8.67
Oxygen	6.29	0.08	6.16-6.38	6.41	0.36	5.74-7.22	6.41	0.37	5.64-6.99	6.17	0.04	6.11-6.20
Chlorine	0.11	0.02	0.08-0.14	0.12	0.02	0.08-0.16	0.15	0.03	0.09-0.17	0.16	0.01	0.15-0.17

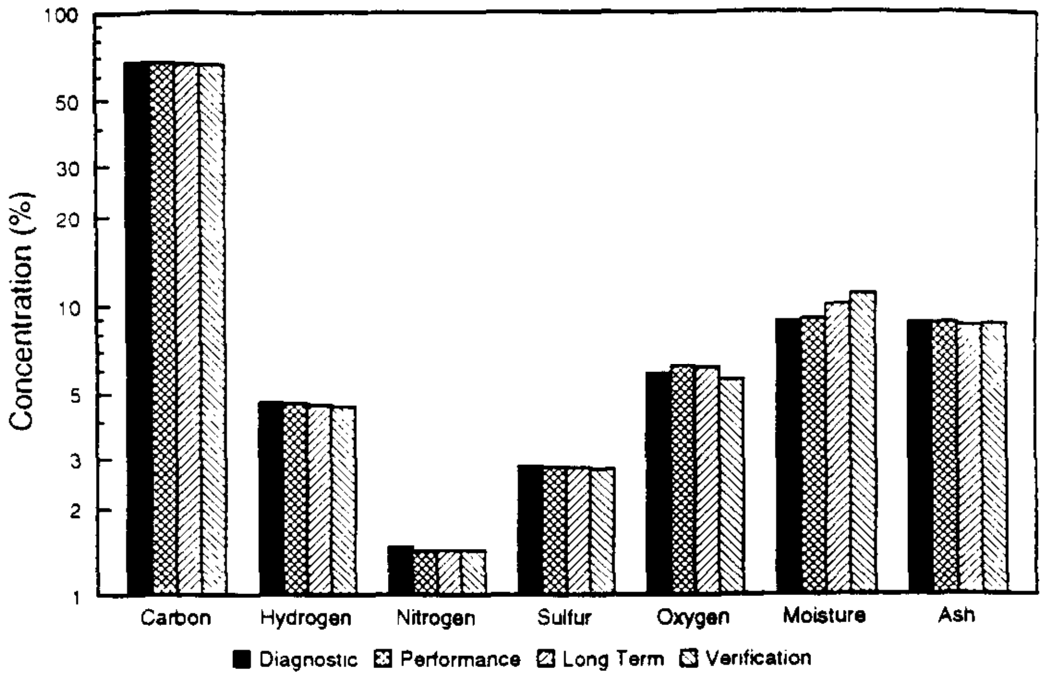

Figure 6-1a. Comparison of the Results of the Coal Analyses During Each Test Element--Phase IIIa

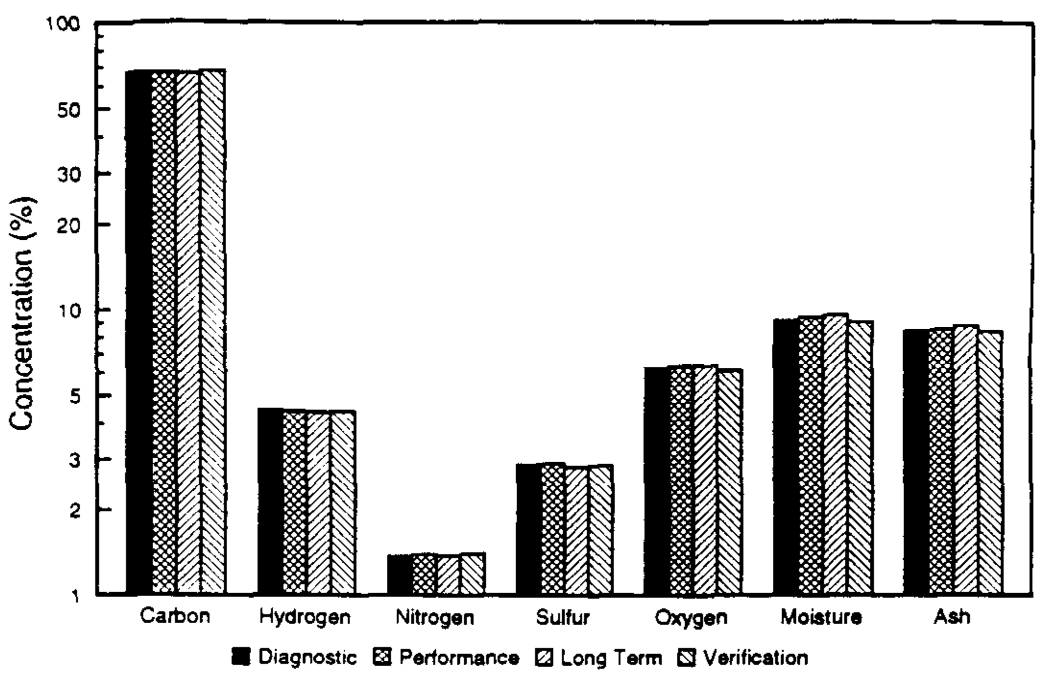

Figure 6-1b. Comparison of the Results of the Coal Analyses During Each Test Element--Phase IIIb

Table 6-3

Comparison of Coal Analyses: Phases I, II, and III
(95% Confidence Intervals)

Parameter	Phase I	Phase II	Phase III
Carbon, wt%	67.94 ± 0.29	66.33 ± 0.23	67.08 ± 0.23
Hydrogen, wt%	4.68 ± 0.03	4.54 ± 0.02	4.52 ± 0.03
Nitrogen, wt%	1.40 ± 0.01	1.41 ± 0.01	1.42 ± 0.01
Sulfur, wt%	2.80 ± 0.10	2.86 ± 0.04	2.84 ± 0.02
Chlorine, wt%	0.17 ± 0.06	0.11 ± 0.01	0.14 ± 0.01
Oxygen, wt%	6.09 ± 0.28	5.88 ± 0.13	6.22 ± 0.09
Ash, wt%	8.78 ± 0.37	9.05 ± 0.15	8.67 ± 0.06
Moisture, wt%	8.31 ± 1.24	9.95 ± 0.26	9.39 ± 0.19

7.0 QUALITY ASSURANCE AND QUALITY CONTROL

The Environmental Monitoring Plan for the Plant Smith ICCT project includes a Quality Assurance/Quality Control (QA/QC) Plan. This QA/QC Plan describes procedures for producing data and results of acceptable quality, 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 III testing.

7.1 Adherence to Accepted Methods

The sampling and analytical methods specified by the EMP and used during Phase III are summarized in Section 3 of this report. The preservation technique and holding time for samples are also presented.

As discussed in Section 3, these methods were followed during the EMP monitoring. In a few cases, substances were measured by methods that were different from the EMP-specified methods, but the methods used are acceptable alternatives for these analyses and for NPDES work.

7.2 Adequate Documentation and Sample Custody

At Plant Smith, the documentation and sample custody procedures that are part of the existing compliance monitoring programs have been approved by the state regulatory agency; these procedures were followed during the EMP activities.

Procedures for documentation and sample custody were reviewed as part of a Technical Systems Audit conducted by Radian Corporation from November 29 to 30, 1990, during the Phase I performance tests. The audit included the activities of Spectrum, ETEC, and SoRI. The report containing the detailed results of this audit is reprinted as Appendix D. This audit found no major problems, and no formal recommendations were issued.

7.3 Quality Assessment

Quality assessment is provided by the collection and analysis of replicate samples. The results of these analyses provide the basis for estimating precision and accuracy for the parameters measured.

During Phase III, replicate samples of the coal feed were collected and analyzed as summarized in Table 7-1. These results show that, in general, excellent accuracy, as measured using the coefficient of variation (COV), was obtained for most of the parameters measured. The COV was much less than 5% for all measurements except for six sets of chlorine measurements and four sets of oxygen measurements. The results for chlorine were expected because it is present at very low concentrations. Also, any errors in the measurement of the other parameters are reflected in the values obtained for oxygen since it is determined by difference.

Table 7-1

Summary of Replicate Analyses for the Coal Feed Samples Collected During Phase III

Date	H_2O, %	C, %	H, %	N, %	S, %	Ash, %	O, %	Cl, %
12/12/91	8.73	68.10	4.60	1.45	2.86	8.56	5.69	0.12
12/12/91	8.55	67.68	4.62	1.45	2.68	7.88	7.14	0.18
% COV	1.0	0.3	0.2	0.0	3.2	4.1	11.3	20.0
12/15/91	8.73	66.88	4.55	1.36	2.88	9.39	6.24	0.15
12/15/91	8.84	66.31	4.63	1.40	3.02	9.16	6.64	0.19
% COV	0.6	0.4	0.9	1.4	2.4	1.2	3.1	11.8
12/20/91	8.83	67.87	4.84	1.41	2.84	8.27	5.93	0.13
12/20/91	8.53	66.36	4.57	1.42	2.70	8.54	7.88	0.14
% COV	1.7	1.1	2.9	0.4	2.5	1.6	14.1	3.7
11/20/91	8.95	68.40	4.64	1.48	2.96	7.01	6.57	0.14
11/20/91	8.93	66.94	4.70	1.38	3.11	7.30	7.64	0.16
% COV	0.1	1.1	0.6	3.5	2.5	2.0	7.5	6.7
01/15/92	8.07	67.07	4.55	1.46	2.72	10.16	5.97	0.13
01/15/92	8.11	65.23	4.74	1.36	2.75	10.24	7.57	0.17
% COV	0.2	1.4	2.0	3.5	0.5	0.4	11.8	13.3
06/09/92	8.25	66.98	4.39	1.40	2.81	9.39	6.79	0.13
06/09/92	8.42	66.26	4.39	1.38	2.79	10.13	6.63	0.13
% COV	1.0	0.5	0.0	0.7	0.4	3.8	1.2	0.0
06/10/92	8.56	67.71	4.34	1.45	2.84	8.40	6.70	0.13
06/10/92	8.69	67.24	4.66	1.41	2.83	8.93	6.24	0.13
% COV	0.8	0.3	3.6	1.4	0.2	3.1	3.6	0.0
06/12/92	8.49	66.87	4.12	1.44	2.85	9.01	7.22	0.10
06/12/92	8.73	66.17	4.22	1.39	2.88	9.67	6.95	0.13
% COV	1.4	0.5	1.2	1.8	0.5	3.5	1.9	13.0
06/19/92	8.54	66.73	4.60	1.38	2.97	9.53	6.25	0.15
06/19/92	8.30	67.21	4.42	1.44	2.87	9.56	6.20	0.12
% COV	1.4	0.4	2.0	2.1	1.7	0.2	0.4	11.1

COV = Coefficient of variation; COV is the standard deviation between the replicates divided by the average value.

8.0 COMPLIANCE REPORTING

During Phase III, which began on December 5, 1991 and ended on September 18, 1992, compliance reports were submitted by Gulf Power Company to the Florida Department of Environmental Regulation, as required by Plant Smith's air operating permit and NPDES permit. The compliance monitoring includes the particulate loading and opacity of the stack inlet gas, as well as the ash pond discharge and groundwater monitoring.

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

9.0 CONCLUSIONS

The following conclusions were drawn as a result of the data presented in this EMP Phase III report:

- Based on an analysis of the long-term monitoring data, LNCFS Level III controls reduced NO_x emissions from Unit 2 by an average of 45% at higher load levels (135 to 200 MW), while average reductions of 37% were achieved by both LNCFS Levels I and II. The level of control produced by LNCFS Levels II and III decreased appreciably at lower unit loads.

- LNCFS Level III operation resulted in higher levels fly ash carbon and LOI compared to either baseline or LNCFS Level II tests at all loads. The LOI appeared to consist primarily of carbon.

- The average carbon monoxide emissions were low, although they were roughly twice as high during LNCFS Level III testing than during the baseline testing (approximately 20 ppm versus 10 ppm corrected to 3% oxygen). The CO emissions during LNCFS Level II operation were approximately the same as for Level III at high loads, while Level I emissions were comparable to the baseline.

- Most of the values obtained for total hydrocarbon emissions were low and in the same range during all test phases, 0.5 to 1.5 ppmv (corrected to 3% oxygen).

- Although there was appreciable scatter in the data, sulfur dioxide emissions were comparable for all test phases, consistent with the similar coal sulfur content measured during all three test phases.

- None of the LNCFS configurations appeared to have any appreciable impact on the fraction of sulfur dioxide converted to SO_3 relative to baseline operation.

- No exceedances of permit limits for aqueous streams were observed during Phase III or any of the previous test phases.

Appendix A

Phase IIIa and IIIb

Gaseous Stream Monitoring Data

Appendix A presents the gaseous stream results obtained during Phase IIIa and IIIb testing. Table A-1 presents the monitoring results by numbered test for the economizer outlet gas during diagnostic, performance, and verification tests. Similarly, Tables A-2 and A-3 present the results for the preheater outlet gas and stack inlet gas, respectively.

Table A-4 presents the results of the particulate matter characterization for the economizer outlet gas during the performance tests. Table A-5 presents the sulfur trioxide and sulfur dioxide concentrations in the economizer outlet gas during the Phase IIIa and IIIb performance tests.

Table A-6 presents the daily averages for the various monitored parameters during long-term testing.

Table A-1a

Short-Term Test Results for the Economizer Outlet Gas During Phase IIIa

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	O_2 (%)	CO (ppmv)
Diagnostic Tests												
55-1	05-Dec-91	179	None	82	30	100	100	100	8.7	250	5.3	16.2
55-2	05-Dec-91	180	None	82	20	100	100	100	8.7	245	5.3	51.1
55-3	05-Dec-91	180	None	82	20	100	100	100	8.7	261	5.8	17.7
55-4	05-Dec-91	180	None	82	20	100	100	100	8.7	295	6.6	6.5
55-5	05-Dec-91	179	None	82	20	100	100	100	8.7	317	7.3	7.7
55-6	05-Dec-91	180	None	83	20	100	100	100	8.7	277	6.3	5.7
56-1	06-Dec-91	182	None	86	20	100	100	100	4.8	223	4.8	79.8
56-2	06-Dec-91	182	None	85	20	100	100	100	4.8	238	5.8	30.2
56-3	06-Dec-91	182	None	85	20	100	100	100	4.8	265	6.1	14.7
56-4	06-Dec-91	182	None	85	20	100	100	100	4.8	292	6.6	16.3
56-5	06-Dec-91	183	None	86	20	100	100	100	4.8	280	6.2	16.6
56-6	06-Dec-91	183	None	86	20	100	100	100	4.8	248	5.2	18.5
57-1	07-Dec-91	179	None	83	20	100	100	100	9.2	230	4.3	89.2
57-2	07-Dec-91	179	None	82	20	100	100	100	9.2	248	4.8	24.9
57-3	07-Dec-91	179	None	83	20	100	100	100	9.2	272	5.9	20.9
57-4	07-Dec-91	179	None	83	20	100	100	100	9.2	301	6.7	14.7
57-5	07-Dec-91	179	None	82	20	100	100	100	9.2	296	6.9	15.3
57-6	07-Dec-91	180	None	83	20	100	100	100	9.2	277	6.5	16.0
57-7	07-Dec-91	179	None	83	20	100	100	100	9.2	253	6.1	24.9

Table A-1a (Continued)

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	O_2 (%)	CO (ppmv)
58-1	08-Dec-91	114	A&B	20	20	100	100	0	9.3	210	4.9	21.7
58-2	08-Dec-91	115	A&B	20	20	100	100	0	9.3	219	4.0	9.3
58-3	08-Dec-91	115	A&B	20	20	100	100	0	9.3	208	3.0	14.9
58-4	08-Dec-91	115	A&B	20	20	100	100	0	9.3	230	4.3	11.2
58-5	08-Dec-91	115	A&B	20	20	100	100	0	9.3	247	5.0	9.4
58-6	08-Dec-91	116	A&B	20	20	100	100	0	9.3	262	5.8	9.5
59-1	09-Dec-91	136	A	20	41	100	100	27	8.1	211	3.9	33.1
59-2	09-Dec-91	137	A	20	41	100	100	24	8	226	4.4	11.9
59-3	09-Dec-91	138	A	20	41	100	100	26	8	245	5.1	11.3
59-4	09-Dec-91	139	A	20	41	100	100	23	8	275	5.9	11.4
59-5	09-Dec-91	138	A&B	20	41	100	100	25	8	260	5.9	12.4
59-6	09-Dec-91	138	A&B	20	41	100	100	25	8.1	231	3.9	20.0
60-1	10-Dec-91	182	None	20	85	100	100	100	18.4	215	2.7	96.5
60-2	10-Dec-91	181	None	20	85	100	100	100	18.4	239	3.8	13.1
61-1	11-Dec-91	134	A	38	20	100	100	100	13.3	276	5.8	11.0
61-2	11-Dec-91	135	A	40	20	100	100	100	13.4	219	3.5	15.9
61-3	11-Dec-91	136	A&B	39	20	11	100	100	13.4	250	3.4	62.0
61-4	11-Dec-91	137	A&B	38	20	10	100	100	13.4	271	4.6	13.2
61-5	11-Dec-91	136	A&B	38	20	12	100	100	13.4	284	6.0	11.0
74-1	12-Jan-92	68	A,B,C	-8	20	-8	-8	10	-0.8	330	5.8	9.2
74-2	12-Jan-92	68	A,B,C	-8	20	-8	-8	12	-0.9	300	4.8	9.7
74-3	12-Jan-92	68	A,B,C	-8	20	-8	-8	10	--	352	6.4	11.0
74-4	12-Jan-92	68	A,B,C	-8	20	-8	-8	10	-0.9	385	7.4	12.5
74-5	12-Jan-92	82	A,B,C	-8	20	-8	17	65	-1	233	5.7	15.2

Table A-1a (Continued)

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	O_2 (%)	CO (ppmv)
75-1	13-Jan-92	80	A,B,C	-8	20	-8	5.9	59	-0.7	250	5.8	12.3
75-2	13-Jan-92	82	A,B,C	-8	20	-8	-8	-8	-0.7	327	5.8	10.6
75-3	13-Jan-92	69	A,B,C	-8	20	-8	-8	-8	-0.8	354	6.1	7.1
75-4	13-Jan-92	69	A,B,C	-8	20	-8	-8	10	-0.9	354	6.2	9.4
75-5	13-Jan-92	68	A,B,C	-8	20	-8	-8	40	-0.9	295	6.2	10.4
Performance Tests												
62-1	12-Dec-91	180	None	83	20	100	100	100	-0.8	231	4.0	15.0
62-2	12-Dec-91	182	None	82	20	100	100	100	-0.7	234	4.0	14.1
63-1	13-Dec-91	180	None	84	20	100	100	100	-1.8	222	4.0	11.6
63-2	13-Dec-91	179	None	83	20	100	100	100	-1.8	227	4.1	10.7
64-1	13-Dec-91	111.9	A&B	20	20	-8	100	100	-1.3	227	5.2	8.0
64-2	13-Dec-91	112.55	A&B	18	20	-8	100	100	-1.3	231	5.2	7.0
65-1	15-Dec-91	113	A&B	18	20	-8	100	100	-1.5	241	5.3	7.1
65-2	15-Dec-91	113	A&B	18	20	-8	100	100	-1.5	238	5.3	4.2
66-1	17-Dec-91	135	A	43	20	31	100	100	-1.1	216	4.8	11.1
66-2	17-Dec-91	137	A	41	20	25	100	100	-1.1	216	4.5	11.4
67-1	18-Dec-91	133	A	39	20	24	100	100	-0.8	216	4.6	12.0
67-2	18-Dec-91	136	A	41	20	24	100	100	-0.8	213	4.4	10.5
68-1	19-Dec-91	181	None	85	20	100	100	100	-0.8	226	3.9	16.8
68-2	19-Dec-91	180	None	82	20	100	100	100	-0.8	229	4.0	15.3
69-1	20-Dec-91	199	None	100	20	100	100	100	-1.1	234	3.8	12.6
69-2	20-Dec-91	200	None	100	20	100	100	100	-1.1	229	3.5	15.9

Table A-1a (Continued)

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	O_2 (%)	CO (ppmv)
Verification Tests												
76-1	10-Mar-92	177	None	81	20	100	100	100	6	230	4.0	82.5
76-2	10-Mar-92	178	None	81	20	100	100	100	6	266	6.4	11.0
76-3	10-Mar-92	181	None	86	20	100	100	100	6	242	4.2	6.1
76-4	10-Mar-92	116	A&B	22	10	-8	100	100	15	286	5.7	4.7
76-5	10-Mar-92	116	A&B	21	10	-8	100	100	15	276	4.9	5.1
76-6	10-Mar-92	116	A&B	22	10	-8	100	100	15	264	4.2	8.1
77-1	11-Mar-92	178	None	82	20	100	100	100	9	306	5.5	5.2
77-2	11-Mar-92	178	None	82	20	100	100	100	9	238	3.7	20.7
77-3	11-Mar-92	135	A	38	20	100	100	10	15	302	6.0	6.0
77-4	11-Mar-92	135	A	38	20	100	100	10	15	274	4.9	5.4
77-5	11-Mar-92	135	A	38	20	100	100	10	15	--	--	--

Table A-1b

Short-Term Test Results for the Economizer Outlet Gas During Phase IIIb

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	O_2 (%)	CO (ppmv)
78-1	14-May-92	184	AMIS	100	80	0	0	0	2	260	2.3	73.1
78-2	14-May-92	184	AMIS	100	80	0	0	0	1	292	3.1	13.2
78-3	14-May-92	184	AMIS	100	80	0	0	0	1	304	4.0	14.0
78-4	14-May-92	185	AMIS	100	80	0	0	0	2	302	3.1	15.0
78-5	14-May-92	183	AMIS	100	80	0	0	0	1	297	3.1	15.7
79-1	15-May-92	180	AMIS	100	80	0	0	0	3	312	4.3	12.0
79-2	15-May-92	180	AMIS	100	80	0	0	0	3	305	3.6	11.8
79-3	15-May-92	181	AMIS	100	80	0	0	0	3	282	3.0	10.7
79-4	15-May-92	180	AMIS	100	80	0	0	0	3	263	2.3	39.7
80-1	16-May-92	184	AMIS	100	80	0	0	0	5	310	4.1	12.8
80-2	16-May-92	185	AMIS	100	80	0	0	0	5	280	3.0	11.7
80-3	16-May-92	186	AMIS	100	80	0	0	0	5	255	2.0	34.0
80-4	16-May-92	185	AMIS	100	80	0	0	0	5	273	2.5	11.7
81-4	17-May-92	79	A,B,C	100	80	0	0	0	3	300	7.3	7.1
81-5	17-May-92	74	A,B,C	100	80	0	0	0	3	268	5.7	7.5
81-6	17-May-92	75	A,B,C	100	50	0	0	0	3	240	4.2	8.2
82-1	18-May-92	197	AMIS	100	80	0	0	0	10	333	4.2	16.7
82-2	18-May-92	113	A&B	100	80	0	0	0	10	295	6.1	12.7
82-3	18-May-92	112	A&B	100	80	0	0	0	10	269	4.7	12.8
82-4	18-May-92	112	A&B	100	80	0	0	0	10	252	3.7	12.5
83-1	19-May-92	200	AMIS	100	80	0	0	0	5	311	3.8	11.9
83-2	19-May-92	132	A	100	78	0	0	0	11	293	5.1	8.8

Table A-1b (Continued)

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	O_2 (%)	CO (ppmv)
83-3	19-May-92	133	A	100	78	0	0	0	12	265	3.9	10.0
83-4	19-May-92	134	A	100	78	0	0	0	12	223	2.4	10.7
83-5	20-May-92	116	A&B	100	78	0	0	0	12	--	--	--
84-1	20-May-92	185	AMIS	100	80	0	0	0	-1	276	3.6	10.0
84-2	20-May-92	192	AMIS	100	80	0	0	0	-1	268	2.8	13.0
85-1	29-May-92	187	AMIS	100	80	0	0	0	3	239	3.0	37.5
85-3	29-May-92	134	A	100	100	0	0	0	3	259	5.2	6.4
85-4	29-May-92	134	A	100	100	0	0	0	3	233	4.0	6.1
85-5	29-May-92	136	A	100	100	0	0	0	3	211	2.9	21.6
86-1	30-May-92	181	AMIS	100	100	0	0	0	4	269	3.2	7.5
86-2	30-May-92	117	A&B	100	100	0	0	0	4	283	6.0	5.6
86-3	30-May-92	119	A&B	100	100	0	0	0	4	259	4.9	5.2
86-4	30-May-92	118	A&B	100	100	0	0	0	4	236	3.7	10.1
87-1	31-May-92	82	A,B,C	100	55	0	0	0	7	312	7.4	9.9
87-2	31-May-92	82	A,B,C	100	55	0	0	0	7	277	5.6	9.3
87-3	01-Jun-92	80	A,B,C	100	55	0	0	0	7	252	4.5	9.4
88-1	01-Jun-92	183	AMIS	100	100	0	0	0	6	263	3.1	8.1
89-1	02-Jun-92	197	AMIS	100	100	0	0	0	3	286	4.0	13.9
89-2	02-Jun-92	200	AMIS	100	100	0	0	0	3	275	3.0	13.6
Performance Tests												
90-1	08-Jun-92	198	AMIS	100	100	0	0	0	7	--	--	--
90-5	08-Jun-92	198	AMIS	100	100	0	0	0	7	--	--	--
92-1	10-Jun-92	182	AMIS	100	100	0	0	0	2	265.2	3.1	11.0
92-2	10-Jun-92	181	AMIS	100	100	0	0	0	2	265	2.9	11.4
92-3	10-Jun-92	181	AMIS	100	100	0	0	0	2	266	2.9	9.3
93-1	11-Jun-92	182	AMIS	100	100	0	0	0	4	263	2.9	7.3

Table A-1b (Continued)

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	O_2 (%)	CO (ppmv)
93-2	11-Jun-92	180	AMIS	100	100	0	0	0	4	263	3.0	10.1
94-1	12-Jun-92	184	AMIS	100	20	100	100	100	0	214	3.6	18.8
94-2	12-Jun-92	184	AMIS	100	20	100	100	100	0	221	3.6	15.6
95-1	6/13-14/92	116	A&B	100	100	0	0	0	7	250	4.6	8.5
95-2	6/13-14/92	117	A&B	100	100	0	0	0	7	252	4.6	8.8
95-3	6/13-14/92	117	A&B	100	100	0	0	0	7	250	4.7	7.1
96-1	6/14-15/92	114	A&B	100	100	0	0	0	7	257	4.6	4.6
96-2	6/14-15/92	113	A&B	100	100	0	0	0	7	258	4.6	4.8
97-1	6/15-16/92	136	A	100	100	0	0	0	8	254	4.2	5.6
97-2	6/15-16/92	137	A	100	100	0	0	0	8	262	4.2	3.9
99-1	6/19-20/92	136	A	100	100	0	0	0	7	262	4.1	5.0
99-2	6/19-20/92	137	A	100	100	0	0	0	7	262	4.1	3.9
Verification Tests												
100-1	15-Sep-92	182	AMIS	100	100	0	0	0	0	303	4.0	5.5
100-2	15-Sep-92	183	AMIS	100	100	0	0	0	0	283	3.1	5.9
100-3	15-Sep-92	184	AMIS	100	100	0	0	0	0	261	2.3	13.3
101-1	16-Sep-92	121	A&B	78	100	0	0	0	0	255	3.9	7.8
101-2	17-Sep-92	118	A&B	78	100	0	0	0	0	281	5.3	3.7
101-3	17-Sep-92	117	A&B	80	100	0	0	0	0	296	5.9	5.2
102-1	17-Sep-92	132	A	100	100	0	0	0	0	222	3.1	10.1
102-2	18-Sep-92	135	A	100	100	0	0	0	0	250	3.9	7.4
102-3	18-Sep-92	133	A	100	100	0	0	0	0	277	4.8	7.3

Table A-2

Short-Term Test Results for the Preheater Gas During Phase III

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	O_2 (%)	CO (ppmv)
Phase IIIa Diagnostic Tests												
74-3	12-Jan-92	68	A,B,C	-8	20	-8	-8	10	--	360	8.6	12.4
Phase IIIa Performance Tests												
62-1	12-Dec-91	180	None	83	20	100	100	100	-0.8	240	5.8	12.6
63-1	13-Dec-91	180	None	84	20	100	100	100	-1.8	231	6.0	10.5
64-1	13-Dec-91	111.9	A&B	20	20	-8	100	100	-1.3	234	7.0	7.2
65-1	15-Dec-91	113	A&B	18	20	-8	100	100	-1.5	244	7.0	5.7
66-1	17-Dec-91	135	A	43	20	31	100	100	-1.1	218	5.7	11.2
67-1	18-Dec-91	133	A	39	20	24	100	100	-0.8	217	6.2	9.2
68-1	19-Dec-91	181	None	85	20	100	100	100	-0.8	233	6.1	11.1
69-1	20-Dec-91	199	None	100	20	100	100	100	-1.1	238	5.7	10.7

Table A-2 (Continued)

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	O_2 (%)	CO (ppmv)
Phase IIIb Performance Tests												
92-2	10-Jun-92	181	AMIS	100	100	0	0	0	2	266	5.6	8.7
92-3	10-Jun-92	181	AMIS	100	100	0	0	0	2	265	5.5	7.8
93-1	11-Jun-92	182	AMIS	100	100	0	0	0	4	263	5.3	7.0
94-1	12-Jun-92	184	AMIS	100	20	100	100	100	0	217	5.9	17.0
94-2	12-Jun-92	184	AMIS	100	20	100	100	100	0	227	6.0	12.8
95-2	6/13-14/92	117	A&B	100	100	0	0	0	7	256	7.0	6.7
96-1	6/14-15/92	114	A&B	100	100	0	0	0	7	262	10.4	4.2
96-2	6/14-15/92	113	A&B	100	100	0	0	0	7	265	7.0	3.7
97-1	6/15-16/92	136	A	100	100	0	0	0	8	257	6.8	6.0
97-2	6/15-16/92	137	A	100	100	0	0	0	8	268	6.7	3.7
99-1	6/19-20/92	136	A	100	100	0	0	0	7	268	6.7	4.4

Table A-3a

Short-Term Test Results for the Stack Inlet Gas During Phase IIIa

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	SO_2 (ppmv)	O_2 (%)	CO (ppmv)	THC (ppmv)
Diagnostic Tests														
55-1	05-Dec-91	179	None	82	30	100	100	100	8.7	259	2366	6.8	16.3	0.7
55-2	05-Dec-91	180	None	82	20	100	100	100	8.7	252	2371	6.6	44.3	0.7
55-3	05-Dec-91	180	None	82	20	100	100	100	8.7	267	2346	7.0	16.6	0.6
55-4	05-Dec-91	180	None	82	20	100	100	100	8.7	299	2330	7.7	5.7	0.6
55-5	05-Dec-91	179	None	82	20	100	100	100	8.7	325	2316	8.4	4.9	0.6
55-6	05-Dec-91	180	None	83	20	100	100	100	8.7	290	2337	7.6	5.7	0.6
56-1	06-Dec-91	182	None	86	20	100	100	100	4.8	224	2357	5.8	155.1	0.6
56-2	06-Dec-91	182	None	85	20	100	100	100	4.8	245	2338	6.4	30.1	0.7
56-3	06-Dec-91	182	None	85	20	100	100	100	4.8	271	2315	7.2	11.6	0.8
56-4	06-Dec-91	182	None	85	20	100	100	100	4.8	301	2316	8.2	12.5	0.7
56-5	06-Dec-91	183	None	86	20	100	100	100	4.8	289	2286	7.8	12.5	0.7
56-6	06-Dec-91	183	None	86	20	100	100	100	4.8	255	2245	6.5	16.2	0.6
57-1	07-Dec-91	179	None	83	20	100	100	100	9.2	235	2298	6.0	121.9	0.6
57-2	07-Dec-91	179	None	82	20	100	100	100	9.2	254	2278	6.6	21.7	0.6
57-3	07-Dec-91	179	None	83	20	100	100	100	9.2	273	2240	7.2	20.0	0.6
57-4	07-Dec-91	179	None	83	20	100	100	100	9.2	300	2222	7.9	13.1	0.6
57-5	07-Dec-91	179	None	82	20	100	100	100	9.2	308	2227	7.9	13.7	0.6
57-6	07-Dec-91	180	None	83	20	100	100	100	9.2	284	2236	7.3	13.9	0.6
57-7	07-Dec-91	179	None	83	20	100	100	100	9.2	257	2259	6.9	32.1	0.6
58-1	08-Dec-91	114	A&B	20	20	100	100	0	9.3	217	2325	5.9	17.6	0.7

Table A-3a (Continued)

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	SO_2 (ppmv)	O_2 (%)	CO (ppmv)	THC (ppmv)
58-2	08-Dec-91	115	A&B	20	20	100	100	0	9.3	227	2379	6.1	6.6	0.7
58-3	08-Dec-91	115	A&B	20	20	100	100	0	9.3	212	2388	5.4	14.6	0.7
58-4	08-Dec-91	115	A&B	20	20	100	100	0	9.3	238	2316	6.6	10.0	0.7
58-5	08-Dec-91	115	A&B	20	20	100	100	0	9.3	252	2397	7.1	7.4	0.6
58-6	08-Dec-91	116	A&B	20	20	100	100	0	9.3	263	2395	7.6	6.8	0.6
59-1	09-Dec-91	136	A	20	41	100	100	27	8.1	216	2366	6.2	37.0	0.8
59-2	09-Dec-91	137	A	20	41	100	100	24	8	232	2357	6.7	9.1	0.7
59-3	09-Dec-91	138	A	20	41	100	100	26	8	248	2334	7.1	9.4	0.7
59-4	09-Dec-91	139	A	20	41	100	100	23	8	284	2336	8.0	7.4	0.7
59-5	09-Dec-91	138	A&B	20	41	100	100	25	8	268	2324	8.1	8.8	0.7
59-6	09-Dec-91	138	A&B	20	41	100	100	25	8.1	237	2326	6.2	18.8	0.7
60-1	10-Dec-91	182	None	20	85	100	100	100	18.4	223	2326	5.3	99.3	0.6
60-2	10-Dec-91	181	None	20	85	100	100	100	18.4	246	2323	6.1	11.4	0.5
61-1	11-Dec-91	134	A	38	20	100	100	100	13.3	289	2332	8.0	8.7	0.6
61-2	11-Dec-91	135	A	40	20	100	100	100	13.4	226	2357	5.8	14.0	0.6
61-3	11-Dec-91	136	A&B	39	20	11	100	100	13.4	257	2374	6.0	46.9	0.6
61-4	11-Dec-91	137	A&B	38	20	10	100	100	13.4	277	2370	7.0	8.5	0.6
61-5	11-Dec-91	136	A&B	38	20	12	100	100	13.4	295	2355	8.2	10.4	0.6
74-1	12-Jan-92	68	A,B,C	-8	20	-8	-8	10	-0.8	335	2373	8.7	7.7	0.8
74-2	12-Jan-92	68	A,B,C	-8	20	-8	-8	12	-0.9	310	2408	8.0	10.2	0.7
74-3	12-Jan-92	68	A,B,C	-8	20	-8	-8	10	--	364	2356	9.3	11.7	1.1
74-4	12-Jan-92	68	A,B,C	-8	20	-8	-8	10	-0.9	402	2357	10.1	12.4	0.8

Table A-3a (Continued)

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	SO_2 (ppmv)	O_2 (%)	CO (ppmv)	THC (ppmv)
74-5	12-Jan-92	82	A,B,C	-8	20	-8	17	65	-1	239	2386	8.7	15.2	0.7
75-1	13-Jan-92	80	A,B,C	-8	20	-8	5.9	59	-0.7	253	2326	8.0	10.5	0.7
75-2	13-Jan-92	82	A,B,C	-8	20	-8	-8	-8	-0.7	335	2347	8.2	9.8	0.6
75-3	13-Jan-92	69	A,B,C	-8	20	-8	-8	-8	-0.8	357	2332	8.3	10.1	0.5
75-4	13-Jan-92	69	A,B,C	-8	20	-8	-8	10	-0.9	365	2337	8.5	8.7	0.3
75-5	13-Jan-92	68	A,B,C	-8	20	-8	-8	40	-0.9	302	2367	8.4	9.9	0.3
Performance Tests														
62-1	12-Dec-91	180	None	83	20	100	100	100	-0.8	239	2327	6.3	14.3	0.9
62-2	12-Dec-91	182	None	82	20	100	100	100	-0.7	245	2350	6.3	15.2	0.6
63-1	13-Dec-91	180	None	84	20	100	100	100	-1.8	234	2359	6.4	9.3	1.1
63-2	13-Dec-91	179	None	83	20	100	100	100	-1.8	242	2343	6.4	7.5	0.6
64-1	13-Dec-91	111.9	A&B	20	20	-8	100	100	-1.3	234	2299	6.6	7.6	0.9
64-2	13-Dec-91	112.55	A&B	18	20	-8	100	100	-1.3	240	2327	7.4	6.4	0.7
65-1	15-Dec-91	113	A&B	18	20	-8	100	100	-1.5	246	2347	7.4	5.0	0.9
65-2	15-Dec-91	113	A&B	18	20	-8	100	100	-1.5	243	2333	7.4	3.2	0.5
66-1	17-Dec-91	135	A	43	20	31	100	100	-1.1	219	2335	5.7	11.2	0.8
66-2	17-Dec-91	137	A	41	20	25	100	100	-1.1	220	2302	6.8	10.6	0.5
67-1	18-Dec-91	133	A	39	20	24	100	100	-0.8	219	2273	6.8	9.0	0.9
67-2	18-Dec-91	136	A	41	20	24	100	100	-0.8	218	2307	6.7	10.3	0.6
68-1	19-Dec-91	181	None	85	20	100	100	100	-0.8	230	2341	6.4	15.3	0.6
68-2	19-Dec-91	180	None	82	20	100	100	100	-0.8	236	2340	6.4	11.1	0.4
69-1	20-Dec-91	199	None	100	20	100	100	100	-1.1	237	2370	6.1	11.7	0.7
69-2	20-Dec-91	200	None	100	20	100	100	100	-1.1	234	2392	6.0	14.5	0.5

Table A-3a (Continued)

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	SO_2 (ppmv)	O_2 (%)	CO (ppmv)	THC (ppmv)
Verification Tests														
76-1	10-Mar-92	177	None	81	20	100	100	100	6	234	2324	6.5	105.5	0.7
76-2	10-Mar-92	178	None	81	20	100	100	100	6	267	2331	7.4	8.8	0.7
76-3	10-Mar-92	181	None	86	20	100	100	100	6	--	--	--	--	--
76-4	10-Mar-92	116	A&B	22	10	-8	100	100	15	--	--	--	--	--
76-5	10-Mar-92	116	A&B	21	10	-8	100	100	15	--	--	--	--	--
76-6	10-Mar-92	116	A&B	22	10	-8	100	100	15	--	--	--	--	--
77-1	11-Mar-92	178	None	82	20	100	100	100	9	--	--	--	--	--
77-2	11-Mar-92	178	None	82	20	100	100	100	9	--	--	--	--	--
77-3	11-Mar-92	135	A	38	20	100	100	10	15	--	--	--	--	--
77-4	11-Mar-92	135	A	38	20	100	100	10	15	--	--	--	--	--
77-5	11-Mar-92	135	A	38	20	100	100	10	15					

Table A-3b

Short-Term Test Results for the Stack Inlet Gas During Phase IIIb

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	SO_2 (ppmv)	O_2 (%)	CO (ppmv)	THC (ppmv)
Diagnostic Tests														
78-1	14-May-92	184	AMIS	100	80	0	0	0	2	257	2422	5.3	57.1	1.0
78-2	14-May-92	184	AMIS	100	80	0	0	0	1	288	2403	5.8	13.5	0.9
78-3	14-May-92	184	AMIS	100	80	0	0	0	1	311	2389	6.7	13.1	0.9
78-4	14-May-92	185	AMIS	100	80	0	0	0	2	303	2376	5.9	13.9	0.9
78-5	14-May-92	183	AMIS	100	80	0	0	0	1	288	2387	6.2	15.7	0.8
79-1	15-May-92	180	AMIS	100	80	0	0	0	3	313	2366	6.9	11.1	0.9
79-2	15-May-92	180	AMIS	100	80	0	0	0	3	308	2396	6.5	10.2	0.9
79-3	15-May-92	181	AMIS	100	80	0	0	0	3	288	2390	5.9	9.8	0.9
79-4	15-May-92	180	AMIS	100	80	0	0	0	3	265	2401	5.3	33.3	0.9
80-1	16-May-92	184	AMIS	100	80	0	0	0	5	319	2381	6.9	11.4	0.9
80-2	16-May-92	185	AMIS	100	80	0	0	0	5	284	2403	5.9	11.3	0.9
80-3	16-May-92	186	AMIS	100	80	0	0	0	5	258	2421	5.1	25.0	0.9
80-4	16-May-92	185	AMIS	100	80	0	0	0	5	275	2394	5.5	10.9	0.9
81-4	17-May-92	79	A,B,C	100	80	0	0	0	3	305	2394	9.5	6.1	0.8
81-5	17-May-92	74	A,B,C	100	80	0	0	0	3	269	2413	8.2	7.2	0.8
81-6	17-May-92	75	A,B,C	100	50	0	0	0	3	245	2430	7.3	9.1	0.9
82-1	18-May-92	197	AMIS	100	80	0	0	0	10	--	--	--	--	--
82-2	18-May-92	113	A&B	100	80	0	0	0	10	308	2311	8.5	11.4	1.0
82-3	18-May-92	112	A&B	100	80	0	0	0	10	281	2371	7.7	11.7	1.8
82-4	18-May-92	112	A&B	100	80	0	0	0	10	257	2392	6.3	13.1	1.3

Table A-3b (Continued)

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	SO_2 (ppmv)	O_2 (%)	CO (ppmv)	THC (ppmv)
83-1	19-May-92	200	AMIS	100	80	0	0	0	5	316	2391	6.3	8.7	1.1
83-2	19-May-92	132	A	100	78	0	0	0	11	297	2387	7.7	10.3	1.0
83-3	19-May-92	133	A	100	78	0	0	0	12	265	2395	6.6	8.1	1.0
83-4	19-May-92	134	A	100	78	0	0	0	12	222	2435	5.3	11.2	1.0
83-5	20-May-92	116	A&B	100	78	0	0	0	12	--	--	--	--	--
84-1	20-May-92	185	AMIS	100	80	0	0	0	-1	--	--	--	--	--
84-2	20-May-92	192	AMIS	100	80	0	0	0	-1	--	--	--	--	--
85-1	29-May-92	187	AMIS	100	80	0	0	0	3	240	2377	5.8	40.1	0.9
85-3	29-May-92	134	A	100	100	0	0	0	3	261	2374	7.6	5.0	0.8
85-4	29-May-92	134	A	100	100	0	0	0	3	232	2388	6.6	6.7	0.8
85-5	29-May-92	136	A	100	100	0	0	0	3	212	2405	5.8	17.7	0.9
86-1	30-May-92	181	AMIS	100	100	0	0	0	4	269	2360	5.9	6.7	1.2
86-2	30-May-92	117	A&B	100	100	0	0	0	4	282	2308	8.2	6.1	1.4
86-3	30-May-92	119	A&B	100	100	0	0	0	4	262	2331	7.5	5.1	1.4
86-4	30-May-92	118	A&B	100	100	0	0	0	4	239	2326	6.5	6.6	1.3
87-1	31-May-92	82	A,B,C	100	55	0	0	0	7	318	2335	9.7	9.7	1.6
87-2	31-May-92	82	A,B,C	100	55	0	0	0	7	280	2368	8.1	8.3	1.6
87-3	01-Jun-92	80	A,B,C	100	55	0	0	0	7	258	2367	7.2	8.2	1.6
88-1	01-Jun-92	183	AMIS	100	100	0	0	0	6	--	--	--	--	--
89-1	02-Jun-92	197	AMIS	100	100	0	0	0	3	289	2427	6.6	11.0	0.8
89-2	02-Jun-92	200	AMIS	100	100	0	0	0	3	274	2430	5.8	12.2	0.9
Performance Tests														
90-1	08-Jun-92	198	AMIS	100	100	0	0	0	7	--	--	--	--	--
90-5	08-Jun-92	198	AMIS	100	100	0	0	0	7	--	--	--	--	--
92-1	10-Jun-92	182	AMIS	100	100	0	0	0	2	260	2342	5.8	8.7	0.8

Table A-3b (Continued)

Test	Date	Load (MW)	MOOS	UCCOFA	LCCOFA	USOFA	MSOFA	LSOFA	Burner Tilt	NO_x (ppmv)	SO_2 (ppmv)	O_2 (%)	CO (ppmv)	THC (ppmv)
92-2	10-Jun-92	181	AMIS	100	100	0	0	0	2	263	2331	5.7	8.4	1.0
92-3	10-Jun-92	181	AMIS	100	100	0	0	0	2	261	2329	5.7	7.6	1.1
93-1	11-Jun-92	182	AMIS	100	100	0	0	0	4	263	2335	5.7	6.8	1.0
93-2	11-Jun-92	180	AMIS	100	100	0	0	0	4	265	2341	5.8	6.5	0.8
94-1	12-Jun-92	184	AMIS	100	20	100	100	100	0	215	2363	6.2	15.7	1.0
94-2	12-Jun-92	184	AMIS	100	20	100	100	100	0	226	2358	6.2	11.8	0.6
95-1	6/13-14/92	116	A&B	100	100	0	0	0	7	253	2320	7.2	7.1	0.8
95-2	6/13-14/92	117	A&B	100	100	0	0	0	7	254	2374	7.1	5.9	1.2
95-3	6/13-14/92	117	A&B	100	100	0	0	0	7	255	2246	7.2	5.9	0.9
96-1	6/14-15/92	114	A&B	100	100	0	0	0	7	260	2318	6.6	4.7	1.1
96-2	6/14-15/92	113	A&B	100	100	0	0	0	7	263	2333	7.1	3.0	1.1
97-1	6/15-16/92	136	A	100	100	0	0	0	8	256	2356	6.8	6.0	1.2
97-2	6/15-16/92	137	A	100	100	0	0	0	8	269	2343	6.9	4.2	1.1
99-1	6/19-20/92	136	A	100	100	0	0	0	7	266	2367	6.9	4.8	1.7
99-2	6/19-20/92	137	A	100	100	0	0	0	7	268	2385	6.9	4.1	1.2
Verification Tests														
100-1	15-Sep-92	182	AMIS	100	100	0	0	0	0	303	2374	7.2	4.5	0.5
100-2	15-Sep-92	183	AMIS	100	100	0	0	0	0	281	2425	6.5	5.0	0.5
100-3	15-Sep-92	184	AMIS	100	100	0	0	0	0	262	2431	5.9	10.8	0.5
101-1	16-Sep-92	121	A&B	78	100	0	0	0	0	256	2337	7.1	5.9	0.5
101-2	17-Sep-92	118	A&B	78	100	0	0	0	0	284	2332	8.2	4.5	0.5
101-3	17-Sep-92	117	A&B	80	100	0	0	0	0	297	2313	8.8	3.8	0.5
102-1	17-Sep-92	132	A	100	100	0	0	0	0	223	2363	6.5	14.3	0.5
102-2	18-Sep-92	135	A	100	100	0	0	0	0	251	2361	7.2	7.0	0.6
102-3	18-Sep-92	133	A	100	100	0	0	0	0	280	2332	8.0	6.9	0.5

Table A-4

Results for the Economizier Outlet Gas During Phase III Performance Tests

PARTICULATE LOADING -- PHASE IIIa			
Test No.	Date	Load (MW)	Loading (gr/dscf)
62	12-Dec-91	180	2.83 2.80 2.76
64	14-Dec-92	115	3.12 2.87 2.84
67	18-Dec-91	135	3.11 2.79 2.83
68	19-Dec-91	180	2.81 2.87 2.87
69	20-Dec-91	200	3.22 3.09 2.98
PARTICULATE LOADING -- PHASE IIIb			
92	10-Jun-92	180	3.02 2.77 2.13
94	12-Jun-92	180	3.28 3.18 2.85
95	6/13-14/92	115	2.96 2.83 2.81
97	6/15-16/92	135	3.26 3.34 3.15

Table A-4 (Continued)

PARTICULATE MATTER CHARACTERISTICS				
Phase IIIa				
Test No.	**Date**	**Load (MW)**	**Carbon (wt%)**	**LOI (wt%)**
62	12-Dec-91	180	5.24	5.6
64	14-Dec-91	115	6.23	6.6
67	18-Dec-91	135	5.55	5.8
68	19-Dec-91	180	5.91	6.1
69	20-Dec-91	200	6.31	6.6
Phase IIIb				
92	10-Jun-92	180	4.2	4.6
94[a]	12-Jun-92	180	6.7	7
95	6/13-14/93	115	3.8	4
97	6/15-16/92	135	4.8	5.3

[a]LNCFS Level III done during Phase IIIb.

PARTICULATE MATTER RESISTIVITY		
Phase IIIa		
Date	**Load (MW)**	**Laboratory Resistivity (ohm-cm)**
12-Dec-91	180	1.0e+09 3.0e+09
14-Dec-91	115	NA 1.0e+10
18-Dec-91	135	5.0e+09 7.0e+09
20-Dec-91	200	1.0e+09 1.0e+09
Phase IIIb		
09-Jun-92	200	8.0e+08 1.0e+09
10-Jun-92	180	1.0e+09 1.0e+09
14-Jun-92	115	5.0e+09 9.0e+09
16-Jun-92	135	4.0e+09 5.0e+09

Table A-5a

SO_3 and SO_2 Results for the Economizer Outlet Gas Phase IIIa Performance Testing

Date	Load (MW)	SO_3 (ppmv)	SO_2 (ppmv)	SO_3/SO_2 Ratio (%)
12-Dec-91	180	13	2,036	0.64
		15	2,028	0.74
		16	2,066	0.77
		9	2,035	0.44
13-Dec-91	180	9	2,082	0.43
		9	2,087	0.43
		10	2,081	0.48
		10	2,089	0.48
14-Dec-91	115	7	1,861	0.38
		9	1,951	0.46
		9	1,950	0.46
		10	1,938	0.52
15-Dec-91	115	5	1,870	0.27
		5	1,877	0.27
		5	1,925	0.26
		6	1,918	0.31
17-Dec-91	135	5	2,009	0.25
		6	2,015	0.30
		6	1,979	0.30
		7	1,987	0.35
18-Dec-91	135	12	1,966	0.61
		11	1,978	0.56
		11	1,977	0.56
		12	1,981	0.61
19-Dec-91	180 (Fine Coal)	15	2,057	0.73
		16	2,045	0.78
		16	2,043	0.78
		16	2,036	0.79
20-Dec-91	200	14	2,138	0.65
		16	2,133	0.75
		16	2,189	0.73
		16	2,179	0.73

Table A-5b

SO_3 and SO_2 Results for the Economizer Outlet Gas Phase IIIb Performance Testing

Date	Load (MW)	SO_3 (ppmv)	SO_2 (ppmv)	SO_3/SO_2 Ratio (%)
10-Jun-92	180	15	2,359	0.64
		15	2,355	0.64
		14	2,341	0.60
		15	2,366	0.63
11-Jun-92	180	9	2,317	0.39
		9	2,335	0.39
		9	2,347	0.38
		9	2,350	0.38
12-Jun-92	180	15	2,252	0.67
	(Level III	15	2,251	0.67
	Conditions)	15	2,274	0.66
		15	2,252	0.67
13-Jun-92	115	7	2,055	0.34
		7	2,031	0.34
		8	2,044	0.39
		8	2,064	0.39
14-Jun-92	115	10	2,093	0.48
		11	2,104	0.52
		11	2,120	0.52
		12	2,101	0.57
15-Jun-92	135	9	2,103	0.43
		9	2,091	0.43
		9	2,110	0.43
		9	2,101	0.43
19-Jun-92	135	9	2,178	0.41
		10	2,173	0.46
		10	2,166	0.46
		10	2,156	0.46

Table A-6a

Daily Average Results for the Stack Inlet Gas During Phase IIIa Long-Term Testing

Consecutive Test Day	Date	Average Load (MW)	NO_x (lb/MBtu)	SO_2 (lb/MBtu)	O_2 (Vol %)	CO (ppmv @ 3% O_2)	THC (ppmv @ 3% O_2)
1	21-Dec-91	168.542	0.349	4.405	6.788	19.103	1.251
2	22-Dec-91	123.346	0.391	4.345	7.803	33.597	1.299
3	23-Dec-91	126.310	0.380	4.312	7.596	57.395	1.547
4	24-Dec-91	123.140	0.407	4.314	8.064	52.746	1.178
5	25-Dec-91	97.790	0.431	4.262	8.252	46.675	0.786
6	26-Dec-91	150.856	0.374	4.258	7.295	20.632	0.890
7	27-Dec-91	148.015	0.352	4.370	7.390	13.716	0.907
8	28-Dec-91	141.399	0.379	4.381	7.562	35.194	1.167
9	29-Dec-91	121.999	0.428	4.342	8.166	27.414	0.887
10	30-Dec-91	158.978	0.394	4.369	7.381	21.830	0.479
11	31-Dec-91	157.178	0.346	4.262	7.096	16.554	0.647
12	01-Jan-92	120.874	0.415	4.277	8.131	11.348	0.719
13	02-Jan-92	157.060	0.368	4.312	7.234	16.396	0.562
14	03-Jan-92	149.466	0.394	4.348	7.329	9.111	0.527
18	07-Jan-92	148.683	0.403	4.442	7.653	17.294	0.813
25	14-Jan-92	180.650	0.353	4.473	6.640	12.184	0.212
33	22-Jan-92	136.437	0.383	4.393	7.513	33.609	0.958
34	23-Jan-92	113.685	0.423	4.266	8.638	22.355	1.010
35	24-Jan-92	163.588	0.388	4.349	6.998	24.860	0.487
39	28-Jan-92	132.004	0.456	4.396	7.973	32.250	0.620
40	29-Jan-92	128.534	0.400	4.488	8.103	46.813	0.517
41	30-Jan-92	155.890	0.407	4.545	7.437	58.860	0.531
42	31-Jan-92	102.225	0.459	4.518	8.697	16.252	0.784
43	01-Feb-92	100.091	0.441	4.561	8.499	25.570	0.647

Table A-6a (Continued)

Consecutive Test Day	Date	Average Load (MW)	NO_x (lb/MBtu)	SO_2 (lb/MBtu)	O_2 (Vol %)	CO (ppmv @ 3% O_2)	THC (ppmv @ 3% O_2)
44	02-Feb-92	113.899	0.476	4.488	8.542	22.267	0.552
48	06-Feb-92	133.371	0.384	4.351	7.757	26.893	1.379
49	07-Feb-92	140.009	0.374	4.286	7.830	20.199	0.931
55	13-Feb-92	188.238	0.334	4.521	5.907	27.577	1.009
60	18-Feb-92	148.772	0.409	4.354	7.542	11.947	1.542
61	19-Feb-92	126.937	0.377	4.360	7.696	13.666	0.937
62	20-Feb-92	125.157	0.381	4.280	7.480	23.341	0.702
63	21-Feb-92	140.980	0.380	4.322	7.084	48.412	0.721
64	22-Feb-92	127.782	0.406	4.255	7.775	32.518	0.763
65	23-Feb-92	116.070	0.415	4.233	7.715	26.125	0.664
66	24-Feb-92	154.986	0.422	4.360	7.492	30.401	0.678
67	25-Feb-92	139.870	0.412	4.339	7.458	21.758	0.578
68	26-Feb-92	148.119	0.420	4.159	7.470	35.904	0.614
69	27-Feb-92	159.780	0.353	4.231	6.844	22.395	0.543
70	28-Feb-92	154.922	0.364	4.229	7.011	32.337	0.491
71	29-Feb-92	137.587	0.378	4.235	7.402	12.674	0.516
72	01-Mar-92	115.945	0.403	4.190	7.824	11.587	0.564
73	02-Mar-92	157.786	0.402	4.274	7.162	30.239	0.598
74	03-Mar-92	141.768	0.392	4.250	7.600	13.471	0.532
75	04-Mar-92	139.879	0.409	4.282	7.330	25.712	0.630
76	05-Mar-92	138.687	0.449	4.278	7.884	15.646	0.620
77	06-Mar-92	152.594	0.393	4.347	7.399	14.053	0.479
78	07-Mar-92	154.356	0.396	4.369	7.604	14.438	0.452
79	08-Mar-92	132.218	0.426	4.341	8.277	12.963	0.547
80	09-Mar-92	161.576	0.356	4.289	7.130	14.272	0.550
83	12-Mar-92	187.725	0.336	4.290	6.523	11.595	0.471

Table A-6b

Daily Average Results for the Stack Inlet Gas During Phase IIIb Long-Term Testing

Consecutive Test Day	Date	Average Load(MW)	NO_x (lb/MBtu)	SO_2 (lb/MBtu)	O_2 (vol %)	CO (ppmv @ 3% O2)	THC (ppmv @ 3% O2)
3	05-Jun-92	183.006	0.404	4.480	6.524	11.771	0.782
4	06-Jun-92	165.867	0.381	4.490	6.609	15.337	0.820
5	07-Jun-92	165.485	0.402	4.479	6.968	17.131	0.840
11	13-Jun-92	171.897	0.381	4.416	6.443	12.723	0.676
18	20-Jun-92	182.485	0.388	4.493	6.278	10.605	1.186
19	21-Jun-92	196.205	0.372	4.432	5.864	9.335	0.966
20	22-Jun-92	196.369	0.395	4.360	5.858	6.150	0.837
21	23-Jun-92	186.790	0.398	4.420	6.335	2.324	0.748
23	25-Jun-92	183.247	0.385	4.627	6.090	8.208	0.729
24	26-Jun-92	186.693	0.398	4.571	6.462	10.838	0.779
25	27-Jun-92	184.512	0.391	4.523	6.436	9.742	0.887
26	28-Jun-92	164.003	0.382	4.485	6.772	8.911	0.863
27	29-Jun-92	183.217	0.385	4.519	6.269	5.201	0.774
29	01-Jul-92	181.702	0.386	4.676	6.097	10.944	0.585
30	02-Jul-92	183.629	0.387	4.601	6.089	11.241	0.495
31	03-Jul-92	183.047	0.405	4.637	6.235	10.830	0.449
32	04-Jul-92	172.959	0.412	4.673	6.655	11.008	0.447
33	05-Jul-92	173.515	0.408	4.523	6.673	8.077	0.424
34	06-Jul-92	194.687	0.399	4.610	6.045	4.446	0.398
35	07-Jul-92	192.000	0.396	4.628	6.016	5.466	0.433
36	08-Jul-92	194.330	0.408	4.529	6.014	5.799	0.449
37	09-Jul-92	193.526	0.395	4.560	5.914	8.762	0.423
38	10-Jul-92	189.531	0.392	4.695	5.938	9.321	0.383

Table A-6b (Continued)

Consecutive Test Day	Date	Average Load(MW)	NO_x (lb/MBtu)	SO_2 (lb/MBtu)	O_2 (vol %)	CO (ppmv @ 3% O2)	THC (ppmv @ 3% O2)
39	11-Jul-92	172.889	0.376	4.744	6.363	11.375	0.384
42	14-Jul-92	190.095	0.417	5.078	7.385	12.648	1.050
43	15-Jul-92	176.354	0.403	4.552	6.869	6.215	0.778
45	17-Jul-92	181.553	0.406	4.634	6.530	10.145	0.723
46	18-Jul-92	180.486	0.419	4.685	6.614	24.569	0.655
47	19-Jul-92	182.840	0.425	4.679	6.629	33.105	0.589
48	20-Jul-92	189.643	0.421	4.625	6.264	17.629	0.530
49	21-Jul-92	189.548	0.410	4.471	6.215	12.102	0.479
50	22-Jul-92	180.062	0.403	4.477	6.533	8.485	0.452
56	28-Jul-92	193.505	0.416	4.644	6.243	7.530	0.613
57	29-Jul-92	185.866	0.400	4.656	6.220	9.111	0.547
58	30-Jul-92	186.714	0.411	4.660	6.357	6.799	0.555
59	31-Jul-92	186.490	0.405	4.657	6.343	6.474	0.535
60	01-Aug-92	181.325	0.410	4.662	6.416	2.613	0.548
61	02-Aug-92	188.512	0.414	4.634	6.278	2.653	0.551
63	04-Aug-92	181.160	0.395	4.647	6.348	18.711	0.573
64	05-Aug-92	181.969	0.394	4.672	6.431	12.105	0.630
65	06-Aug-92	184.997	0.414	4.673	6.497	6.944	0.679
66	07-Aug-92	187.784	0.422	4.645	6.431	8.521	0.642
67	08-Aug-92	190.499	0.419	4.698	6.495	9.580	0.631
68	09-Aug-92	189.962	0.410	4.722	6.313	9.319	0.578
69	10-Aug-92	194.785	0.413	4.655	6.169	7.726	0.622
70	11-Aug-92	192.940	0.393	4.628	6.024	8.023	0.601
71	12-Aug-92	190.985	0.396	4.541	6.175	6.899	0.566
72	13-Aug-92	194.722	0.395	4.460	6.100	9.021	0.520
73	14-Aug-92	190.118	0.406	4.424	6.456	8.266	0.540

Table A-6b (Continued)

Consecutive Test Day	Date	Average Load(MW)	NO_x (lb/MBtu)	SO_2 (lb/MBtu)	O_2 (vol %)	CO (ppmv @ 3% O2)	THC (ppmv @ 3% O2)
74	15-Aug-92	188.221	0.418	4.489	6.465	7.564	0.559
75	16-Aug-92	180.339	0.405	4.543	6.715	8.420	0.589
76	17-Aug-92	190.037	0.418	4.415	6.424	8.155	0.585
77	18-Aug-92	181.738	0.410	4.504	6.831	6.924	0.518
78	19-Aug-92	192.150	0.410	4.567	6.525	8.202	0.435
79	20-Aug-92	186.255	0.421	4.596	6.654	5.426	0.438
80	21-Aug-92	193.302	0.414	4.555	6.521	7.921	0.467
81	22-Aug-92	191.282	0.412	4.562	6.448	9.019	0.498
82	23-Aug-92	179.663	0.413	4.466	6.753	8.873	0.532
83	24-Aug-92	193.375	0.423	4.405	6.459	7.039	0.522
84	25-Aug-92	185.678	0.407	4.476	6.362	5.625	0.517
85	26-Aug-92	193.013	0.406	4.503	6.374	6.943	0.553
86	27-Aug-92	194.964	0.397	4.536	6.305	6.488	0.525
87	28-Aug-92	195.834	0.403	4.531	6.281	9.378	0.508
88	29-Aug-92	181.044	0.412	4.557	6.768	5.817	0.533
89	30-Aug-92	163.976	0.410	4.515	7.260	2.990	0.582

Appendix B

Phase IIIa and IIIb

Aqueous Stream Monitoring Data

Table B-1 presents the analytical results for the groundwater monitoring during Phase III. Data are presented for the eight monitoring wells sampled. All of the monitoring data for the ash pond discharge are presented in the body of this report (Section 5).

Table B-1

Groundwater Monitoring Results During Phase III

Well		1	2	3	4	5	6	7	8
Date		**12/06/91**	**12/06/91**	**12/06/91**	**12/06/91**	**12/06/91**	**12/06/91**	**12/06/91**	**12/06/91**
Aluminum	mg/L	0.3	0.077	3.8	0.84	3.6	1.4	2.5	0.043
Cadmium	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chloride	mg/L	5600	46	15	1100	850	1400	100	140
Chromium	mg/L	<0.010	<0.010	0.01	<0.010	<0.010	<0.010	0.012	<0.010
Conductivity	umho/cm	17,000	470	76	4,800	2,800	5,700	640	800
Iron	mg/L	8.8	1.4	3.0	0.44	13	1.4	3.9	2.8
Manganese	mg/L	0.13	<0.010	0.023	0.16	0.035	0.55	<0.010	0.012
Nickel	mg/L	0.039	0.069	0.064	0.055	0.069	0.068	0.071	0.059
pH	S.U.	6.0	7.1	6.1	5.3	3.9	5.9	6.2	7
Sulfate	mg/L	730	2.9	8.6	690	98	670	32	20
TDS	mg/L	9,800	260	49	2,700	1,300	3,400	350	480
Gross Alpha	pCi/L	22	6.5	20	7	55	12	7.5	3.9
Gross Beta	pCi/L	160	6.4	11	35	37	71	10	5.4
Date		***03/03/92***	***03/03/92***	***03/03/92***	***03/03/92***	***03/03/92***	***03/03/92***	***03/03/92***	***03/03/92***
Aluminum	mg/L	0.19	<0.050	1.6	1.8	4.4	0.97	0.88	<0.050
Cadmium	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chloride	mg/L	6,600	19	7.7	1,100	840	1,500	150	140
Chromium	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Conductivity	umho/cm	16,000	420	64	4,600	2,400	5,700	480	780
Iron	mg/L	3.8	1.6	1.4	0.49	13	0.72	3.3	2.9
Manganese	mg/L	0.064	<0.010	0.017	0.14	0.043	0.86	<0.010	0.011
Nickel	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
pH	S.U.	5.9	7.2	5.9	5.2	3.9	5.8	6.3	7
Sulfate	mg/L	740	5.8	12	690	90	680	40	26
TDS	mg/L	10,000	250	50	2,800	1,300	3,000	160	510
Gross Alpha	pCi/L	20	2.3	11	8	0	16	43	4.6
Gross Beta	pCi/L	190	5.1	11	74	15	78	42	8.1

Table B-1 (Continued)

Well		1	2	3	4	5	6	7	8
Date		**05/15/92**	**05/15/92**	**05/15/92**	**05/15/92**	**05/15/92**	**05/15/92**	**05/15/92**	**05/15/92**
Aluminum	mg/L	0.81	<0.050	1.6	2.1	5	4.2	2.4	<0.050
Cadmium	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chloride	mg/L	5,600	17	12	1,200	980	1,600	120	160
Chromium	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.015	<0.010
Conductivity	umho/cm	17,000	440	70	5,500	2,800	6,000	500	830
Iron	mg/L	7.7	2	1.1	0.58	15	1.9	6.5	3
Manganese	mg/L	0.084	<0.010	0.15	0.14	0.042	0.54	0.012	0.013
Nickel	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
pH	S.U.	6.1	7.3	5.7	5.2	4.2	5.6	6	7.3
Sulfate	mg/L	720	7	12	660	80	670	36	28
TDS	mg/L	8,800	270	62	2,700	1,400	3,500	340	590
Gross Alpha	pCi/L	61	1.6	5.9	20	74	6	6.9	8.4
Gross Beta	pCi/L	180	2.4	3.8	77	46	61	7.7	0
Date		**07/30/92**	**07/30/92**	**07/30/92**	**07/30/92**	**07/30/92**	**07/30/92**	**07/30/92**	**07/30/92**
Aluminum	mg/L	0.31	0.13	1.4	3.2	43	2.1	1.8	<0.050
Cadmium	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Chloride	mg/L	7,000	1,500	1,700	1,400	1,500	1,900	1,300	1,300
Chromium	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.025	<0.010
Conductivity	umho/cm	14,000	360	60	3,800	2,100	3,300	340	650
Iron	mg/L	12	2.3	1.2	0.78	16	1.2	5.3	3.1
Manganese	mg/L	0.29	0.010	0.011	0.15	0.043	0.82	0.012	0.012
Nickel	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
pH	S.U.	6.1	7.2	5.9	5.2	4.3	6.0	6.1	7.1
Sulfate	mg/L	800	<1.0	1.2	700	95	720	17	17
TDS	mg/L	10,000	260	73	2,700	1,500	2,700	280	590
Gross Alpha	pCi/L	48	0.6	4.9	47	59	20	3.4	4.9
Gross Beta	pCi/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A = Not analyzed.
TDS = Total dissolved solids.

Appendix C

Phase IIIa and IIIb

Solid Stream Monitoring Data

Table C-1 presents the results for the analysis of coal samples obtained during each test element in Phases IIIa and IIIb.

Table C-1

Coal Analyses During Phase III Testing

Date	Moisture (wt %)	Carbon (wt %)	Hydrogen (wt %)	Nitrogen (wt %)	Chlorine (wt %)	Sulfur (wt %)	Ash (wt %)	Oxygen (wt %)
PHASE IIIa DIAGNOSTIC TESTS								
12/05/91	8.79	67.29	4.55	1.49	0.17	3.24	8.89	5.75
12/06/91	10.69	65.49	4.45	1.47	0.12	2.65	9.41	5.83
12/07/91	8.56	67.82	4.59	1.47	0.15	2.59	8.79	6.18
12/08/91	8.81	67.05	4.49	1.45	0.16	2.95	9.08	6.17
12/09/91	9.54	67.36	4.58	1.46	0.16	2.80	8.39	5.89
12/10/91	9.06	68.12	4.66	1.44	0.16	2.63	8.37	5.73
12/11/91	8.54	68.10	4.64	1.45	0.17	2.65	8.87	5.75
01/08/92	9.17	67.23	4.77	1.45	0.13	2.73	8.73	5.91
01/09/92	7.80	67.84	4.78	1.50	0.12	2.84	9.42	5.82
01/10/92	8.49	67.99	4.79	1.52	0.14	2.98	8.61	5.62
01/11/92	9.00	68.50	4.73	1.45	0.20	2.83	7.94	5.55
01/12/92	8.14	68.46	4.77	1.46	0.18	2.92	8.48	5.77
01/13/92	7.77	68.48	4.81	1.50	0.12	2.96	8.54	5.93
PHASE IIIa PERFORMANCE TESTS								
12/12/91	8.56	68.10	4.60	1.45	0.12	2.86	8.73	5.69
12/12/91	7.88	67.68	4.62	1.45	0.18	2.68	8.55	7.14
12/12/91	8.82	67.18	4.56	1.46	0.14	2.72	8.89	6.37
12/12/91	8.75	67.75	4.59	1.50	0.12	2.71	8.73	5.97
12/13/91	8.52	67.71	4.60	1.46	0.12	2.79	8.82	6.09
12/13/91	8.42	67.84	4.64	1.48	0.13	2.75	8.72	6.15
12/14/91	8.81	67.54	4.59	1.48	0.18	2.79	8.66	6.13

Table C-1 (Continued)

Date	Moisture (wt %)	Carbon (wt %)	Hydrogen (wt %)	Nitrogen (wt %)	Chlorine (wt %)	Sulfur (wt %)	Ash (wt %)	Oxygen (wt %)
12/14/91	8.68	67.27	4.52	1.44	0.13	2.79	9.10	6.20
12/14/91	9.42	67.47	4.56	1.44	0.13	2.62	8.88	5.62
12/15/91	9.65	66.79	4.54	1.43	0.11	2.93	8.87	5.80
12/15/91	9.20	66.84	4.60	1.43	0.12	2.89	9.63	5.41
12/15/91	9.39	66.88	4.55	1.36	0.15	2.88	8.73	6.24
12/15/91	9.16	66.31	4.63	1.40	0.19	3.02	8.84	6.64
12/17/91	9.42	66.71	4.62	1.33	0.17	2.85	9.08	5.99
12/17/91	8.73	67.69	4.70	1.37	0.16	2.77	8.54	6.19
12/18/91	9.80	66.66	4.57	1.32	0.17	2.81	8.51	6.33
12/18/91	8.95	67.60	4.67	1.38	0.17	2.70	8.45	6.25
12/18/91	8.92	67.52	4.60	1.36	0.17	2.72	8.53	6.53
12/19/91	8.84	67.58	4.58	1.46	0.16	2.76	8.60	6.19
12/19/91	10.14	66.35	4.46	1.43	0.25	2.79	8.45	6.39
12/20/91	9.25	67.05	4.73	1.46	0.10	2.80	8.66	6.05
12/20/91	8.96	67.12	4.72	1.47	0.15	2.90	8.85	5.97
12/20/91	8.27	67.87	4.84	1.41	0.13	2.84	8.83	5.93
12/20/91	8.54	66.36	4.57	1.42	0.14	2.70	8.53	7.88
PHASE IIIa LONG-TERM TESTING								
11/20/91	7.01	68.40	4.64	1.48	0.14	2.96	8.95	6.57
11/20/91	7.30	66.94	4.70	1.38	0.16	3.11	8.93	7.64
11/27/91	9.05	67.32	4.53	1.45	0.13	2.89	8.78	5.98
12/04/91	9.98	66.12	4.51	1.48	0.15	2.75	9.07	6.09
12/25/91	9.90	66.16	4.63	1.44	0.14	2.83	8.99	6.05
01/01/92	8.95	66.82	4.61	1.53	0.14	2.83	8.96	6.30
01/08/92	8.57	67.57	4.66	1.44	0.14	2.84	8.76	6.15
01/15/92	10.16	67.07	4.55	1.46	0.13	2.72	8.07	5.97

Table C-1 (Continued)

Date	Moisture (wt %)	Carbon (wt %)	Hydrogen (wt %)	Nitrogen (wt %)	Chlorine (wt %)	Sulfur (wt %)	Ash (wt %)	Oxygen (wt %)
01/15/92	10.24	65.23	4.74	1.36	0.17	2.75	8.11	7.57
01/22/92	10.83	66.34	4.57	1.37	0.16	2.61	8.27	5.99
01/29/92	12.80	64.12	4.38	1.34	0.16	2.70	8.58	6.08
02/07/92	10.43	66.64	4.59	1.43	0.08	2.75	8.32	5.84
02/12/92	10.07	67.08	4.49	1.43	0.15	2.78	8.26	5.90
02/20/92	11.71	65.84	4.49	1.39	0.14	2.67	7.93	5.97
02/26/92	11.19	66.48	4.50	1.42	0.18	2.66	7.92	5.82
03/05/92	11.52	66.05	4.43	1.43	0.09	2.73	8.27	5.57
03/18/92	9.62	66.99	4.56	1.47	0.07	2.74	8.91	5.70
04/01/92	11.10	66.45	4.53	1.45	0.08	2.73	8.40	5.34
PHASE IIIa VERIFICATION TESTS								
03/10/92	10.82	66.46	4.50	1.43	0.09	2.76	8.66	5.37
03/11/92	10.90	66.15	4.48	1.43	0.08	2.71	8.62	5.72
PHASE IIIb DIAGNOSTIC TESTS								
05/14/92	8.53	67.81	4.54	1.38	0.08	2.89	8.63	6.22
05/15/92	9.20	67.50	4.55	1.35	0.08	2.81	8.21	6.37
05/16/92	8.68	67.56	4.54	1.33	0.08	2.98	8.64	6.27
05/20/92	8.49	67.40	4.55	1.37	0.09	3.02	9.01	6.16
05/29/92	9.19	67.11	4.44	1.41	0.12	2.88	8.62	6.36
05/30/92	9.33	67.01	4.52	1.41	0.12	2.82	8.52	6.38
06/01/92	9.98	66.71	4.28	1.40	0.14	2.87	8.54	6.21
06/02/92	10.39	66.31	4.35	1.39	0.13	2.87	8.38	6.32
PHASE IIIb PERFORMANCE TESTS								
06/09/92	8.95	66.98	4.55	1.41	0.12	2.95	8.39	6.77
06/09/92	9.39	66.98	4.39	1.40	0.13	2.81	8.25	6.79
06/09/92	10.13	66.26	4.39	1.38	0.13	2.79	8.42	6.63

Table C-1 (Continued)

Date	Moisture (wt %)	Carbon (wt %)	Hydrogen (wt %)	Nitrogen (wt %)	Chlorine (wt %)	Sulfur (wt %)	Ash (wt %)	Oxygen (wt %)
06/09/92	8.80	67.64	4.50	1.43	0.13	2.90	8.65	6.08
06/10/92	8.40	67.71	4.34	1.45	0.13	2.84	8.56	6.70
06/10/92	8.93	67.24	4.66	1.41	0.13	2.83	8.69	6.24
06/10/92	8.78	67.18	4.17	1.43	0.15	2.75	8.66	7.02
06/10/92	7.61	67.67	4.80	1.45	0.12	2.87	9.41	6.19
06/11/92	8.32	67.79	4.65	1.46	0.12	2.82	8.57	6.39
06/11/92	8.73	67.41	4.44	1.45	0.10	2.85	8.37	6.75
06/11/92	9.39	67.01	4.22	1.44	0.10	2.83	8.48	6.63
06/12/92	9.01	66.87	4.12	1.44	0.10	2.85	8.49	7.22
06/12/92	9.67	66.17	4.22	1.39	0.13	2.88	8.73	6.95
06/12/92	10.86	65.82	4.34	1.43	0.12	2.93	8.75	5.87
06/12/92	10.20	65.56	4.55	1.37	0.13	2.86	8.78	6.66
06/13/92	9.50	66.73	4.66	1.39	0.12	2.92	8.54	6.25
06/13/92	10.52	65.74	4.47	1.37	0.12	2.98	8.56	6.35
06/13/92	10.28	66.36	4.51	1.37	0.08	3.01	8.54	5.92
06/14/92	10.14	66.70	4.53	1.37	0.10	2.94	8.57	5.74
06/14/92	10.53	66.23	4.46	1.36	0.08	2.88	8.47	6.08
06/15/92	10.27	66.06	4.72	1.41	0.08	3.12	8.52	5.90
06/15/92	8.91	67.19	4.71	1.40	0.16	2.89	8.83	6.08
06/16/92	9.39	66.56	4.50	1.38	0.14	2.94	8.98	6.25
06/16/92	10.11	66.37	4.25	1.39	0.15	2.85	8.67	6.36
06/18/92	9.29	66.45	4.23	1.42	0.14	3.25	9.13	6.24
06/19/92	9.78	66.56	4.04	1.40	0.16	3.09	8.64	6.49
06/19/92	9.67	66.58	3.89	1.38	0.13	3.00	8.65	6.82
06/19/92	9.53	66.73	4.60	1.38	0.15	2.97	8.54	6.25
06/19/92	9.56	67.21	4.42	1.44	0.12	2.87	8.30	6.20

Table C-1 (Continued)

Date	Moisture (wt %)	Carbon (wt %)	Hydrogen (wt %)	Nitrogen (wt %)	Chlorine (wt %)	Sulfur (wt %)	Ash (wt %)	Oxygen (wt %)
06/19/92	9.88	66.34	4.35	1.41	0.13	3.06	8.66	6.30
06/20/92	10.37	65.86	4.19	1.38	0.10	2.90	8.65	6.66
PHASE IIIb LONG-TERM TESTING								
05/27/92	7.52	67.91	4.71	1.41	0.13	2.95	8.84	6.66
06/03/92	10.05	66.25	4.31	1.39	0.13	2.67	8.93	6.40
06/24/92	9.43	66.65	4.21	1.39	0.09	3.08	8.88	6.36
07/21/92	9.94	66.24	4.48	1.37	0.17	2.70	8.58	6.68
07/29/92	11.26	64.83	4.35	1.36	0.16	2.74	9.25	6.21
08/05/92	9.87	66.26	4.30	1.37	0.17	2.79	8.43	6.99
08/11/92	8.35	67.29	4.55	1.39	0.14	2.93	9.35	6.14
08/26/92	10.52	65.62	4.30	1.37	0.17	2.77	8.81	6.59
10/14/92	9.83	67.08	4.39	1.41	0.16	2.80	8.85	5.64
PHASE IIIb VERIFICATION TESTS								
09/15/92	9.10	67.70	4.41	1.42	0.17	2.85	8.33	6.20
09/16/92	9.11	67.49	4.46	1.38	0.15	2.88	8.56	6.11
09/17/92	9.11	67.37	4.36	1.42	0.16	2.87	8.67	6.20