DOE/PC/90545--T2

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DE92 001641

Full-Scale Demonstration

Low-NOx Cell Burner Retrofit

Quarterly Report No. 2

for the period - January 1, 1991 through March 31, 1991

DOE Agreement No.: DE-FC22-91PC90545

B&W CRD Agreement No.: CRD-1250

Patents Cleared by Chicago on July 3, 1991

Prepared by:

Babcock & Wilcox
a McDermott Company

MASTER

May 24, 1991
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DISCLAIMER

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1.0 EXECUTIVE SUMMARY

The Full Scale Demonstration Low-NOx Cell (LNC) Burner Project (DOE Agreement No. DE-FC22-90PC90545) progress from January 1, 1991 through March 31, 1991 identified in this, the second Quarterly Report. The Report centers on Phase I - Design, and Phase IIA - Procurement and Fabrication status.

The LNC Burner project involves retrofitting the two-nozzle cell burners at Dayton Power & Light's, 605 MWe J.M. Stuart Unit #4 Boiler near Aberdeen, Ohio with LNC Burners (a burner and intregal NOx port). Previous pilot-scale tests have shown such an arrangement to achieve 50% reduction in NOx emission levels. This full-scale project will determine the commercial applicability of this technology.

Funding Agreements were signed with both Allegheny Power and the Ohio Coal Development Office (OCDO). The Electric Power Research Institute (EPRI) remains the only agreement to negotiate. The second advisory committee meeting, which also served as the 90% Design Review Meeting, was held on March 12, 1991. Tours of DP&L Stuart Station Unit #4 were conducted as a sidelight to this meeting. As a result, committee members were able to inspect the LNC Burner equipment that is now on-site awaiting the outage.

Formal documentation for the cost plan and Operating & Maintenance manuals as well as draft copies of the Project Evaluation Plan, the Detailed Work Plan, the Technical Progress Quarterly Report #1, Preliminary Public Design Report and the Environmental Monitoring Plan were submitted to DOE PETC for review and approval.

Pre-retrofit testing emissions data has been analyzed and preliminary results delineated. Baseline NOx levels for DP&L Stuart Station Unit #4 firing the test Kentucky fuel is approximately 1.2 lbs of NOx/million Btu of input at full boiler load with all mills in service and 20% excess air operation. Preliminary analysis of HVT flue gas temperature, flue gas velocity and O_2 field test data taken during the Pre-Retrofit testing shows the Numerical Model prediction capability to be valid.

Laboratory testing work continues. Corrosion retort tests were started in February, 1991. The test conditions will vary alloy composition, coating processes, gas temperatures and mixed gas composition with variable H_2S levels. The retort tests will be completed by August, 1991.

Dayton Power & Light has finalized design and procurement of the control system upgrade equipment necessary to handle LNC Burner operation. All of the fabricated equipment for the LNC Burner System, except for ceramic piping, is complete and has been shipped to the jobsite. All shipments will be completed by June, 1991.

2.0 INTRODUCTION

As per the Cooperative Agreement No. DE-FC22-90PC90545 dated October 11, 1990, the following quarterly report has been prepared for Phases I and IIA of the Full-Scale Demonstration of Low NOx Cell Burner Project. The period covered by this quarterly report is January 1, 1991 through March 31, 1991. This report is the second quarterly prepared for the project.

Phase I - Design work accomplished during this quarter follows. Under Task 1 - Management & Reporting, formal documentation for the cost plan and Operating & Maintenance manuals as well as draft copies of the Project Evaluation Plan, the Detailed Work Plan, the Technical Progress Quarterly Report #1, Preliminary Public Design Report and the Environmental Monitoring Plan were submitted to DOE PETC. Funding Agreements were signed with both Allegheny Power and the Ohio Coal Development Office (OCDO). Additionally, the second advisory committee meeting was held on March 12, 1991. Under Task 3 - Pre-Retrofit Testing, baseline test data analysis and pre-retrofit test report writing was initiated. Laboratory Corrosion testing work continued with the major emphasis on alloy/H_2S retort test work. Actual baseline test data results were compared to the predicted results from numerical modelling of the standard cell burner. The 90% Design Review milestone involving Task 4 - Functional Engineering & Task 5 - Detailed Design Engineering was completed. Activities in Task 2 - Test Plan Development, and Task 6 - Permitting were concluded last quarter.

Phase IIA - Procurement and Fabrication work accomplished during this quarter for Task 1 - Management & Reporting centered around discussions for a workscope change to install a corrosion test panel. Work under Task 3 - Manufacturing & Fabrication shows all materials, except for ceramic piping, completed and shipped to the jobsite.

The major components of this report deal with the preliminary results of Phase I, Task 3 - Pre-Retrofit Testing.

3.0 PROJECT DESCRIPTION

3.1 PROJECT OVERVIEW

The current energy policy of the United States includes the expanded use of coal in utility and industrial applications. However, the increased use of coal must not conflict with environmental goals and thus requires development of cost-effective technology to control the pollutants resulting from coal combustion. Of major concern is the problem of oxides of nitrogen in the Northeastern United States and portions of Canada.

U.S.-installed steam generating units (ie. boilers) equipped with pulverized-coal-fired, cell-type burners account for approximately 26,000 MW of electric power generating capacity. Ten thousand MW of generating capacity is located in Ohio. The balance is located primarily in the Midwest and Northeast, but also in the South and West. Coal-fired generating units equipped with cell-type burners produce about 20% of the Pre-New Source Performance Standards (NSPS) utility NOx emissions with an uncontrolled emission rate of approximately 1,000,000 t/yr NOx as NO_2. Replacement of the standard cell burners with Low-NOx Cell (LNC) burners can potentially reduce NOx emissions by 50% per boiler, or 500,000 - 600,000 tons per year if applied to all pre-NSPS boilers of this type.

Currently there is no other commercially-available technology that can achieve NOx emission reductions on the order of 50% in cell-fired utility boilers without resorting to pressure part modifications. The unique cell burner configuration precludes the use of commercially-available low-NOx burner designs. This is due to the proximity of the burner throats and the relatively small burner throat openings typical of the pre-NSPS cell burner design. Low-NOx burner designs operating on the principle of delayed combustion require larger throat openings, i.e., lower burner air velocities, to inhibit the formation of volatile NO in the early stages of combustion. Furthermore, optimum NOx reduction with standard low-NOx burner designs is achieved when heat release rate per unit volume is minimized. The existing cell burner configuration does not lend itself to either of these requirements.

Realizing the need, Babcock & Wilcox and the Electric Power Research Institute (EPRI) have invested a large amount of resources in the research and development of an unique, "plug in" Low-NOx Cell burner for retrofitting these existing boilers equipped with standard cell burners. Refer to Appendix A for sketches showing existing standard cell burner arrangement versus the proposed low-NOx cell burner arrangement.

3.2 PROJECT BACKGROUND

The low-NOx cell burner operates on the principle of staged combustion. The lower burner of each two-nozzle cell is modified to accommodate all the fuel input previously handled by two nozzles. Secondary air, less than theoretically required for complete combustion, is introduced to the lower burner. The remainder of secondary air is directed to the upper "port" of each cell to complete the combustion process.

B&W/EPRI have thoroughly tested the LNC burner at two pilot scales (6 million Btu per hour and 100 million Btu per hour), and tested a single full-scale burner in a utility boiler. Combustion tests at two scales have confirmed NOx reduction with the low-NOx cell on the order of 50% relative to the standard cell burner at optimum operating conditions. The technology is now ready for full unit, full-scale demonstration.

From the standpoint of a cost-effective NOx reduction technology the low-NOx cell burner is, by design, ideally suited for retrofit to existing two-nozzle cell burner installations. The "plug-in" design will fit existing wall tube openings eliminating outage time and material/ labor expense associated with pressure part modifications and burner relocations. Potentially, this burner can be installed on all utility boilers currently equipped with two-nozzle cell burners, and can be adapted to units with three-nozzle cell burners.

Since pressure part changes are not required for the replacement, low-NOx cell burners are the most cost-effective NOx control alternative for boilers equipped with standard cell burners. The cost effectiveness (dollars per ton NOx removal) for the low-NOx cell burners is about one-half of that for conventional low-NOx burners, and one-tenth that for selective catalytic reduction.

The low-NOx cell burner retrofit is expected to be compatible with all U.S. coals currently being burned in the original cell burners. No loss to domestic coal sourcing will be recognized. Utilities representing 70% of the potential low-NOx cell burner retrofit market (capacity basis) are participating in the project.

To accelerate commercialization of this promising technology in controlling NOx levels in pre-NSPS power plants, a full-scale retrofit of a complete boiler system is to be performed. This project at Dayton Power & Light's J.M. Stuart Unit #4, located along the Ohio River between Manchester and Aberdeen, Ohio, will permit actual full-scale NOx levels to be quantified and demonstrate the ability of the equipment to reliably meet conservative utility industry standards.

Unit No. 4 is a supercritical Universal Pressure, single-reheat, Carolina-type boiler, fired with pulverized coal. The unit is designed for a maximum continuous capacity of 4,400,000 lbs steam/hr delivered to a 3500 psig (nominal) General Electric turbine-generator for a maximum gross generating capacity of 605 MWe.

Existing combustion equipment consists of 24 two-nozzle cell burners, 6 MPS-89K pulverizers, and 6 gravimetric feeders. The burners are arranged in an opposed-fired configuration with 12 cell burners on each wall, 2 high by 6 wide. The existing burner throat openings are 38 inches in diameter.

3.3 PROJECT OBJECTIVES

The overall objective of the Full-Scale Low-NOx Cell (LNC) Burner Retrofit project is to demonstrate the cost-effective reduction of NOx generated by a large, base-loaded (70% capacity factor or greater), coal-fired utility boiler. Specific objectives include:

- At least 50% NOx reduction over standard two-nozzle cell burners, without degradation of boiler performance or life.

- Acquire and evaluate emission and boiler performance data before and after the retrofit to determine NOx reduction and impact on overall boiler performance.

- Demonstrate that the LNC burner retrofits are the most cost-effective alternative to emerging, or commercially-available NOx control technology for units equipped with cell burners.

The focus of this demonstration is to determine maximum NOx reduction capabilities without adversely impacting plant performance, operation and maintenance. In particular, the prototype evaluations will resolve many technical issues not possible to address fully in the previous pilot-scale work and the single full-scale burner installation. These include low-NOx combustion system impact on:

(1) boiler thermal efficiency
(2) furnace temperature and heat absorption profiles
(3) slagging and fouling
(4) waterwall corrosion
(5) gaseous and particulate emissions
(6) boiler operation considerations

3.4 HOST SITE BOILER

The host site is an existing utility boiler owned by Dayton Power & Light Company, Cincinnati Gas & Electric Company, and Columbus Southern Power Company. The following is a summary of pertinent information.

- OPERATING UTILITY: The Dayton Power & Light Company

- UNIT ID: J.M. Stuart No. 4

- LOCATION: Route 52, P.O. Box 468
  Aberdeen, Adams County, Ohio 45101

- NAME PLATE RATING: 605 MW NDC

- TYPE: Tandem Steam Turbine

- PRIMARY FUEL: Eastern Bituminous Pulverized Coal
  from Ohio, West Virginia, and Kentucky

- OPERATION DATE: 1974

- BOILER ID: Babcock & Wilcox UP No. 106

- BOILER GENERAL CONDITION: Commercial Operation/Good Condition

- BOILER TYPE: Supercritical, Once-Through

- DEMONSTRATION FUEL: Eastern Bituminous Pulverized Coal

- BURNERS: 24 Two-Nozzle Cells, to be replaced with Low-NOx Cell Burners

- PARTICULATE CONTROL: Electrostatic Precipitators

- PAST EMISSIONS MONITORING: Precipitators - 99+% collection efficiency
  NOx (full load) - 1.2 lb/10^6 Btu

3.5 PROJECT TEAM

The Low NOx Cell Burner Project Team consists of the U.S. Department of Energy, The Babcock & Wilcox Company, Dayton Power & Light, the Electric Power Research Institute (EPRI).

Team members from B&W represent the Research and Development Division (R&DD), the Fossil Power Division (FPD), the Energy Service Division (ESD) and the Contract Research Division (CRD).

Major subcontractors are Acurex and a yet unassigned installation contractor. Acurex has been designated to perform continuous emissions monitoring activities as well as various analytical requirements during the testing program. The installation subcontractor will be the Dayton Power & Light - J.M. Stuart Station maintenance contractor. They will perform pre-outage, outage, and start-up work necessary to install the Low-NOx Cell Burners and its associated equipment.

A summary of the overall project organization is as follows:

Project Organization

- Department of Energy - 48.4% funding co-sponsor

- Babcock & Wilcox - Prime contractor, project manager, and funding co-sponsor

- Dayton Power & Light - Host site utility and funding co-sponsor

- EPRI - Technical advisor and funding co-sponsor

- Ohio Coal Development Office - Advisory committee member and funding co-sponsor

- Utility advisory committee members and funding co-sponsors

  Allegheny Power System
  Centerior Energy Corporation - Funding thru EPRI
  Duke Power Company - Funding thru EPRI
  New England Power Company - Funding thru EPRI
  Tennessee Valley Authority - Funding thru EPRI

- Acurex Corporation - testing subcontractor

- DP&L Stuart Station Maintenance Contractor - LNCB installation

3.6 PROJECT PHASES

The LNC Burner project, which is a $9.796 million project, consists of four separate phases which are planned to occur over a 32-month period. These are:

- Phase I - Design

  During this phase, the Low-NOx Cell (LNC) Burner System will be designed based upon B&W's pilot-scale combustion tests, and experience/knowledge of full-scale burner/OFA port/control system retrofits. Additionally, collection of baseline emissions and performance data, along with performance of general boiler system assessment, will be completed at DP&L's J.M. Stuart Unit #4 prior to the LNC Burner retrofit.

- Phase IIA - Procurement & Fabrication

  In order to meet the construction schedule, long lead-time equipment will be ordered and fabricated during the first budget period. To facilitate the funding of this procurement activity, Phase II is divided into two parts, Phase IIA and Phase IIB.

- Phase IIB - Installation

  The LNC Burner system will be installed and started up to provide a fully operational system prior to testing.

- Phase III - Operation

  Parametric/optimization and long term performance tests will assess the potential of the technology from both the resulting emission reductions and boiler performance capability aspects. Both full-load and reduced-load operations will be evaluated for the LNC Burner technology. Finally, readiness for commercialization will be determined from both a technical and economic viewpoint.

4.0 PROJECT STATUS

The time period covered by this project quarterly report #2 is January 1, 1991 through March 31, 1991. Progress will be discussed on a task basis for each of the Phase I and Phase IIA activities.

4.1 PHASE I - DESIGN

Activities in Phase I include the following tasks: Management and Reporting, Test Plan Development, Pre-Retrofit Testing, Functional Engineering, Detailed Design Engineering, and Permitting.

4.1.1 Task 1 - Management and Reporting

Dayton Power & Light has found it necessary to delay the Stuart Station Unit #4 outage. The outage will shift from the planned Spring, 1991 date to a September 22, 1991 start date. As a result, a request was submitted to DOE for a six-month extension to the first budget period. DOE approved an extension to August 30, 1991 for the first budget period and an extension of project completion to May 31, 1993.

Monthly reports covering the time period of this report were completed and issued to DOE PETC on schedule. Formal documentation for the cost plan as well as Operating & Maintenance manuals were submitted to DOE PETC. Additionally, draft copies of the Project Evaluation Plan, the Detailed Work Plan, the Technical Progress Quarterly Report #1, Preliminary Public Design Report, and the Environmental Monitoring Plan were also submitted during this period.

Funding Agreements were signed with both Allegheny Power and the Ohio Coal Development Office (OCDO). The Electric Power Research Institute (EPRI) remains the only agreement to negotiate.

The second advisory committee meeting was held on March 12, 1991 at the Drawbridge Inn, Cincinnati, Ohio. The meeting was utilized as the Design Review Meeting. Tours of DP&L Stuart Station Unit #4 were conducted and on-site fabricated materials were inspected.

4.1.2 Task 2 - Test Plan Development

The final Pre-Retrofit Test Plan was approved by DOE. The plan identifies all test parameters, sampling instrumentation, equipment location, test date forms, test procedures, and testing matrix for both the baseline pre-retrofit tests and the Low-NOx Cell Burner Tests.

4.1.3 Task 3 - Pre-Retrofit Testing

Task 3 includes planning and coordination, diagnostic testing and baseline characterization (unit condition assessment, boiler modifications for baseline testing numerical modeling, continuous emissions monitoring system (CEMS) installation, data acquisition equipment purchase and installation, baseline testing, laboratory testing), and completion of a Pre-Retrofit Test Report.

Most of the subtasks defined above were completed prior to the period covered by this report. Only those subtasks involving ongoing work are reported below.

4.1.3.2 Subtask 3.2 - Diagnostic Testing and Baseline Characterization

Numerical Modeling

HVT flue gas temperature, flue gas velocity and O_2 data taken during the Pre-Retrofit testing was analyzed and then compared to model predictions. As can be seen in appendix A, the predicted data compares favorably to the actual field data. Some extremes in the data points are attributable to slag and ash build-up on the probe, thereby distorting the readings.

Baseline Testing

The coal utilized during the pre-retrofit testing was restricted to coal from one Kentucky mine. This same coal is planned for use during post-retrofit optimization testing. DP&L normally utilizes coal pile blending of their West Virginia and Kentucky coals with Ohio coal to a ratio of approximately 10% Ohio coal. The limit on use of Ohio Coal is due to sulfur emission regulations. It would be very difficult to characterize a coal pile blend, therefore, coal type was restricted during baseline testing and will again be restricted during optimization testing. Long term testing will utilize DP&L's normal blended coal.

Pre-retrofit testing data has been analyzed and preliminary results have been delineated. Cell type boilers exhibit NOx levels in the range of 1.0 to 1.8 lbs/million Btu of input. As the field test results located in appendix B show, baseline NOx levels for DP&L Stuart Station Unit #4 firing the test Kentucky fuel is approximately 1.2 lbs of NOx/million Btu of input at full boiler load with all mills in service and 20% excess air operation. Lower furnace N_2O and H_2S levels were negligible.

Laboratory Testing

Laboratory Corrosion Testing work continues. The object of this subtask is to conduct retort tests of various candidate alloys by exposing them to simulated low-NOx combustion gases at different H_2S concentrations and temperatures. The low-NOx flue gas compositions were determined by theoretical calculations of coal combustion at predicted air/fuel stoichiometric ratios. These compositions are being simulated in the laboratory and used for the corrosion retort tests.

The retort tests were started in February 1991. A total of 18 materials, including carbon steel, alloy steels, stainless steels, and coating systems, are being exposed to the simulated LNCB mixed gases. It is anticipated that five or six retort tests, each lasting 1000 hours, will be completed in the next 7 months. The test conditions vary in alloy composition, coating process, temperature (500, 700, and 900 C) and mixed gas composition (0.05, 0.25, and 0.5% H_2S).

Combining the prospective results from the laboratory tests with the corrosion data already available from previous B&W studies, a corrosion model will be originated and the corrosion rates of candidate alloys under LNCB environments will be predicted.

4.1.4 Task 4 - Functional Engineering

The 90% Design Review Meeting was held on March 12, 1991. Also, a draft of the Preliminary Public Design Report has been submitted for DOE PETC review and comments. The finalized copy will be released in May, 1991.

4.1.5 Task 5 - Detailed Design Engineering

The 90% Design Review Meeting was held on March 12, 1991. A draft of the Final Public Design Report will be submitted for DOE PETC review and comments in June, 1991.

Dayton Power & Light has finalized control system upgrades as noted in Appendix C. The extent of control system modifications will be plant specific. Therefore, the changes shown here may not apply to other boiler installations equipped with cell burners.

4.1.6 Task 6 - Permitting

This task is complete.

4.2A Phase IIA - Procurement and Fabrication

Activities in Phase IIA include the following tasks: Management and Reporting, Procurement, and Manufacturing and Fabrication.

4.2A.1 Task 1 - Management and Reporting

A meeting was held with DP&L, DOE PETC, and B&W to discuss possible modifications to the corrosion test plans. A corrosion test panel with various corrosion resistant materials applied to the external tube face is being proposed. Suggested panel layout is shown in Appendix D. Additionally, there are areas in the DP&L Stuart Unit #4 that will need to be sandblasted to provide a base metal surface for ultrasonic testing. DP&L has installed Aluminized spray coated panels in the areas of the furnace that are of interest regarding corrosion analysis. Removal of the coating is required to ascertain rates of corrosion of the base metal for a one year operation.

B&W is still evaluating options and costs to provide the best technical and most cost effective approach. Funding sources are also being sought for this work addition.

4.2A.2 Task 2 - Procurement

All raw material and sublet fabricated material procurement order work was completed last quarter.

4.2A.3 Task 3 - Manufacturing and Fabrication

Manufacturing of the Low-NOx Cell Burners is complete and all twenty-four burners have shipped to the job site. Additionally, the following auxiliary equipment was fabricated and delivered to the jobsite. . .non-ceramic coal piping, coal pipe knife gate valves, support steel, support rods and hangers.

The ceramic piping fabrication has been delayed. The vendor expects to complete shipment by June, 1991.

5.0 PLANNED ACTIVITIES

Planned activities for the next quarter, April, May, and June 1991 will focus on completing the Environmental Monitoring Plan, the Project Work Plan, the Project Evaluation Plan, Project Evaluation Report, Public Design Reports, and the Baseline Test Report. In addition, based upon the near completion of first budget period activities, a Continuation Application Request will be submitted for approval.

Phase IIA, Task 3 - Manufacturing and Fabrication will be continued towards the expected completion date of June, 1991.

APPENDIX A

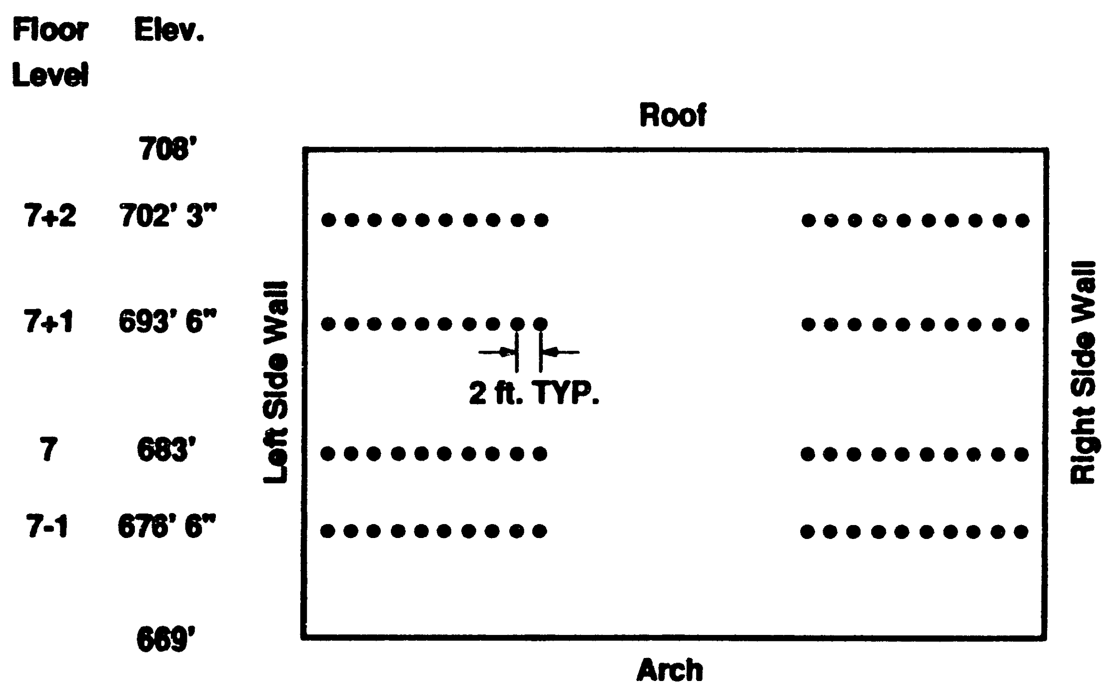
Numerical Modeling Status

March 12, 1991

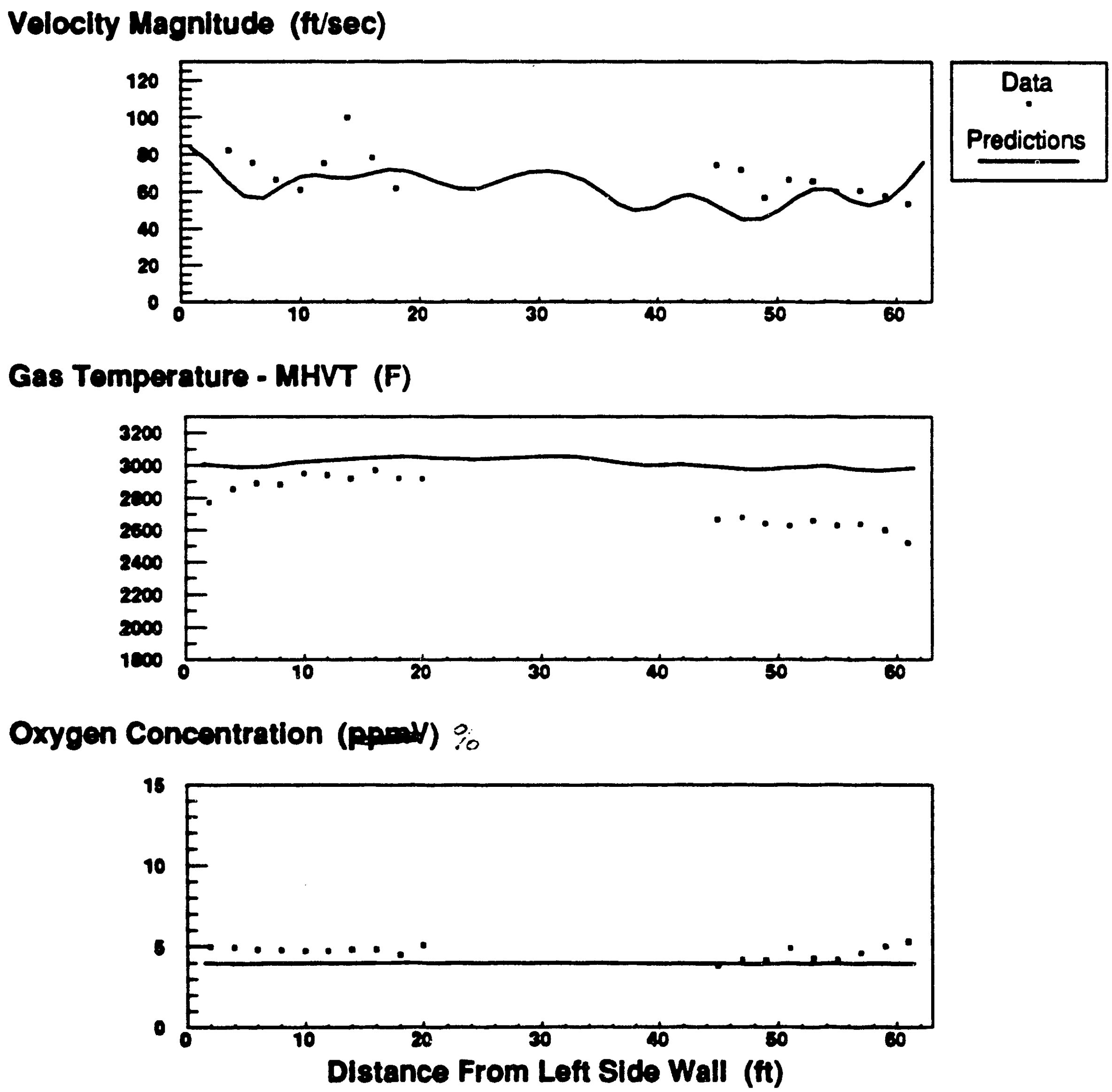
- Validation Activities
- Comparison of Predictions and Data
- Conclusions
- Future Work

Furnace Exit Sampling Locations

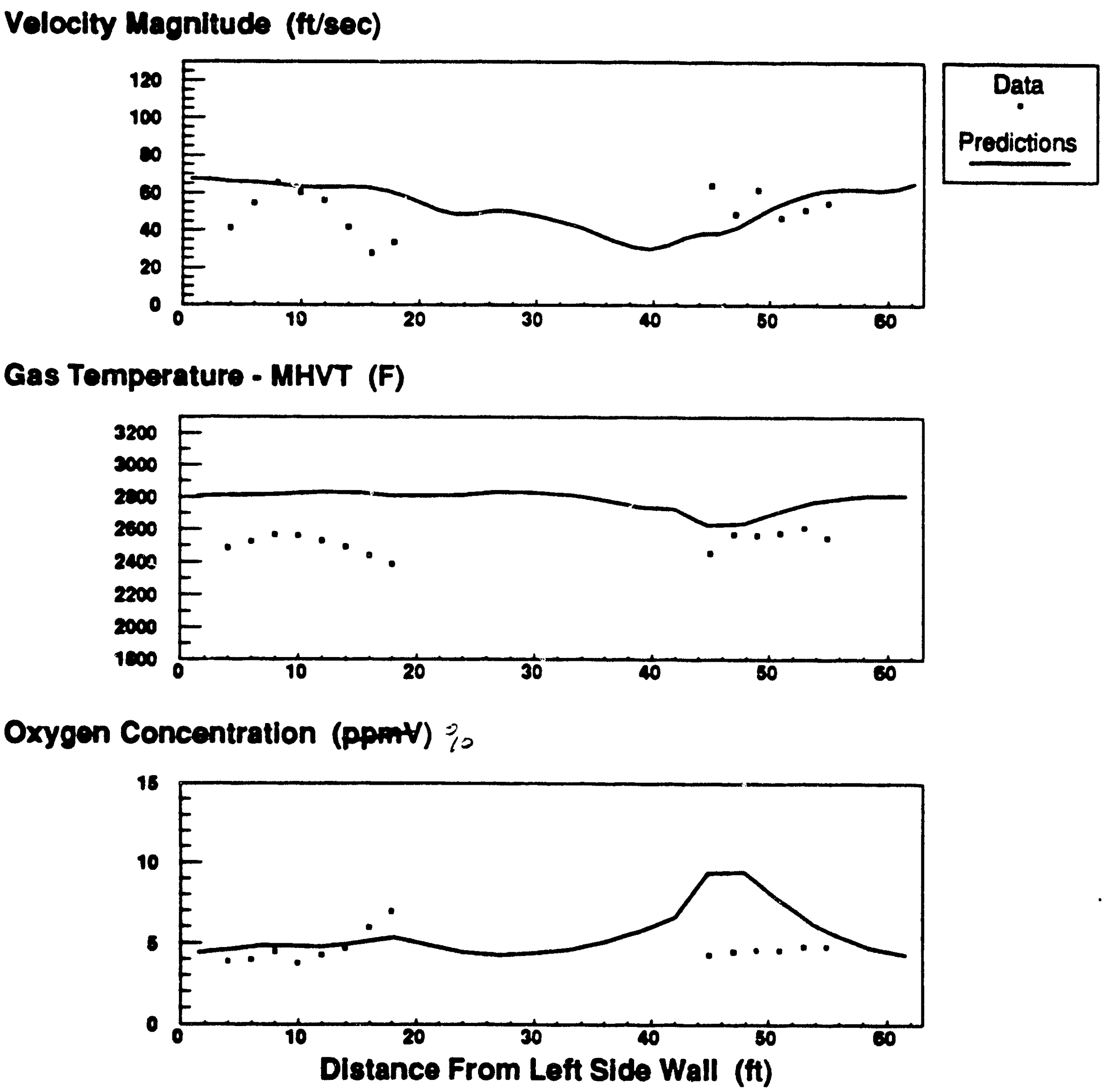
View Looking Into Secondary Superheater



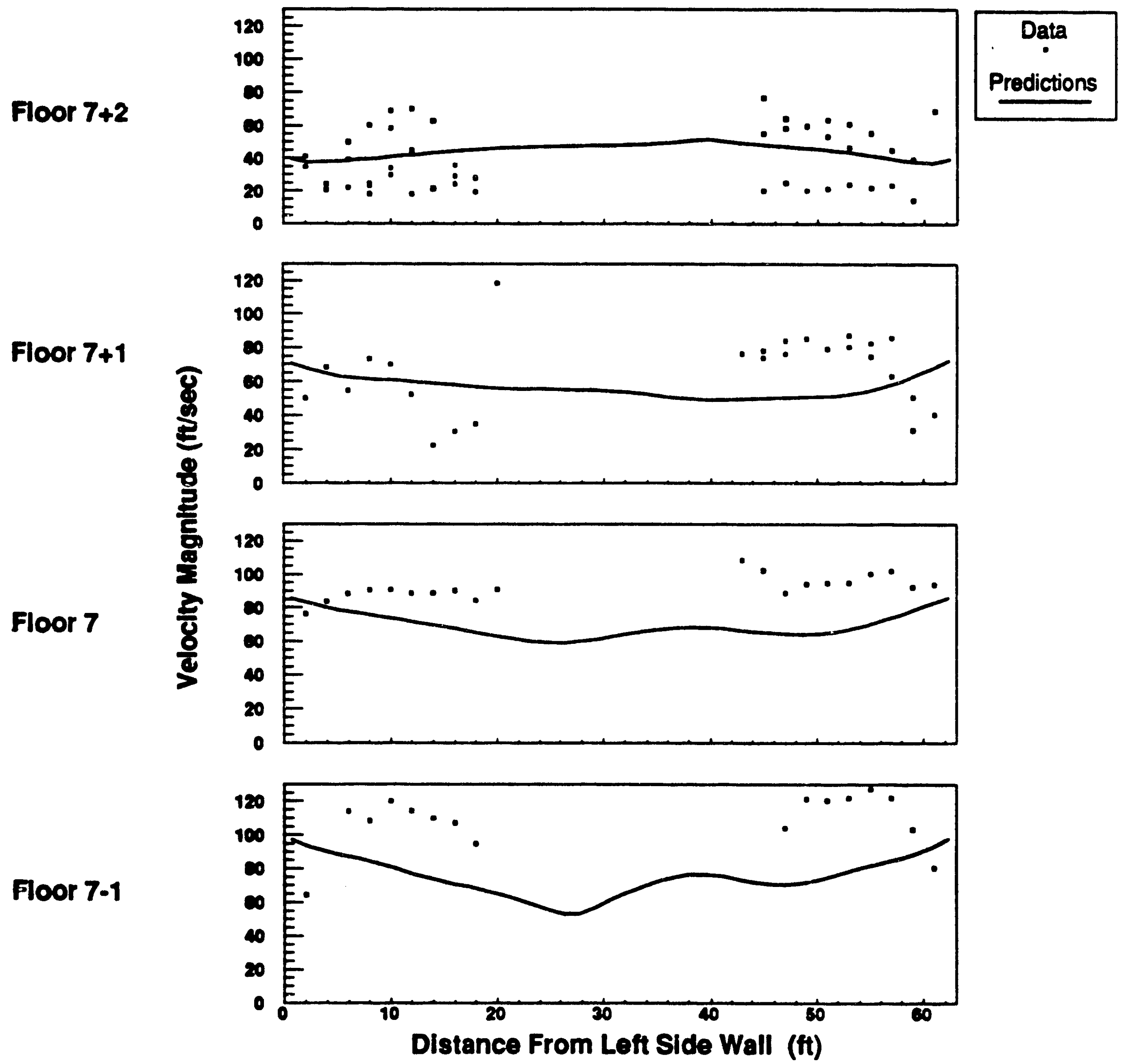
Velocity Magnitudes, Gas Temperature and Oxygen Concentration 40 ft. Above the Burners for Full Load



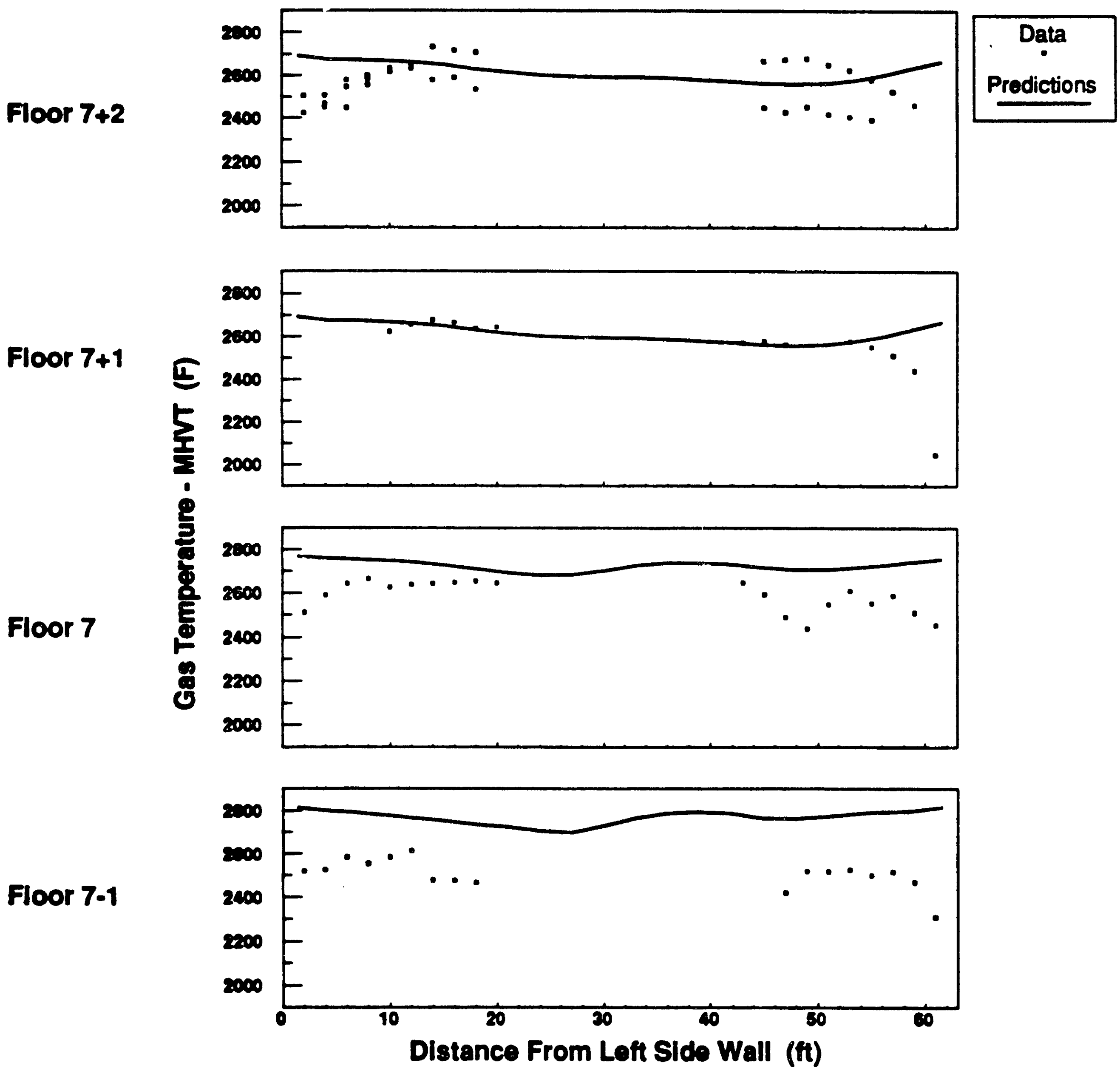
Velocity Magnitudes, Gas Temperature and Oxygen Concentration 40 ft. Above the Burners for Intermediate Load



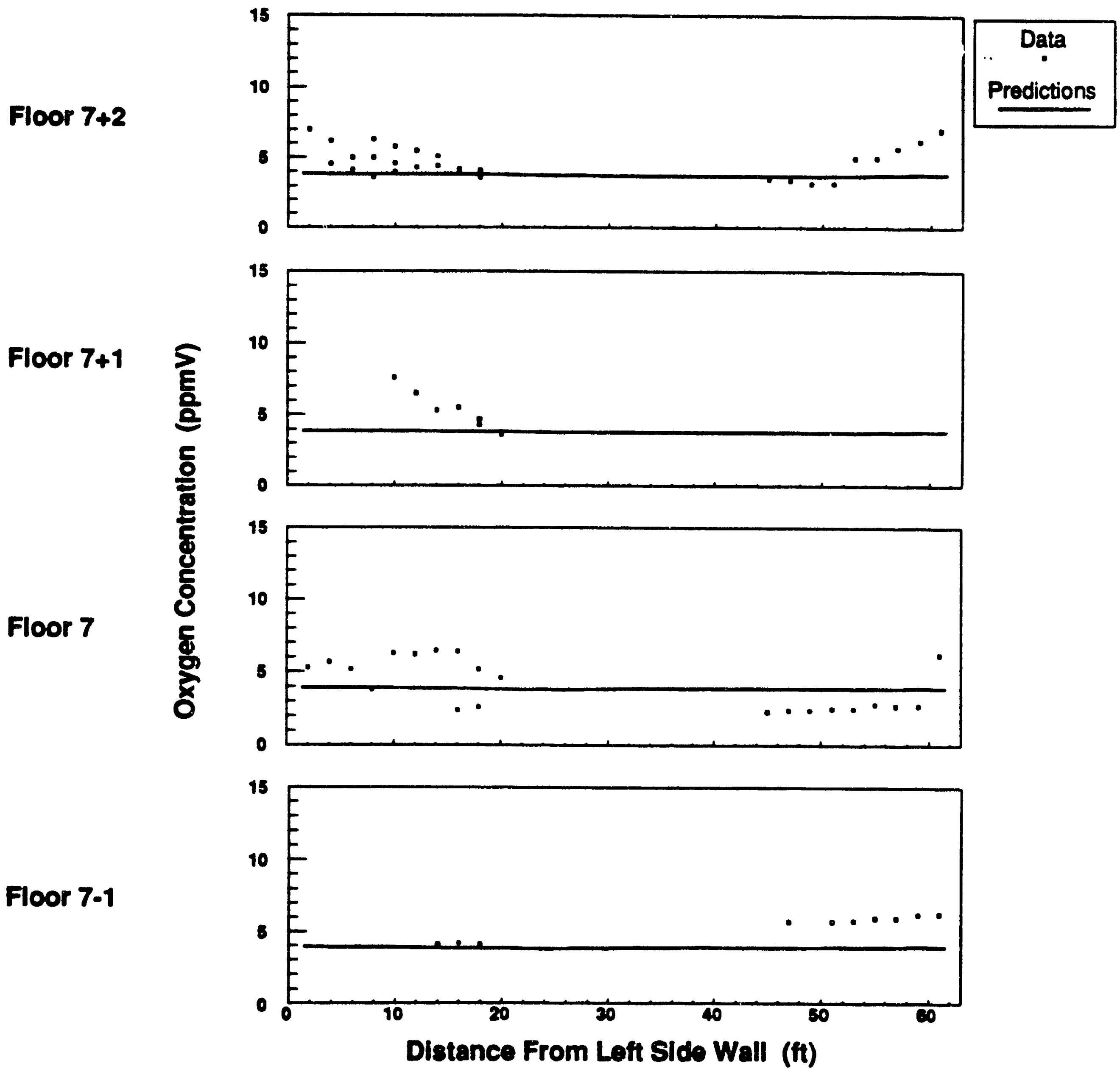
Velocity Magnitudes at the Furnace Exit Plane for Full Load



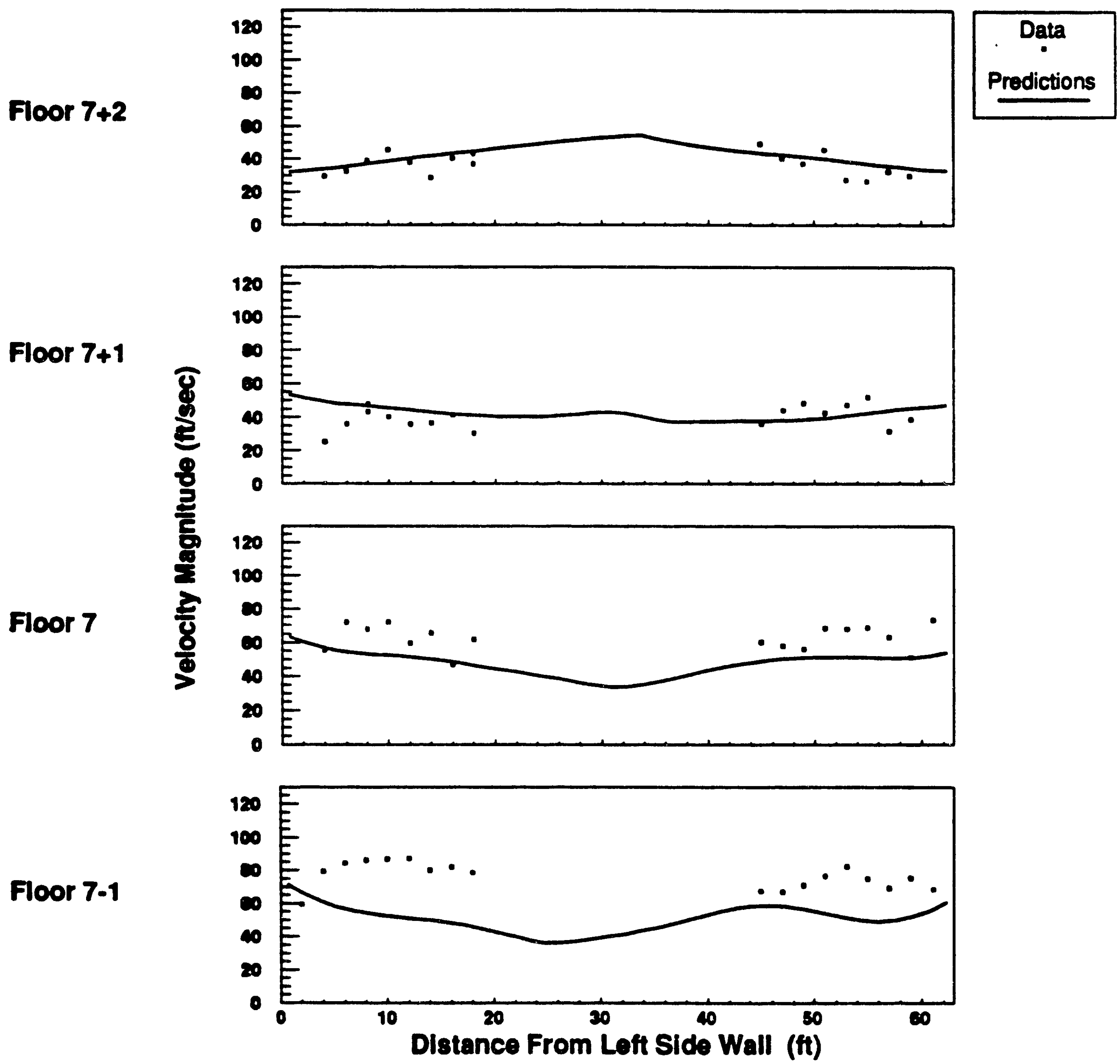
Furnace Exit Gas Temperatures for Full Load



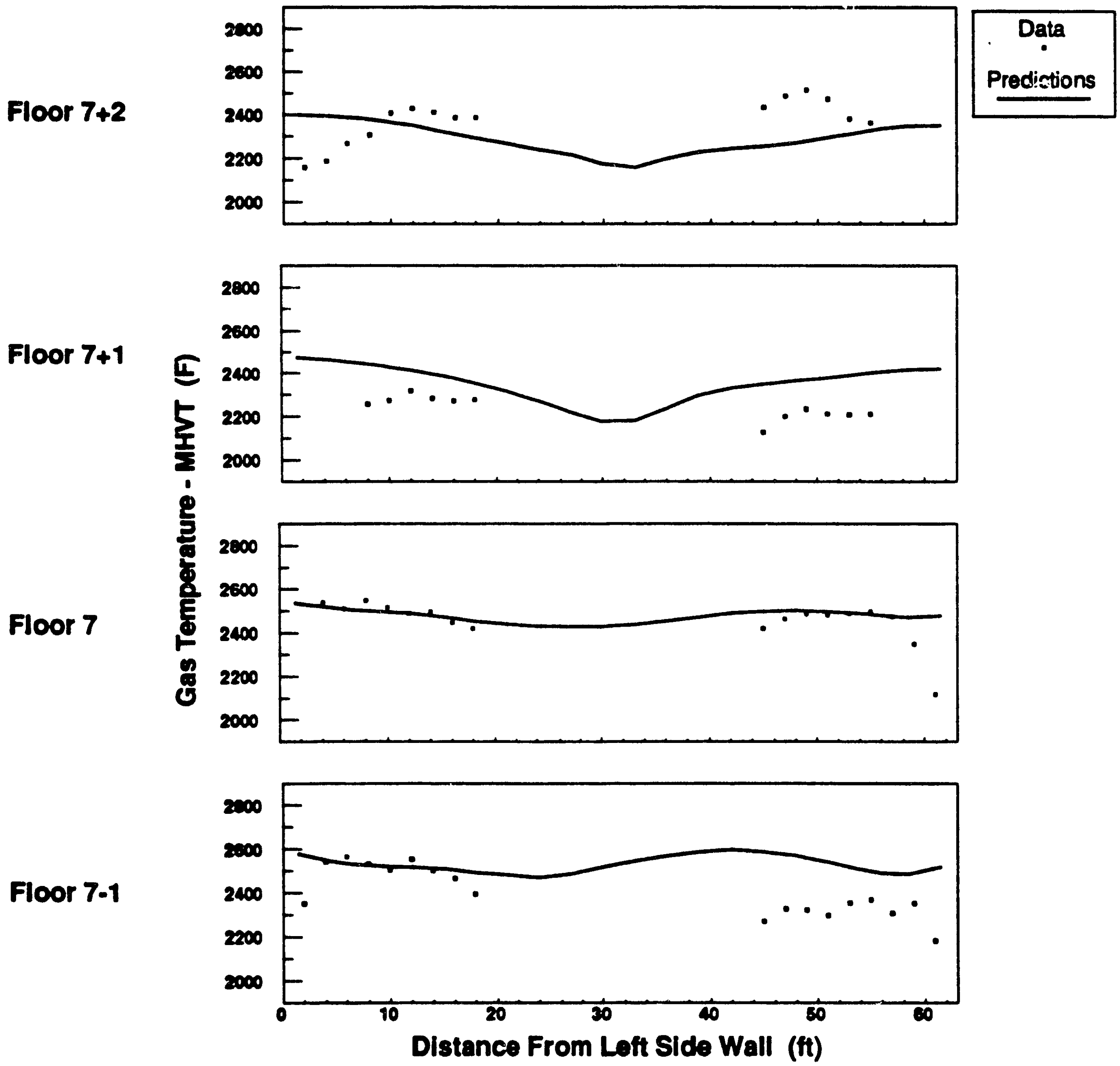
Oxygen Concentration at the Furnace Exit for Full Load



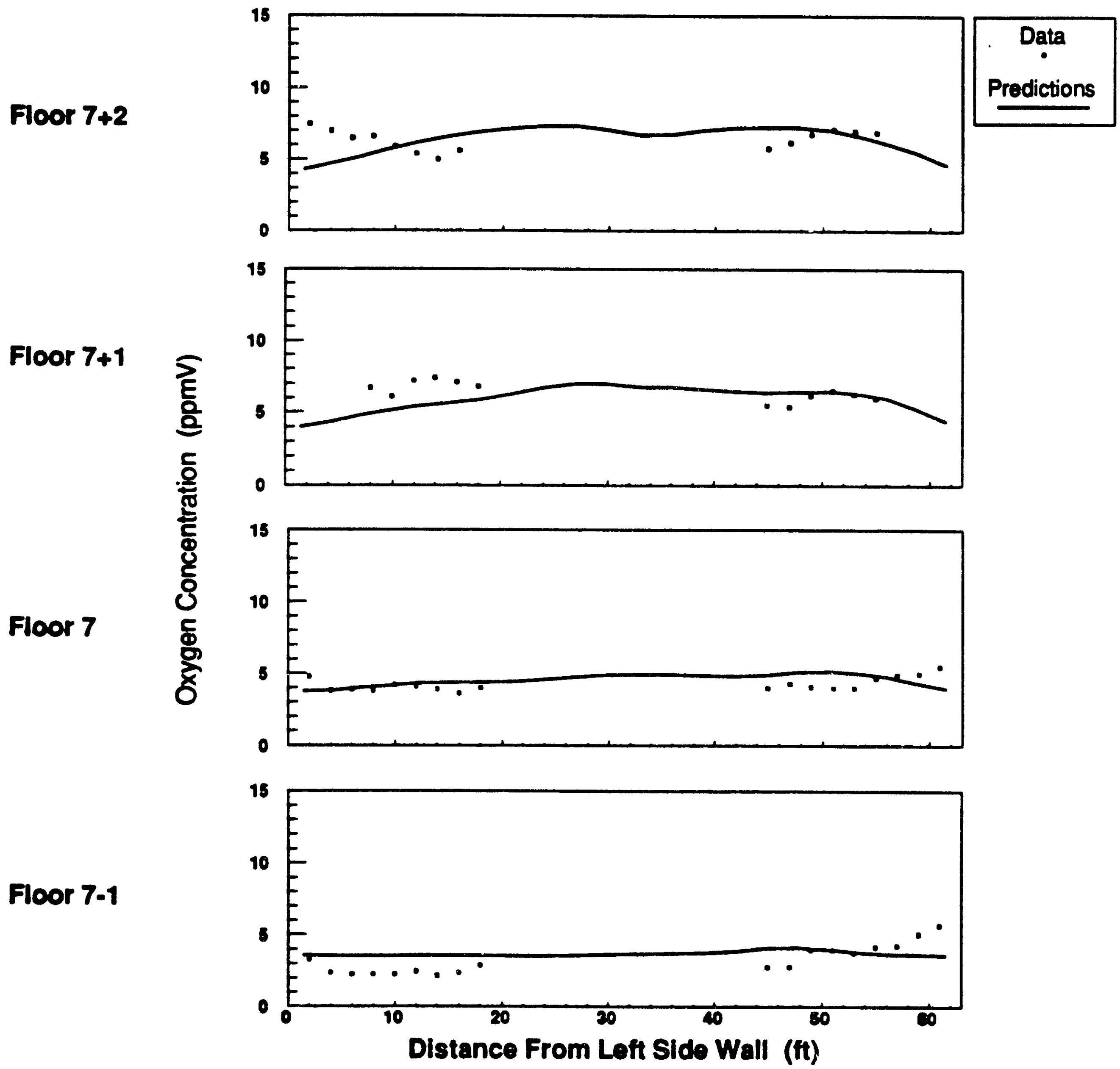
Velocity Magnitudes at the Furnace Exit Plane for Intermediate Load



Furnace Exit Gas Temperatures for Intermediate Load



Oxygen Concentration at the Furnace Exit for Intermediate Load



Parametric Variations at the Furnace Exit

	Velocity Magnitude (ft/sec)	Temperature (F)	Oxygen Concentration (%)	Carbon Monoxide Concentration (ppmV)
Full Load				
Data	20 → 120	2500 → 2700	~Uniform	Too sparse
Predictions	40 → 95	2650 → 2800	~Uniform	
Intermediate Load				
Data	30 → 85	2400 → 2500	Nonuniform	50 → 80
Predictions	30 → 70	2300 → 2550	Nonuniform	2 → 30

APPENDIX B

PRE-RETROFIT BASELINE TEST MATRIX - BURNER/BOILER CHARACTERIZATION TESTS ACCOMPLISHED
MARCH 5,1991

								ACUREX SAMPLING				B&W SAMPLING		B&W PROBING			B&W SAMPLING				
								ECON OUT	STK	AH OUT	ECON OUT	ECON OUT	AH OUT	LWR	MID	UPPER	UNBURNED CARBON			COAL	FEEDER
DAY, DATE, TEST-TIME	TEST	TEST OBJECTIVE	LOAD +	LOAD MW	ECON OUT +	ECON OUT O2 pct.	PULVS OUT OF SERV.	+ A B C D	A	Insitu + D	PT-BY-PT + E F R S T	GRID + E F R S T	GRID + E F R S	FURN + U F R	FURNACE + V F R W	FURNACE + V F R W	BOILER BOTTOM (GRAB)	ECON. HOPPER (GRAB)	PRECIP HOPPER (GRAB)	(PROX. & ULT)	(SLAG/ FOUL)
MON OCT 22 07:40-20:46	1	Effect of O2	H	605	N	3.53	NONE	(+UBC) X X X	X		X X X X	X X X X	X X X X			X X X X	X	X	(+LOI) X	X	X
TUE OCT 23 10:28-17:59	2	Effect of O2	H	606	H	4.16	NONE	X		X	X X X X	X X X X	X X X X		X X X X	X X X X	X	X	X	X	X
WED OCT 24 10:43-14:13	1C	Effect of O2	H	602	N	3.89	NONE	X X X X	X	X	X X X X X	X X X X	X X X X		X X X X	X X X X					
15:42-18:34	1C	Effect of O2	H	607	N	3.38	NONE	X X X X	X	X	X X X X X	X X X X	X X X X		X X X X	X X X X				X	X
THU OCT 25 21:45-23:06	7	Repeat Test 1	H	604	N	4.54	NONE			X	SINGLE PT X X X X X	X X X X	X X X X				X		X	X	X
FRI OCT 26 01:36-07:01	3	Effect of O2	I	458	N	5.35	-A	X X X X	X	X	X X X X X	X X X X	X X X X		X X X X	X X X X				X	X
SAT OCT 27 00:44-04:09	5	Effect of O2	I	462	H	5.20	-A	X X X X	X	X	X X X X X	X X X X	X X X X		X X X X		X		X	X	
MON OCT 29 11:43-18:09	8	VARY BOOS	H	602	N	3.85	-A	X X X	X		X X X X X	X X X X	X X X X				X	X	X	X	
TUE OCT 30 08:59-14:37	10	E-mill brg. Failure VARY BOOS	H	605	N	4.05	-E	X			X X X X X	X X X X X	X X X X				X	X	X	X	
WED OCT 31 08:32-12:16	6A	Effect of O2	H	603	L	3.23	NONE	X			X X X X X	X X X X X	X X X X								
14:15-15:38	6B	Effect of O2	H	602	L	3.18	NONE	X			X X X X X	X X X X X	X X X X				X	X	X	X	

+ H=High, I=Intermediate, L=Low, N=Normal, A=Particulate Matter, B=Loss of Ignition, C=Size, D=Resistivity, E=NOx, F=O2, R=CO2, T=THC, U=H2S, V=Temperature, W=Velocity

TABLE II PRE-RETROFIT BASELINE TEST MATRIX - BURNER/BOILER CHARACTERIZATION TESTS ACCOMPLISHED (CONTINUED)
MARCH 5, 1991

								ACUREX SAMPLING				B&W SAMPLING		B&W PROBING			B&W SAMPLING				
								ECON OUT	STK	AH OUT	ECON OUT	ECON OUT	AH OUT	LWR	MID	UPPER	UNBURNED CARBON			COAL	FEEDER
DAY, DATE, TEST-TIME	TEST	TEST OBJECTIVE	LOAD +	LOAD MW	ECON OUT +	ECON OUT O2 pct.	PULVS OUT OF SERV.	+ A B C D	A	Insitu + D	PT-BY-PT + E F R S T	GRID + E F R S T	GRID + E F R S	FURN + U F R	FURNACE + V F R W	FURNACE + V F R W	BOILER BOTTOM (GRAB)	ECON. HOPPER (GRAB)	PRECIP HOPPER (GRAB)	(PROX. & ULT)	(SLAG/ FOUL)
THU-FRI NOV 1-2 22:31-02:26	11	VARY BOOS	H	604	N	4.36	-F				X X X X	X X X X	X X X X	X X X			X	X	X	X	
FRI-SAT NOV 2-3 22:12-00:43	16	Effect of O2 (REPEAT TEST 3	I	464	N	4.76	-A	X			X X X X	X X X X	X X X X	X X X			X	X	X	X	
SAT NOV 3 01:15-03:16	17	Effect of O2	I	463	L	4.08	-A				X X X X	X X X X	X X X X				X	X	X	X	
SAT-SUN NOV 3-4 21:02-00:30	14	Effect of O2	L	345	N	6.25	-A,-F				X X X X	X X X X	X X X X				X	X	X	X	
SUN NOV 4 00:52-01:57	15	Effect of O2	L	346	H	6.80	-A,-F				X X X X	X X X X	X X X X				X	X	X	X	
MON NOV 5 10:13-15:49	1R1	(LOI STRATIF.) REPEAT TEST 1	H	606	N	3.44	NONE	(+UBC) X			X X X X	X X X X	X X X X	X			X	X	(+LOI) X	X	
TUE NOV 6 09:41-14:58	1R2	(LOI STRATIF.) REPEAT TEST 1	H	605	N	3.45	NONE	X			SINGLE PT X X X X	X X X X	X X X X	X X X			X	X	X	X	
WED NOV 7 09:15-10:32	12	VARY BOOS	H	603	N	4.26	-B				X X X X	X X X X X	X X X X								
11:13-13:53	13	C-BURN.PIPE LK VARY BOOS	H	600	N	4.20	-C				X X X X	X X X X X	X X X X				X	X	X	X	
THUR NOV 8 08:18-09:00	12	VARY BOOS	H	604	N	4.16	-B				X X X X	X X X X X	X X X X								
11:13-12:40	12	(C-FEEDER LEAK) VARY BOOS	H	604	N	4.08	-B				X X X X	X X X X X	X X X X				X	X	X	X	
12:54-18:15	9	VARY BOOS	H	604	N	3.86	-D				X X X X	X X X X X	X X X X				X	X	X	X	

+ H=High, I=Intermediate, L=Low, N=Normal, A=Particulate Matter, B=Loss of Ignition, C=Size, D=Resistivity, E=NOx, F=O2, R=CO2, T=THC, U=H2S, V=Temperature, W=Velocity

Clean Coal Technology III Project
Full Scale Demonstration of Low NOx Cell Burner
Baseline Testing

Data Acquisition

Performance Monitoring

Gas Sampling Grids

Boiler Gas Outlet - used a 40 point sampling grid in each gas outlet flue to measure O_2, CO_2, CO and Temperature.

Airheater Gas Outlet - used a 36 point sampling grid in each gas outlet flue to measure O_2, CO_2, CO, NOx and temperature.

Sampling Technique - asperate samples from probes through averaging bubblers and ice bath conditioners.

Sensors -

O_2 - Beckman 755 Thermomagnetic Analyzer

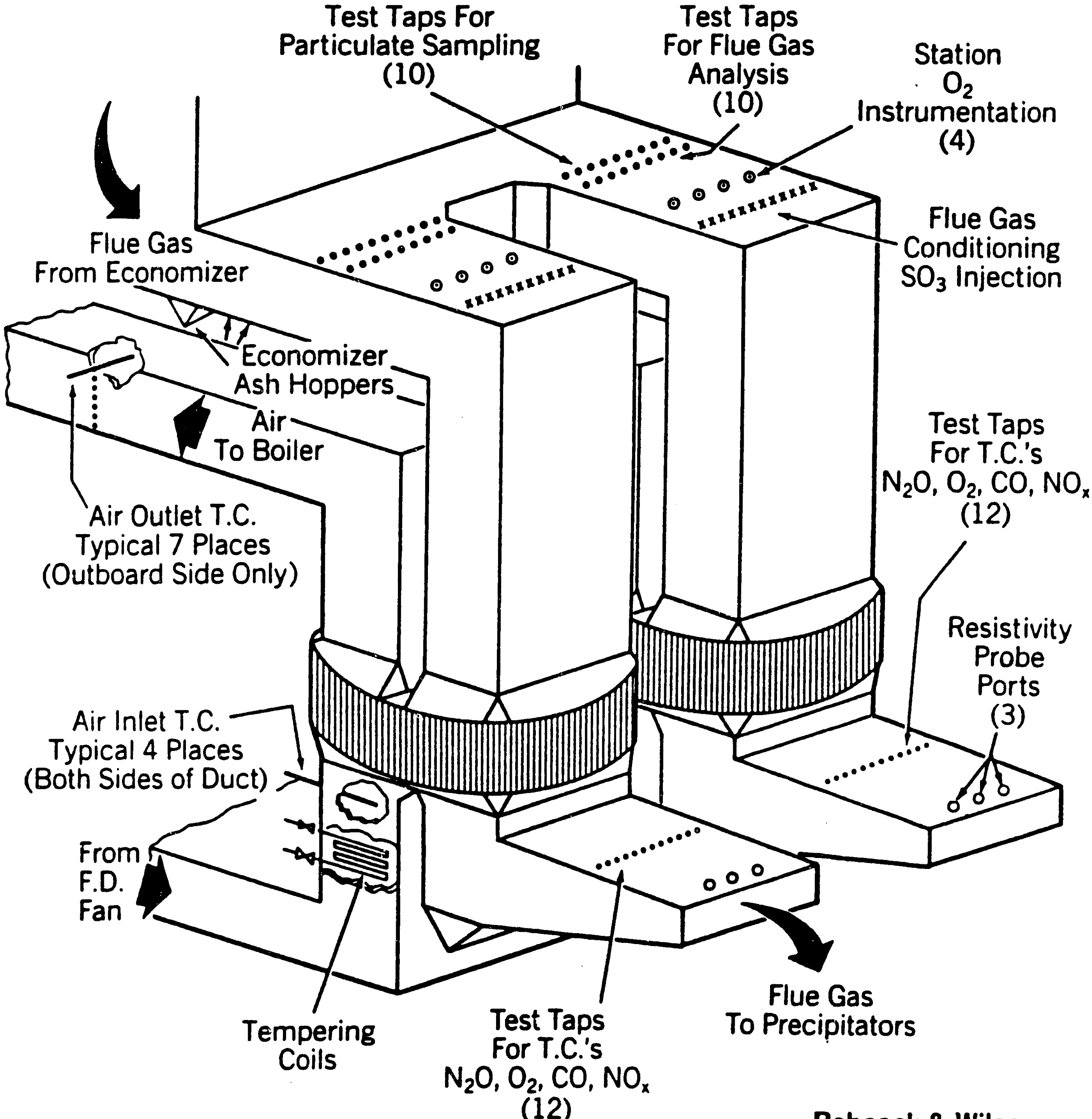
CO_2 - Beckman 864/865 Non-dispersive IR Analyzer

CO - Same as CO_2

NOx - Thermo Electron Chemiluminescence

Temperature - Type K Thermocouples

Emissions Test Port Locations on Stuart Unit #4



Babcock & Wilcox
a McDermott company
September 1990

Clean Coal Technology III Project
Full Scale Demonstration of Low NOx Cell Burner
Baseline Testing

Data Acquisition

Performance Monitoring

Data Acquisition Computer

HP - 9000 / 216 Computer -

Interfaced to plant computer instrumentation.

Scanned on 1 minute intervals

Recorded pressures, temperatures, flows, electrical power, flue gas O_2s

Interfaced to HP-3497 multiplexing DVM.

Scanned on 5 minute intervals

Recorded pressures, temperatures, flows, flue gas O_2s, COs, CO_2s.

Engineering unit conversions, range checking

Archival Storage

Send input to Performance System Computer

Clean Coal Technology III Project
Full Scale Demonstration of Low NOx Cell Burner
Baseline Testing

Data Acquisition

Performance Monitoring

Fuel - Ash Sampling

<u>Barge Coal Samples</u>

Each barge of coal used for test

<u>Coal Feeder Samples</u>

Each feeder in-service for each test

Samples composited for each test

<u>Bottom Ash</u>

Samples collected during each test

<u>Economizer Ash</u>

Samples collected during each test

<u>Precipitator Ash</u>

Samples collected during each test

Clean Coal Technology III Project
Full Scale Demonstration of Low NOx Cell Burner
Baseline Testing

Data Acquisition

Gaseous Emissions & Particulate Sampling

Boiler Gas Outlet

<u>EPA Method 17</u>

Particulates emissions

<u>Continuous Emissions Monitoring</u>

Used B&W Test Grids

Sampled point - by - point, and 4 point composite

Measured, NO, NO_2, CO, CO_2, O_2, and

Total Hydro Carbons

Boiler Gas Outlet

<u>EPA Method 5</u>

Particulates emissions

Table 3-1. Continuous monitoring equipment in the Acurex mobile laboratory

Instrument	Principle of Operation	Manufacturer	Instrument Model	Range
NO NO_x	Chemiluminescence	Thermo Electron	10 AR	0 to 100 ppm 0 to 500 ppm 0 to 1,000 ppm 0 to 5,000 ppm
CO	Nondispersive infrared (NDIR)	ANARAD	500R	0 to 1,000 ppm
CO_2	Nondispersive infrared (NDIR)	ANARAD	AR500	0 to 20 percent
O_2	Fuel cell	Teledyne		0 to 5 percent 0 to 25 percent
Total hydrocarbon	Flame ionization detector (FID)	Beckman	400	0 to 1 ppm 0 to 10 ppm 0 to 100 ppm 0 to 1,000 ppm 0 to 10,000 ppm 0 to 1 percent 0 to 2 percent
Sample gas conditioner	Refrigerant dryer-condenser	Hankinson	E-4G-SS	10 scfm
Strip chart recorder	Dual-pen analog	Linear	400	0 to 10 mV 0 to 100 mV 0 to 1 V 0 to 10 V
Data logger	Electronic	Autodata/Acurex	10	99 channels programmable

Clean Coal Technology III Project

Full Scale Demonstration of Low NOx Cell Burner
Baseline Testing

Data Acquisition

Experimental Techniques

Furnace Probing

Lower Furnace (Burner Zone)

- Gas Temperature
- H_2S

Furnace Exit Plane

- Gas Temperature
- O_2, CO, CO_2
- Velocity

In-Situ Ash Resistivity

Airheater Inlet

- Before SO_3 injection ports

Airheater Outlet

Table I - Ultimate Fuel Analysis

Sample ID	Higher Heating Value Btu/lb	C % wt.	H_2 % wt.	S % wt.	O_2 % wt.	N_2 % wt.	H_2O % wt.	Ash % wt.	Theoretical Air #/ 10k BTU
01CM1022902100	12041.0	67.42	4.63	.95	7.57	1.22	4.55	13.66	7.510
02CM1023901800	11957.0	66.99	4.54	.90	7.25	1.41	5.02	13.89	7.505
01CM1024902030	11760.0	65.83	4.40	1.07	7.61	1.15	6.31	13.63	7.469
01CM1025902400	11982.0	66.60	4.53	1.10	7.37	1.31	5.61	13.48	7.452
03CM1026900740	11839.0	65.95	4.48	1.12	7.91	1.16	5.39	13.99	7.445
05CM1027900410	11888.0	66.61	4.47	1.14	7.32	1.15	5.47	13.84	7.498
08CM1029901800	11560.0	64.87	4.41	1.17	7.32	1.25	5.78	15.20	7.520
10CM1030901530	11730.0	65.46	4.42	.96	7.12	1.23	5.72	15.09	7.472
06CM1031901530	12060.0	67.56	4.57	1.02	7.30	1.28	5.05	13.22	7.507
11CM1102900230	11770.0	65.75	4.39	1.15	7.66	1.11	5.81	14.13	7.453
16CM1103900100	11764.0	65.75	4.49	1.08	7.62	1.01	4.92	15.13	7.485
17CM1103900230	11618.0	64.66	4.49	1.01	8.03	1.17	6.04	14.60	7.453
14CM1103902300	11894.0	66.39	4.55	1.03	7.77	1.29	4.71	14.26	7.475
15CM1104900100	11908.0	66.15	4.55	1.44	7.57	1.24	4.77	14.28	7.466
01CM1105901600	11786.0	64.93	4.57	1.11	8.05	1.11	4.87	15.36	7.399
01CM1106901430	11849.0	66.29	4.64	1.05	7.46	1.31	5.07	14.18	7.532
13CM1107901630	11898.0	65.83	4.58	1.07	8.07	1.21	4.45	14.79	7.418
12CM1108901300	11966.0	66.59	4.60	1.02	7.68	1.41	4.81	13.89	7.467
09CM1108901730	12366.0	68.54	4.71	1.15	8.20	1.03	4.57	11.80	7.424

Table III - Unburned Carbon

Test ID	Carbon in Refuse by B&W			Carbon in Flue Dust by Acurex
	Bottom Ash	Econ Hopper	Precip Hopper	
	% wt	% wt	% wt	% wt
1	1.72	3.37	2.53	1.31
1CA	7.63		1.50	0.77
1CB	7.63		1.50	
7				
1R1	1.74	7.13	1.81	1.14
1R2	0.99	4.77	1.14	0.86
2	4.21	4.97	2.49	1.46
6 A	4.67	7.22	1.85	
6 B	4.67	7.22	1.85	
8	4.42	7.34	1.82	
12A	2.40	5.99		
12B	1.06	5.39	1.56	
12C	1.06	5.39	1.56	
13	2.04	3.56	2.17	
9	1.87	11.57	3.02	
10	2.22	5.98	1.64	1.19
11	4.10	5.40	1.94	
3				1.20
16	4.58	11.80	1.86	
5	10.40		1.91	1.09
17	5.58	13.54	0.98	
14	7.12	14.11	1.27	
15	7.34	22.69	0.82	

Table II - Efficiency

Test ID	Efficiency as Tested	Efficiency Corrected to Base	Output	Excess Air
	%	%	10^6 BTU / hr	%
1	89.47	89.37	4822.8	19.8
1CA	89.48	89.39	4833.1	22.3
1CB	89.71	89.42	4822.1	18.7
7	89.67	89.66	4884.6	27.0
1R1	89.50	89.28	4849.9	19.1
1R2	89.49	89.34	4846.4	19.2
2	89.37	89.43	4821.6	24.1
6 A	89.79	89.56	4818.4	17.7
6 B	89.86	89.43	4827.5	17.4
8	89.66	89.51	4795.6	22.0
12A	89.68	89.55	4813.7	24.9
12B	89.89	89.77	4806.0	24.2
12C	89.96	89.75	4803.4	23.5
13	89.72	89.50	4853.7	24.4
9	90.08	89.72	4822.7	22.0
10	89.90	89.72	4817.5	23.3
11	89.80	89.67	4816.3	25.6
3	89.79	89.95	3731.1	33.4
16	89.76	89.93	3730.3	28.6
5	89.71	89.88	3747.7	32.2
17	89.67	89.87	3730.4	23.6
14	90.12	90.44	2867.9	41.5
15	90.23	90.51	2875.9	46.9

Table IV - NOx Emissions

Test ID	Flue Gas Leaving Economizer				Flue Gas Leaving SAH		NOx Concentration (ppm)				NOx Emissions	
	Acurex		B&W		B&W		Acurex		B&W		Acurex	B&W
	Excess O_2 %	Excess Air %	Excess O_2 %	Excess Air %	Excess O_2 %	Excess Air %	Meas. Leaving Econ	Corr. to 3% O_2	Meas. Leaving SAH	Corr. to 3% O_2	Lbs per 10^6 Btu	Lbs per 10^6 Btu
1	3.330	18.3	3.534	19.7	4.855	29.3	863.0	879.2	769.1	858.0	1.201	1.172
1CA	3.495	19.4	3.891	22.2	5.277	32.8	869.0	893.7	752.2	861.9	1.219	1.176
1CB	3.495	19.4	3.375	18.7	4.648	27.7	869.0	893.7	765.6	843.3	1.219	1.151
7	3.700	20.8	4.542	26.9	4.643	27.7	898.0	934.5	806.7	888.3	1.269	1.207
1R1	3.670	20.6	3.441	19.1	4.739	28.4	806.0	837.3	731.4	810.1	1.128	1.091
1R2	4.255	24.7	3.452	19.2	4.839	29.2	889.0	956.0	752.9	839.1	1.310	1.160
2	4.190	24.3	4.157	24.1	5.490	34.5	863.0	924.5	780.0	906.1	1.263	1.238
6 A	3.080	16.7	3.225	17.7	4.614	27.5	821.5	825.2	723.0	794.6	1.128	1.086
6 B	3.074	16.7	3.178	17.4	4.734	28.4	0.0	0.0	713.1	789.6	0.000	1.079
8	3.895	22.2	3.854	21.9	5.373	33.5	752.0	791.6	623.1	718.3	1.086	.985
12A	4.930	29.9	4.259	24.8	5.712	36.4	781.0	875.4	691.7	815.2	1.190	1.108
12B	3.820	21.7	4.161	24.1	5.156	31.7	882.0	924.3	599.0	681.1	1.256	.926
12C	3.820	21.7	4.077	23.5	5.154	31.7	882.0	924.3	649.3	738.1	1.256	1.003
13	4.450	26.2	4.196	24.3	5.674	36.1	842.0	916.2	787.6	925.9	1.236	1.249
9	3.975	22.7	3.860	21.9	5.142	31.6	895.0	946.6	722.3	820.5	1.278	1.108
10	3.900	22.2	4.046	23.3	5.436	34.1	784.0	825.5	681.4	788.7	1.125	1.075
11	4.340	25.4	4.355	25.5	5.565	35.2	722.0	780.4	610.2	712.3	1.062	.969
3	4.765	28.6	5.348	33.3	6.034	39.3	621.5	689.5	554.5	667.6	.936	.906
16	4.380	25.7	4.757	28.6	6.002	39.0	644.0	697.8	561.0	674.1	.951	.919
5	4.850	29.2	5.201	32.1	6.435	43.1	645.0	719.3	588.6	728.4	.983	.995
17	4.710	28.2	4.081	23.5	5.622	35.7	656.0	725.3	542.3	635.4	.987	.864
14	6.670	45.4	6.249	41.3	7.269	51.7	498.0	626.4	377.3	495.4	.852	.674
15	7.600	55.3	6.803	46.7	7.852	58.3	542.0	729.5	392.0	537.8	.991	.731

Low NOx Cell Burner Project

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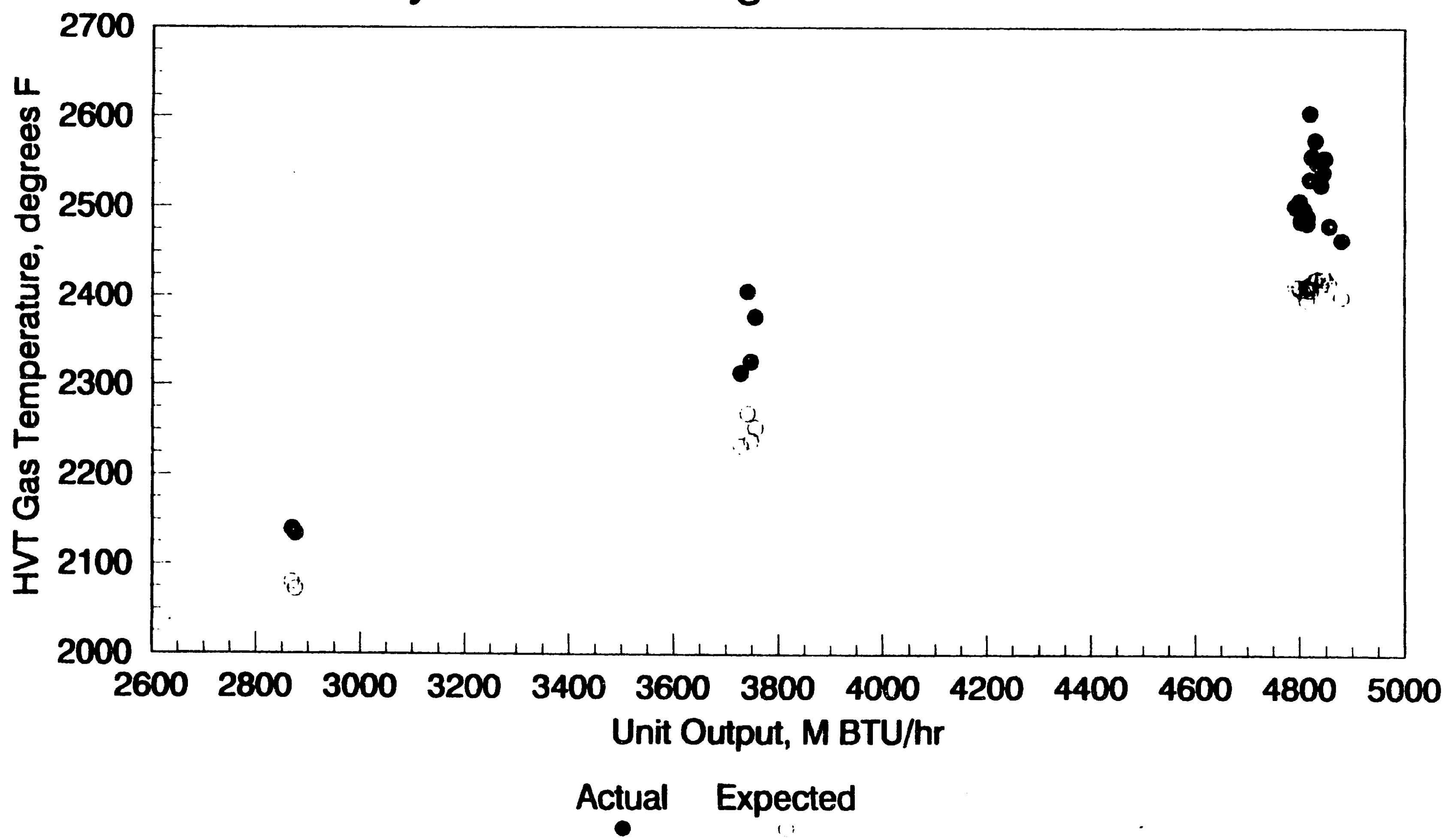

Baseline Test Data
Oct / Nov 1990

Low NOx Cell Burner Project

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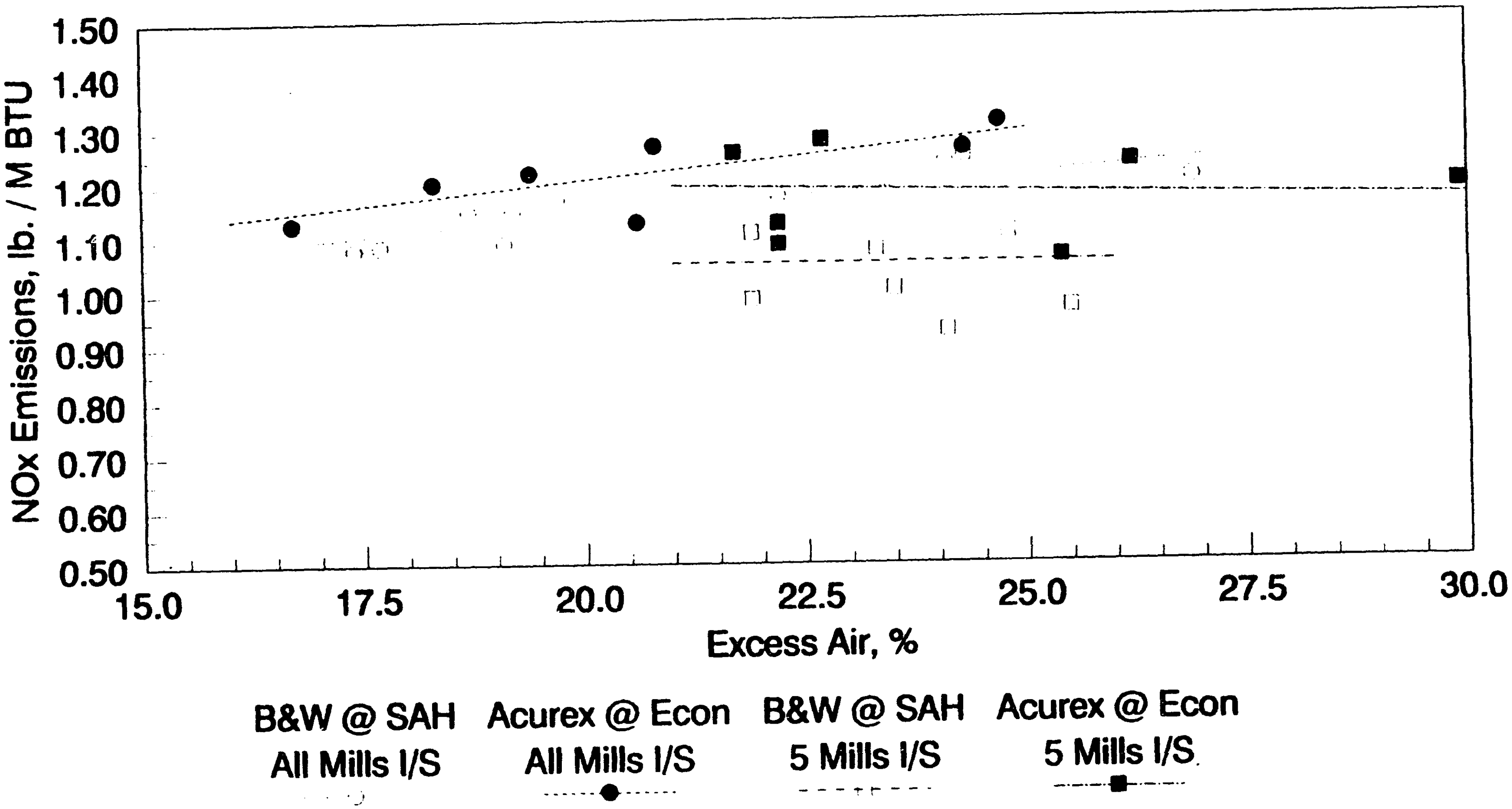
Full Load Tests



Baseline Test Data
Oct / Nov 1990

Low NOx Cell Burner Project

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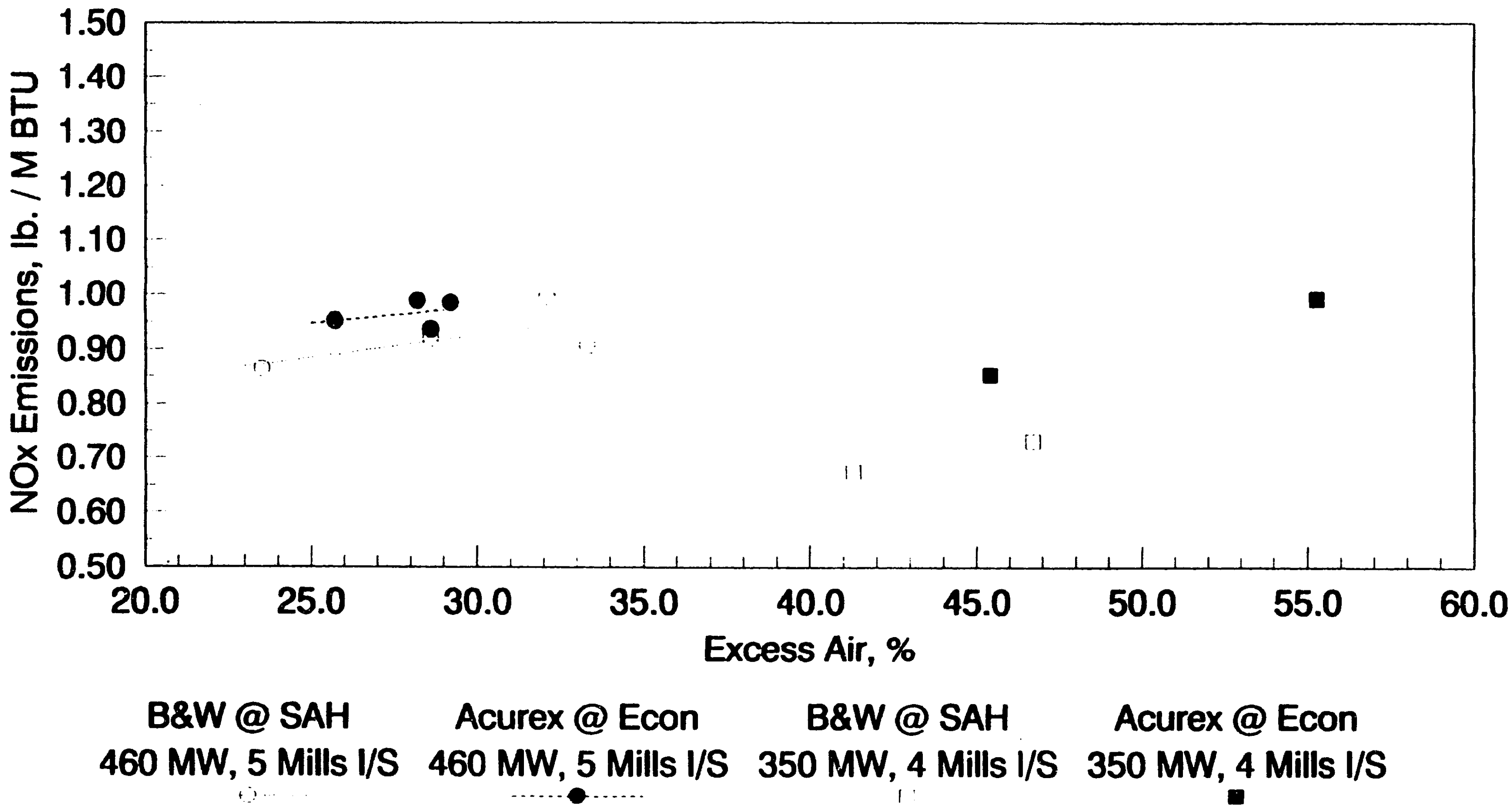
Partial Load Tests



Baseline Test Data
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Low NOx Cell Burner Project

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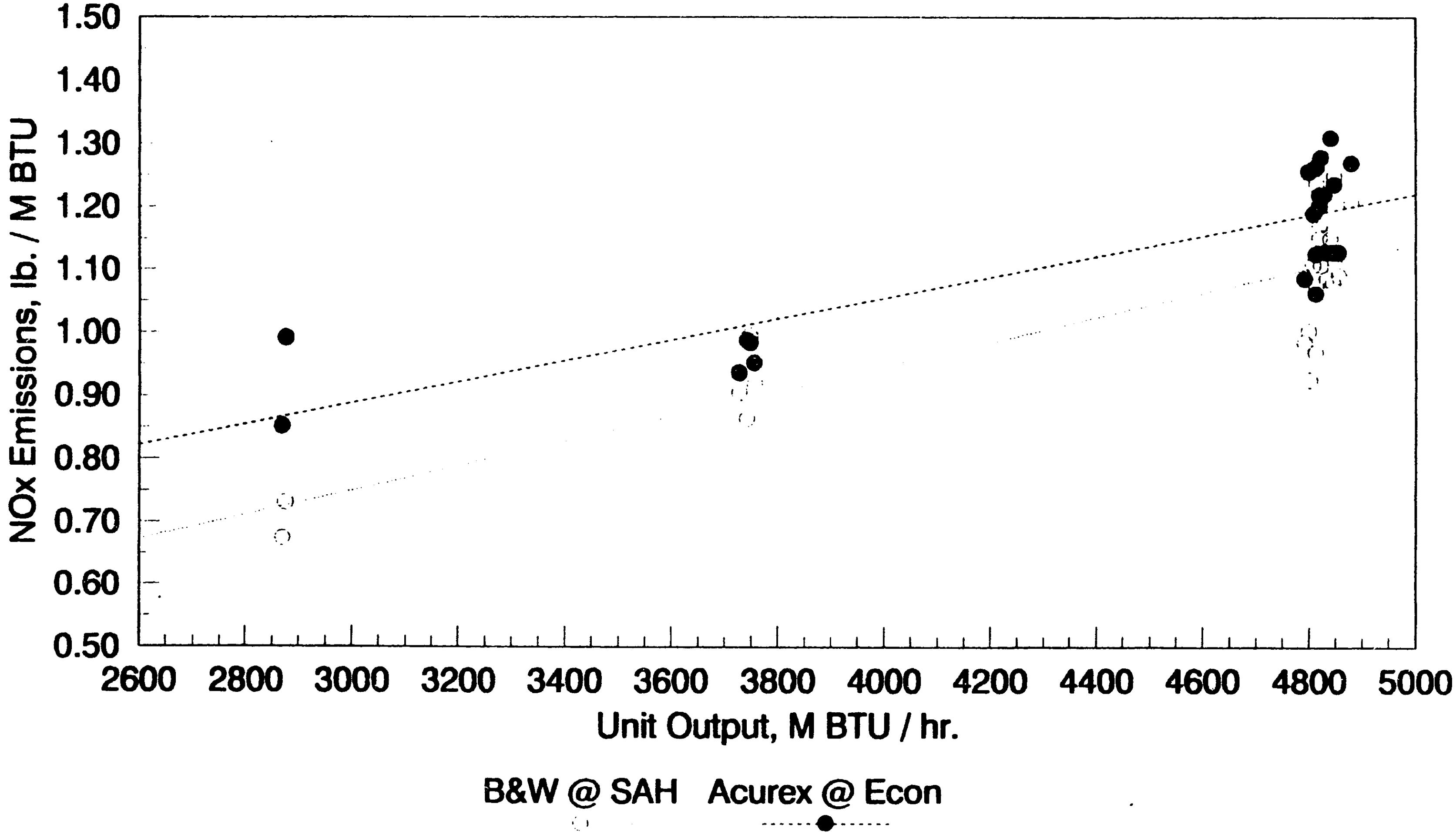


Baseline Test Data
Oct / Nov 1990

TABLE 1. EMISSION AND COLLECTION EFFICIENCY DATA

		EMISSIONS				
		--ECONOMIZER OUTLET--				
TEST	DATE	LEFT (lb/hr)	RIGHT (lb/hr)	TOTAL (lb/hr)	STACK (lb/hr)	ESP COLLECTION EFFICIENCY (%)
TEST #1	10/22/90	36826	64012	100838	441.0	99.56%
TEST #1	10/24/90	24599	35808	60407	346.5	99.43%
TEST #3	10/26/90	18603	20382	38985	332.9	99.15%
TEST #5	10/27/90	14445	22394	36839	69.5	99.81%
TEST #6	10/31/90	38929	40442	79371	NM	
TEST #8	10/29/90	27940	28700	56640	288.5	99.49%

NM - Not Measured

TABLE 2. PARTICULATE SUMMARY, ECONOMIZER OUTLET

TEST	DATE	GAS FLOWRATE LEFT (acfm)	GAS FLOWRATE RIGHT (acfm)	GAS FLOWRATE LEFT (dcfm)	GAS FLOWRATE RIGHT (dcfm)	PARTICULATE DATA SUMMARY: PARTICULATE LOADING LEFT (gr/dscf)	PARTICULATE LOADING RIGHT (gr/dscf)	F FACTOR (dscf/mBtu)	PARTICULATE EMISSIONS LEFT ** (lb/mBtu)	PARTICULATE EMISSIONS RIGHT ** (lb/mBtu)
TEST #1	10/22/90	1,492,580	1,602,874	686,720	736,829	7.1820	10.137	10,314	12.52	17.67
TEST #1	10/24/90	1,509,172	1,697,733	695,223	784,231	4.1288	4.6564	10,290	7.220	8.290
TEST #3	10/26/90	1,414,657	1,546,413	650,733	711,109	4.0333	3.3445	10,274	7.579	6.439
TEST #5	10/27/90	1,446,576	1,544,487	665,838	710,622	3.0232	3.6772	10,293	5.773	7.022
TEST #6	10/31/90	1,484,544	1,646,537	682,687	758,712	7.5838	6.2198	10,338	13.09	10.89
TEST #8	10/29/90	1,484,527	1,660,968	683,150	764,866	5.6264	4.3784	10,294	9.922	8.154

* - For nonisokinetic tests (see Table 4), the corrected particulate loading concentration is listed.
** - f Factor based on coal analysis collected during respective test condition.
NM - Not Measured

TABLE 3. PARTICULATE SUMMARY, STACK

				PARTICULATE DATA SUMMARY		
TEST	DATE	GAS FLOWRATE (acfm)	GAS FLOWRATE (dscfm)	PARTICULATE LOADING (gr/dscf)	F FACTOR (dscf/mBtu)	PARTICULATE EMISSIONS (lb/mBtu)
TEST #1	10/22/90	1,658,614	1,101,291	0.0467	10,314	0.0814
TEST #1	10/24/90	1,609,148	1,086,626	0.0372	10,290	0.0657
TEST #3	10/26/90	1,477,747	974,136	0.0399	10,274	0.0759
TEST #5	10/27/90	1,495,687	991,724	0.0082	10,293	0.0157
TEST #6	10/31/90	NM	NM	NM	10,338	NM
TEST #8	10/29/90	1,729,599	1,147,263	0.0293	10,294	0.0532

NM - Not Measured

TABLE 1. BASELINE NOx TESTS -- STUART UNIT 4
LOSS ON IGNITION (LOI) SUMMARY

TEST No.	DATE	FLYASH SAMPLE No.	SAMPLE DESCRIPTION	LOI (%) LOW	HIGH	AVERAGE
1	10-22-90	9998	M-17 composite -Econ left	1.01	1.14	1.07
		9997	M-17 composite -Econ right	1.50	1.59	1.55
2	10-23-90	9909	LOI traverse - port C left econ	0.87	1.46	1.17
		9912	LOI traverse - port G right econ	1.10	1.25	1.17
		9913	LOI traverse - port G left econ	1.95	2.10	2.02
		9914	LOI traverse - port E right econ	1.36	1.55	1.46
1	10-24-90	9161	M-17 composite - Econ right	0.84	0.99	0.91
		9162	M-17 composite - Econ left	0.58	0.66	0.62
3	10-26-90	9163	M-17 composite - Econ right	1.47	1.50	1.48
		9165	M-17 composite - Econ left	0.9	0.94	0.92
5	10-27-90	9164	M-17 composite - Econ left	0.83	1.03	0.93
		9166	M-17 composite - Econ right	1.06	1.44	1.25
10	10-30-90	9175	LOI traverse - PT.1 Econ ?	1.11	1.12	1.11
		9176	LOI traverse - PT.2 Econ ?	1.04	1.24	1.14
		9177	LOI traverse - PT.3 Econ ?	1.35	1.47	1.41
		9178	LOI traverse - PT.3 Econ ?	1.32	1.51	1.41
		9179	LOI traverse - PT.2 Econ ?	0.89	0.9	0.90
		9180	LOI traverse - PT.1 Econ ?	1.15	1.17	1.16
		Average of traverse test 10		1.14	1.24	1.19
1	11-05-90	9967	LOI traverse - port B,pt. 2 econ right	1.22	1.27	1.25
		9964	LOI traverse - port B,pt. 2 econ left	0.9	1.14	1.02
		9968	LOI traverse - port I,pt. 2 econ right	1.04	1.12	1.08
		9965	LOI traverse - port F,pt. 2 econ left	1.12	1.31	1.21
1	11-06-90	9170	LOI traverse - port G,pt. 3 econ left	1.28	1.52	1.40
		9973	LOI traverse - port G,pt. 3 econ right	0.43	0.53	0.48
		9183	LOI traverse - port D,pt. 1 econ right	0.54	0.65	0.59
		9970	LOI traverse - port D,pt. 3 econ left	1.39	1.58	1.48
		9183	LOI traverse - port D,pt. 1 econ right	0.54	0.65	0.59
		9181	LOI traverse - port A,pt. 3 econ right	1.22	1.32	1.27
		9168	LOI traverse - port A,pt. 3 econ left	0.98	1.06	1.02
		9171	LOI traverse - port C,pt. 1 econ left	0.52	0.55	0.59
		9972	LOI traverse - port I,pt. 1 econ right	0.21	0.34	0.28
		Average of traverse test 1		0.88	1.01	0.94

FIGURE 4
LOSS ON IGNITION (LOI)
BASELINE TESTS -- STUART UNIT 4

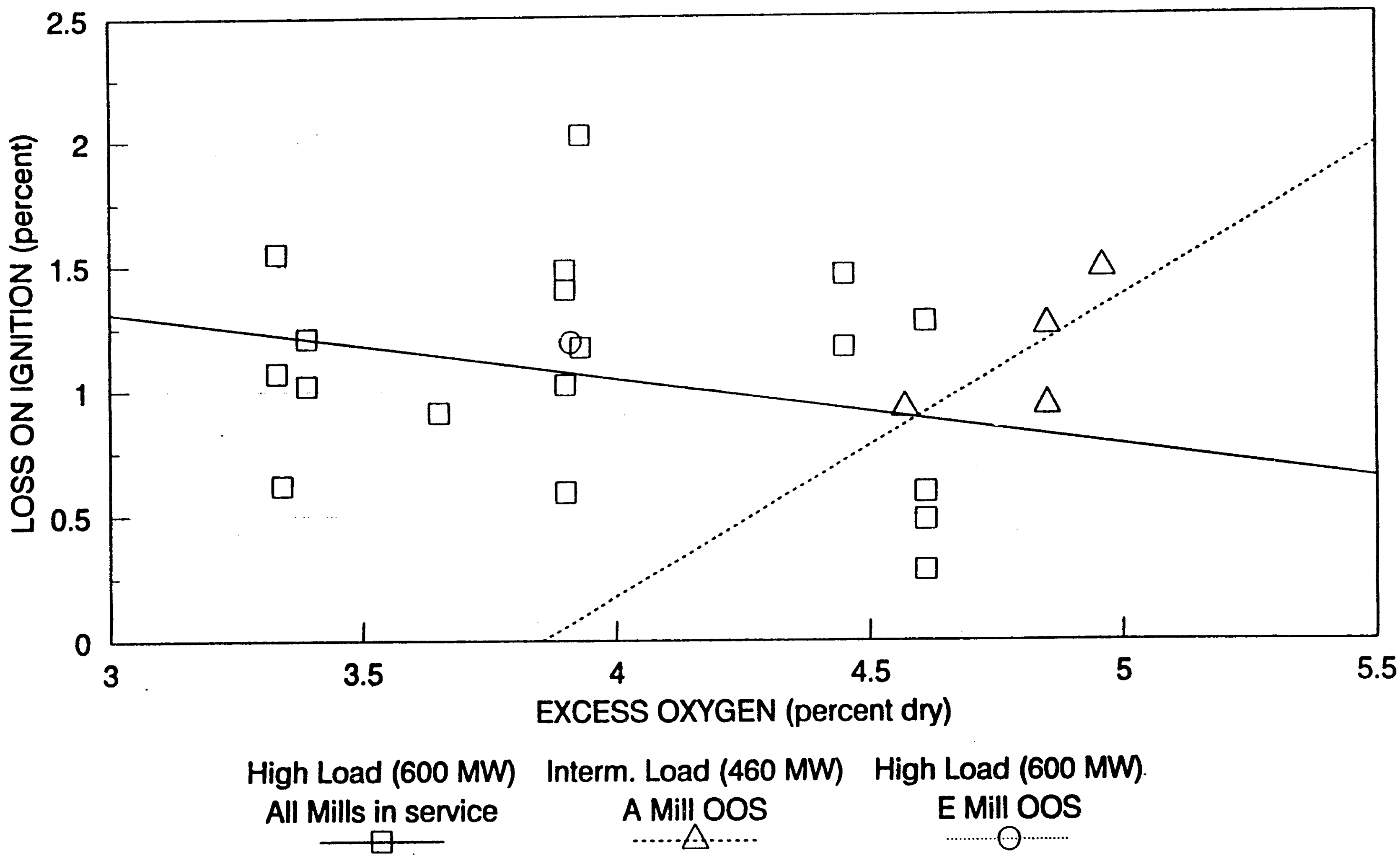
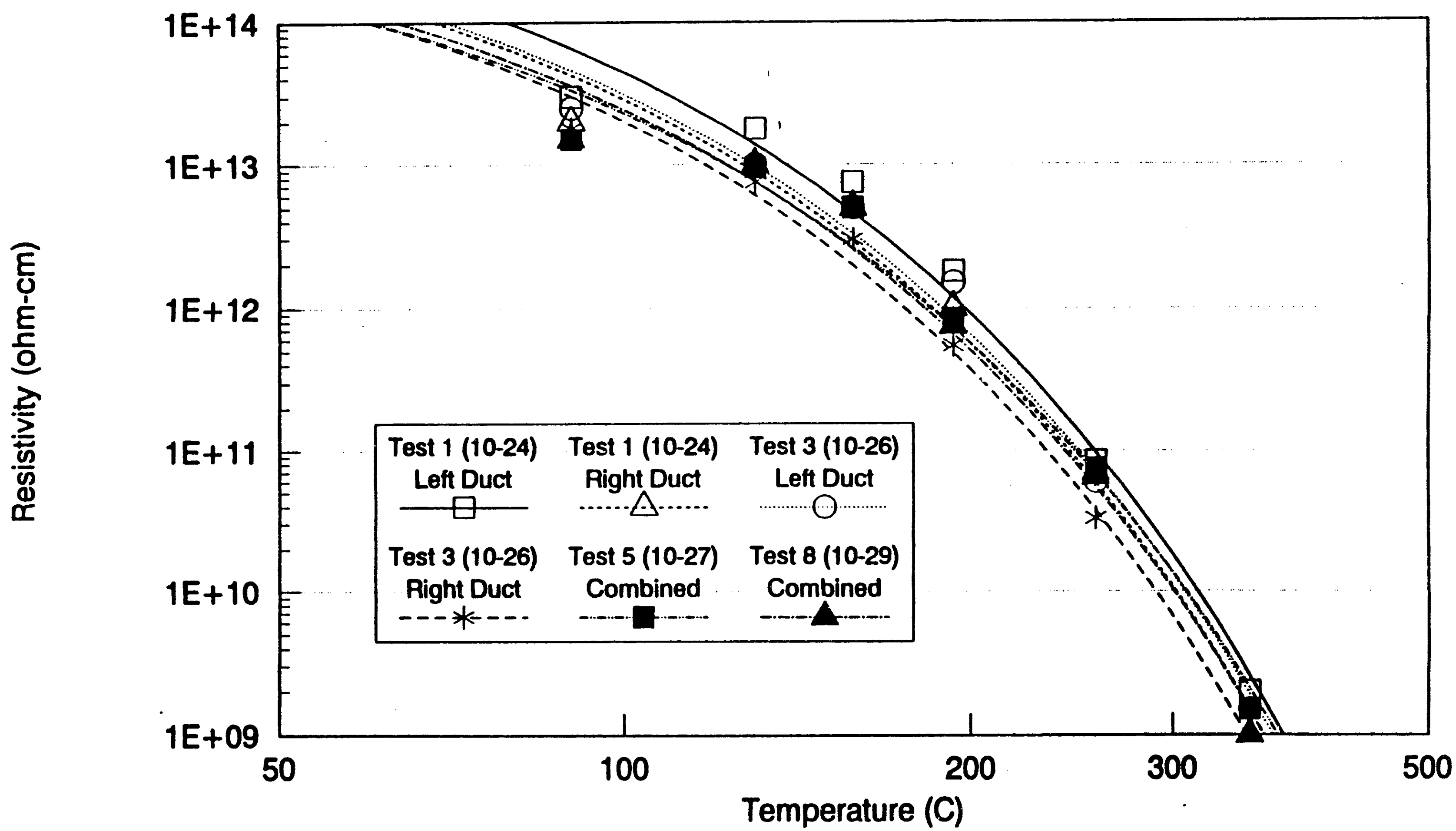
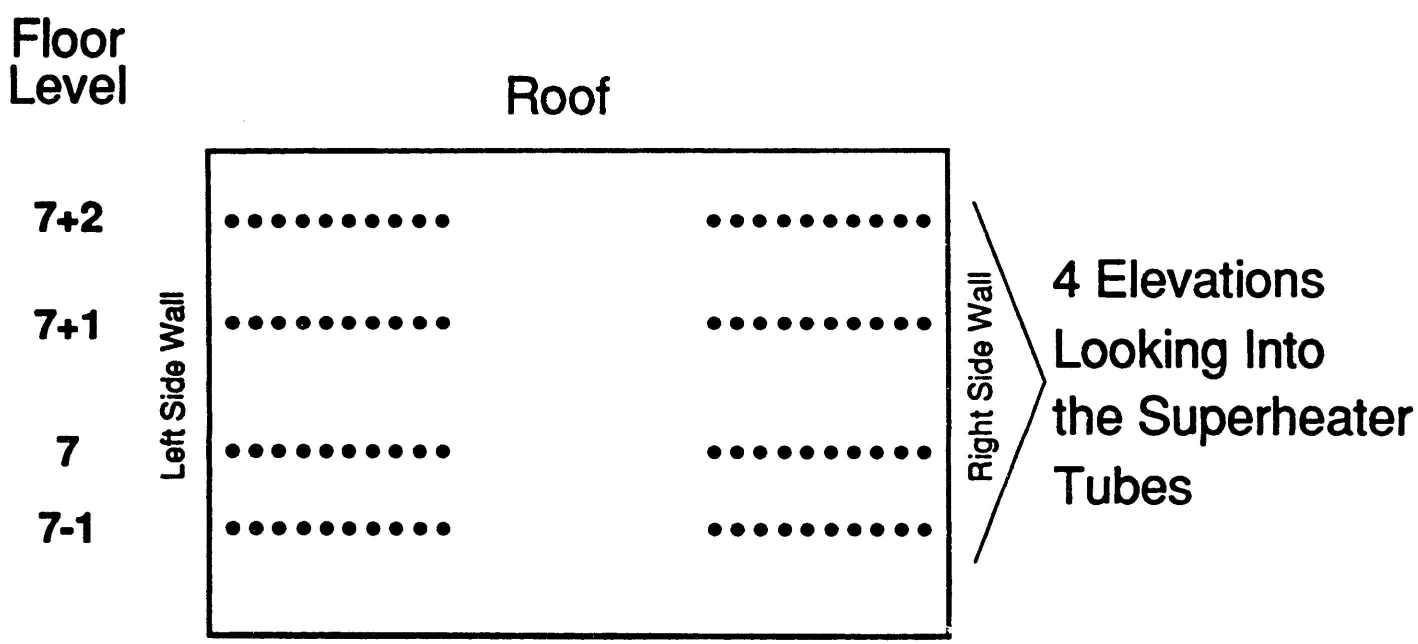


FIGURE
FLYASH RESISTIVITY -- ECONOMIZER OUTLET
STUART UNIT 4 -- BASELINE TESTS



Resistivity in accordance with IEEE Standard 548-1984, ascending mode

UPPER FURNACE SAMPLING LOCATION



8 PORTS SAMPLED
10 MEASUREMENTS PER PORT

- 20 FT PENETRATION OF 63 FT FURNACE
- DATA OBTAINED AT 2 FT INTERVALS

SAMPLING EQUIPMENT/PROCEDURE
UPPER FURNACE SAMPLING

EQUIPMENT

- Fecheimer Probe
- Oxygen and Carbon Dioxide Analyzers
- B&W Pressure Averaging Instrument

DATA OBTAINED

- Gas Velocities
- Gas Temperatures
- Gas Species: O_2 and CO_2

SAMPLING EQUIPMENT/PROCEDURE MIDDLE FURNACE SAMPLING

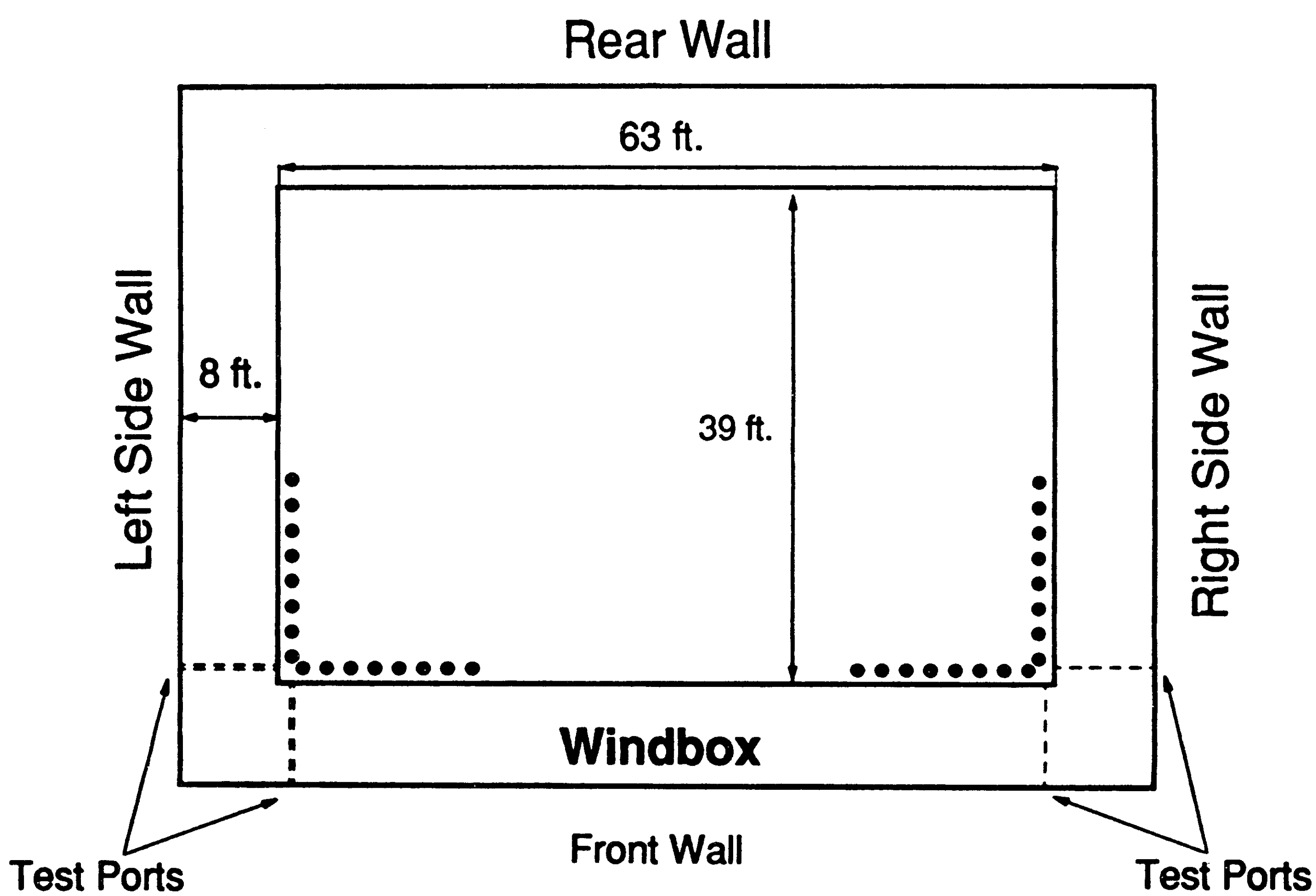
EQUIPMENT

- Fecheimer Probe
- Oxygen and Carbon Dioxide Analyzers
- B&W Pressure Averaging Instrument

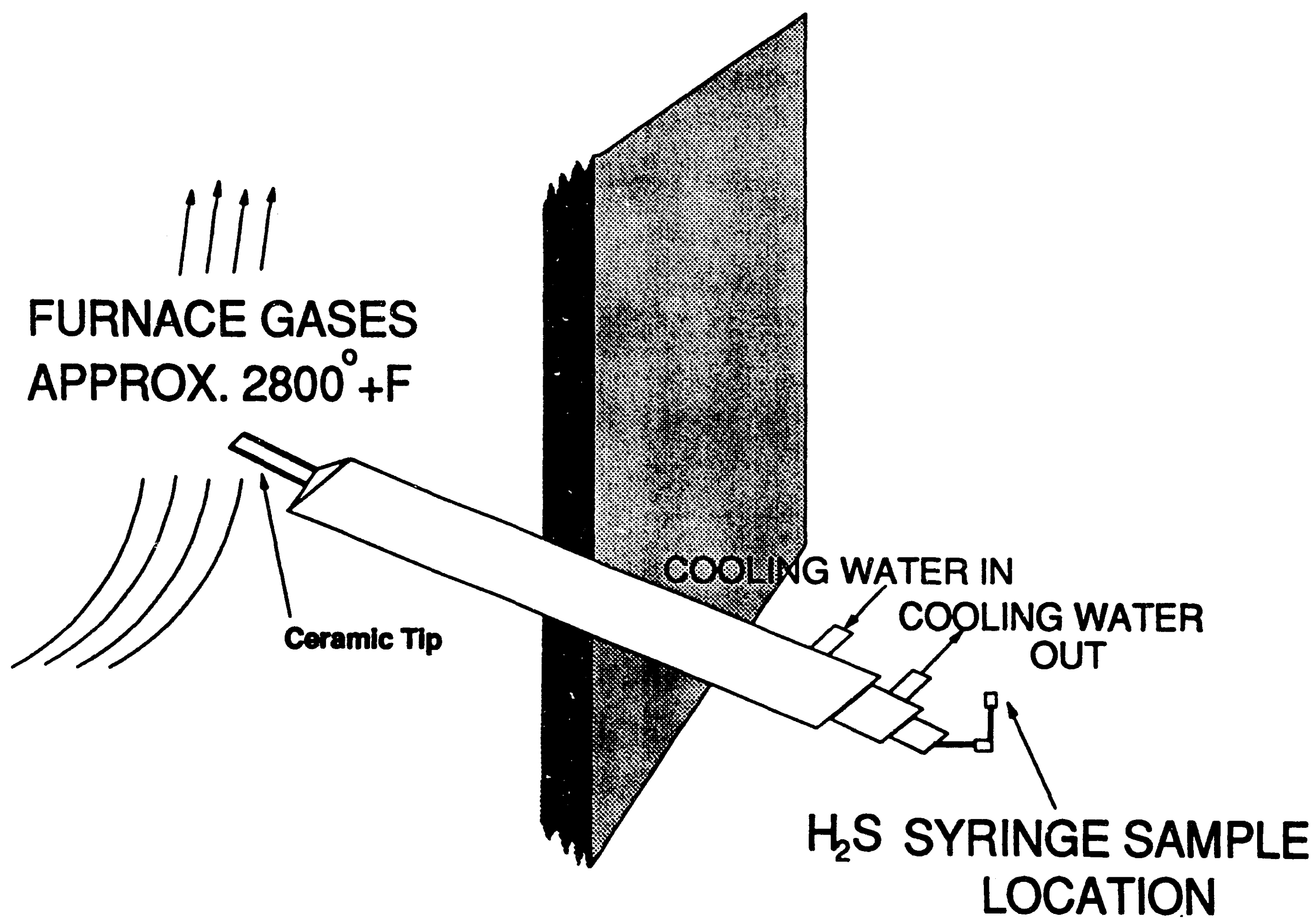
DATA OBTAINED

- Gas Velocities
- Gas Temperatures
- Gas Species: O2 and CO2

LOWER FURNACE SAMPLING LOCATION
BURNER LEVEL ELEVATION



H_2S SAMPLING PROBE



Babcock & Wilcox
a McDermott Company

MEASURED H_2S AT FOUR PORT LOCATIONS

	LOCATION						
	Left Side		Left Front		Right Front	Right Side	
Distance Inserted, Ft.	GC	Dragar	GC	Dragar	GC	GC	Dragar
2	—	—	—	—	—	<10	—
4	0	0	0	0	—	—	0
6	0	0	0	0	—	<10	0
8	—	—	0	0	90	0	0
10	—	—	0	0	19	—	—
12	0	0	0	0	23	22	0
14	0	0	0	0	—	10	10
16	10	—	—	—	14	19	22
18	—	—	—	—	—	—	—

CORROSION TASK STATUS

Unit #4 Evaluation of Options Complete

- o Test Panel Installation Suggested
- o Sandblast Selected Tubes
- o Measure Local H2S Levels

Laboratory Retort Test In Progess

- o Test Materials To Be Exposed for 1000 hrs
- o Correlations To Include B&W Existing Data Base
- o Predictive Corrosion Model

SLAGGING/FOULING TASK STATUS

FIELD SAMPLES COLLECTED

- o Coal and Ash Chemistry 90% Complete

EVALUATION OF PERFORMANCE DATA

- o Cleanliness Factors From Boiler Diagnostics System Documented

N_2O SAMPLING EQUIPMENT/PROCEDURE
ECONOMIZER OUTLET

EQUIPMENT

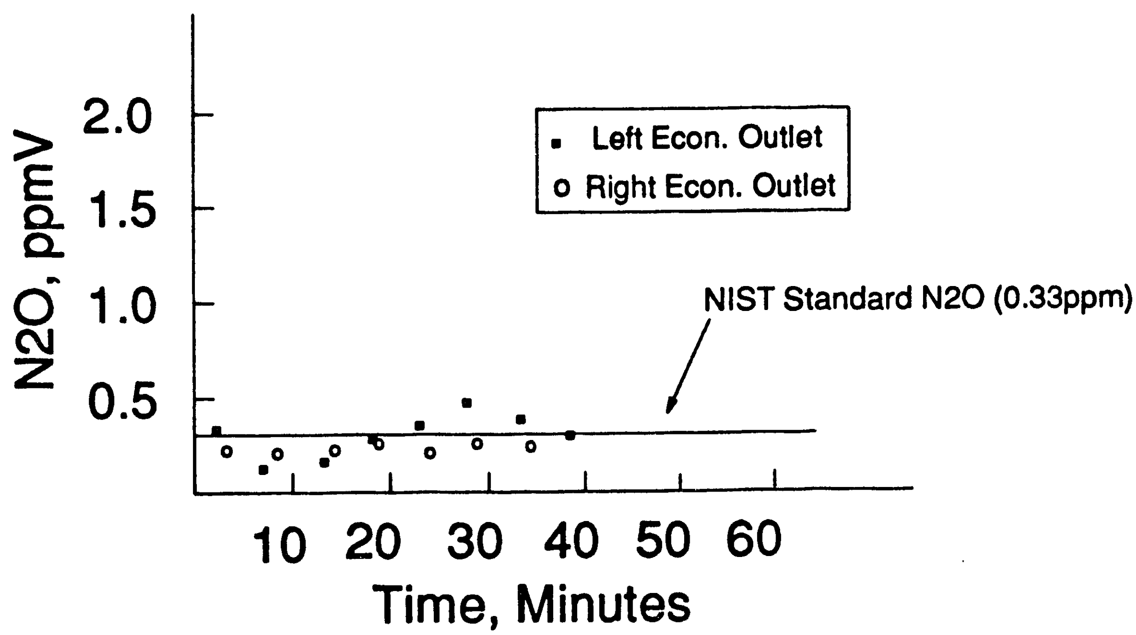
- Vacuum Pump at Sample Port
- Oxygen and Carbon Dioxide Analyzers
- Gas Chromatograph with ECD

DATA OBTAINED

- Nitrous Oxide Levels (ppmV)
- Local Oxygen Levels (% by volume)

N_2O AT ECONOMIZER OUTLET

Comparison With 0.33ppm NIST Standard



APPENDIX C

J. M. STUART STATION
UNIT #4
LOW NOX BURNER CONTROLS OVERVIEW

Contracted with SEGA to design controls

Six PLCs – one per Mill group

Two motor control cabinets

- 30 KVA – 480 to 120v transformer
- 24 breakers and reversing contacts

24 NEMA interface junction boxes

48 Jordan Actuators

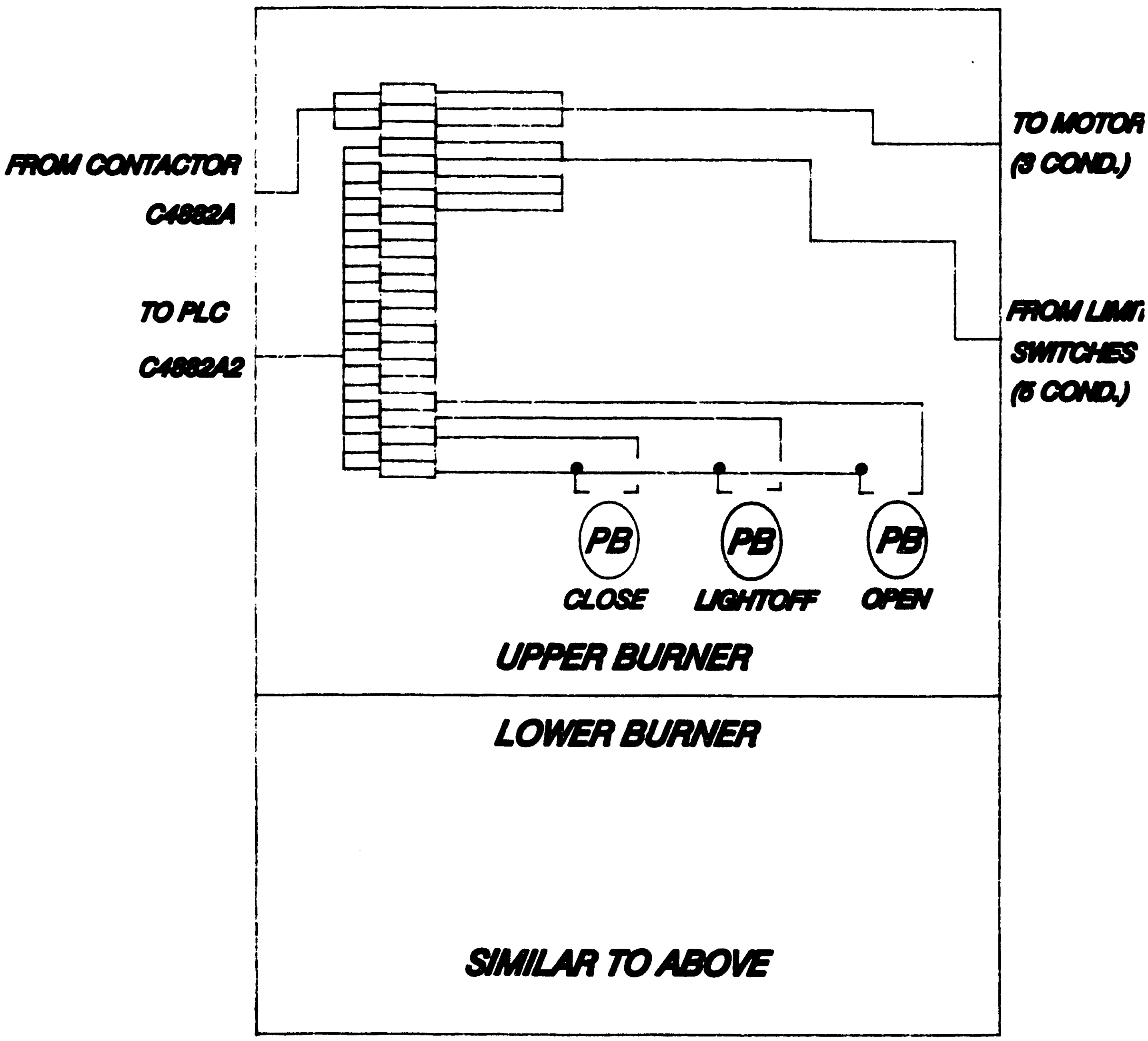
- 6.8 full load amps
- 13.2 stall motor amps
- 5.2 no load amps

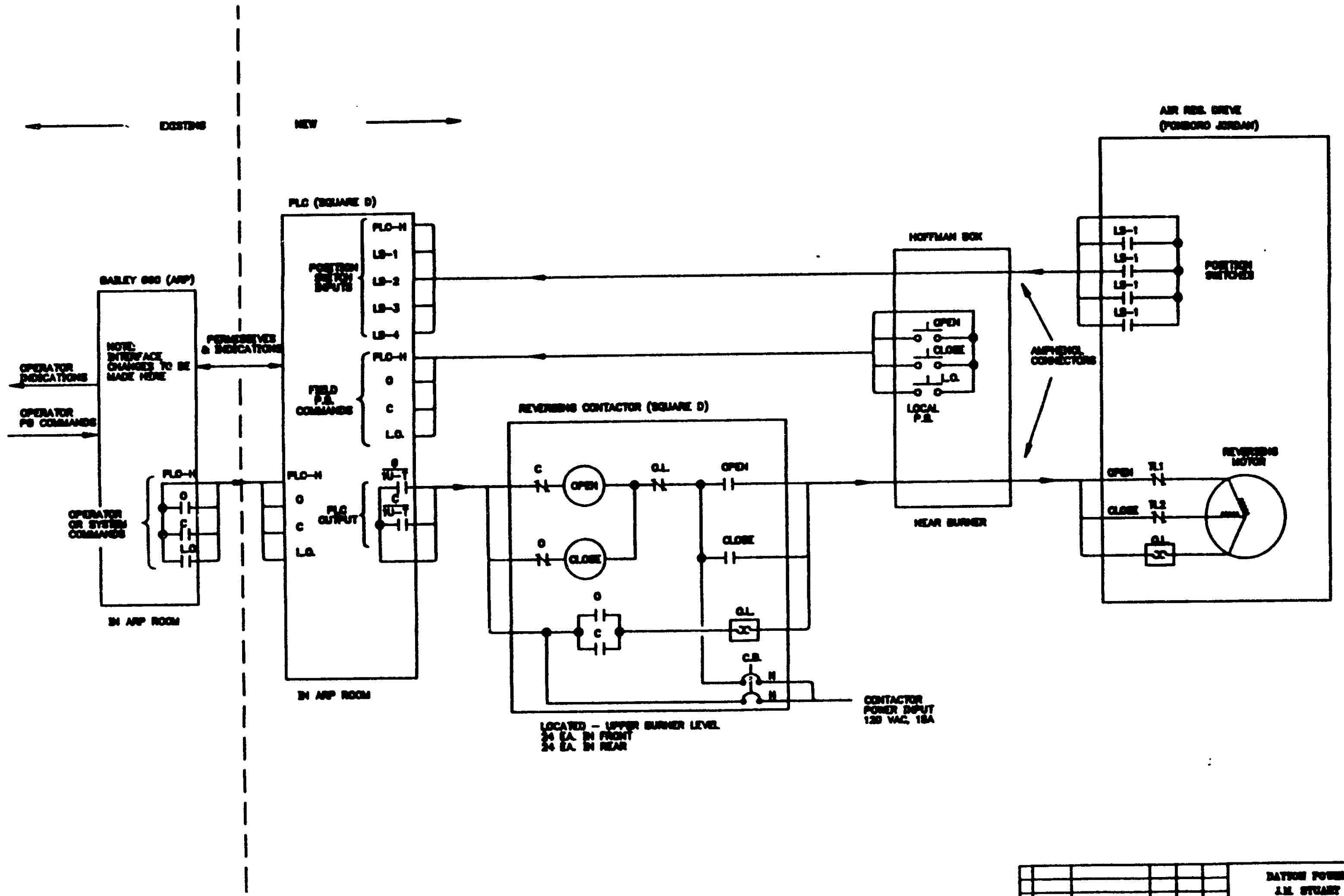
Original System

- Limitorques with 13 contacts
- Multiconductor cable
- 208 v @ 4.0 full load amps

AIR REGISTERS
24 EACH

HOFFMAN TYPE BOX NEAR BURNER



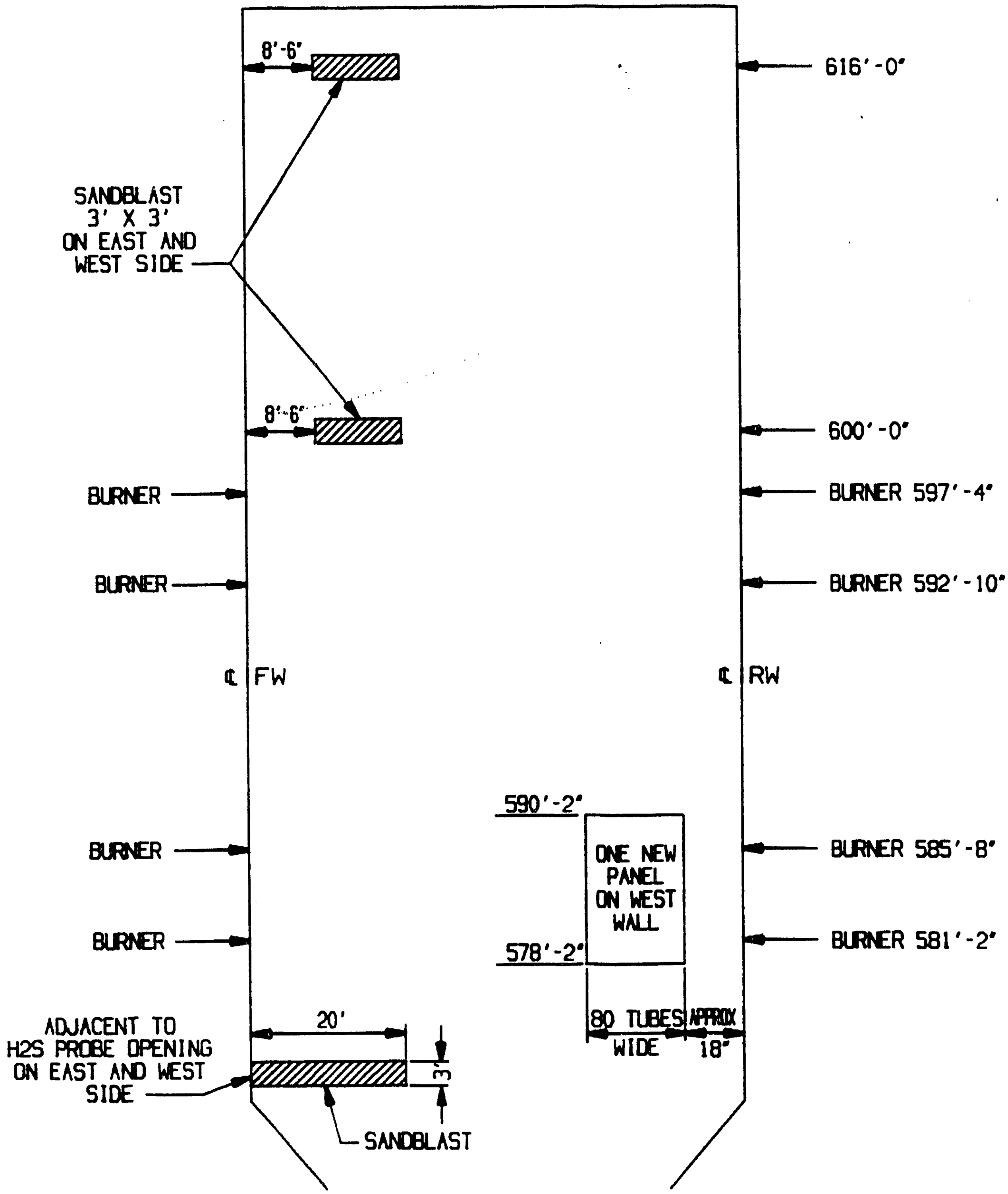


DAYTON POWER & LIGHT
J.M. STUART STATION
UNIT 4

Sega.

APPENDIX D

LOW NOx CELL BURNER RETROFIT PROJECT
D P & L-J M STUART UNIT NO.4
CORROSION TESTING



881FR KLEISLEY-5

Low NOx Cell Burner Retrofit Project

New Corrosion Test Panel

80 Tubes wide consisting of the following materials (approx. 10 tubes each):

SA213T2 bare
SA213T22 bare
SA213T91 bare (or SA213T9)
SA213T2 with either
  TP304H weld overlay or
  Bi-metallic T2/TP304H
SA213T2 with 2 coatings

Panel would also require:

4 temperature thermocouples
4 ports to sample H_2S

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END

DATE FILMED

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