DOE/PC/90545-T6

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Full-Scale Demonstration

Low-NOx Cell™ Burner Retrofit

Quarterly Report No. 4

for the period - July 1, 1991 through September 30, 1991

DOE Agreement No.: DE-FC22-90PC90545

B&W CRD Agreement No.: CRD-1250

Patents Cleared by Chicago on March 12, 1992

Prepared by:

Babcock & Wilcox
a McDermott Company

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1.0 EXECUTIVE SUMMARY

The Full Scale Demonstration Low-NOx Cell™ Burner (LNCB™) Project (DOE Agreement No. DE-FC22-90PC90545) progress from July 1, 1991 through September 30, 1991 identified in this, the Fourth Quarterly Report. The Report centers on Phase I - Design, Phase IIA - Procurement and Fabrication, Phase IIB - Installation and Phase III - Operation status.

The LNCB™ 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 LNCB™ (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.

The Electric Power Research Institute (EPRI) remains the only outstanding agreement to negotiate. However, a mid-October signing is likely. Final versions of the Continuation Application, and the Environmental Monitoring Plan and updated versions of the Detailed Work Plan and the Management Plan were submitted to DOE PETC. DOE approved the application for continuation of the project through completion of Phase III. All Phase I and Phase IIA work is now complete.

Baseline test results were released to DOE PETC in a draft copy of the Pre-Retrofit Test Report. Laboratory Corrosion testing work concluded in mid August 1991. Formal Reports on the testing will be part of Phase III test results.

All LNCB™ equipment including the corrosion test panels (refer to Appendix A, figure numbers 3.4 and 3.5 for panel configuration and location in DP&L Stuart Unit #4), and four (4) furnace tube wall surface chordal thermocouples have been manufactured and shipped to the jobsite.

Pre-Outage Construction work was completed during the period of this report. The DP&L Stuart Station Unit #4 outage began at midnight Friday, September 20, 1991. The six (6) week outage will conclude November 3, 1991.

As a result of the outage shifting from March to September 1991, the testing work schedules for parametric and optimized testing for the LNCB™ project now coincide with the schedules planned for another B&W/DOE Project . . . Cyclone Reburn. Additionally, testing on this semi-outdoor unit would occur in the middle of winter. Besides the obvious concerns with the performance of manpower and equipment in freezing weather, DP&L would have storage/handling problems with the "isolated" test coal. To avoid such conflicts, testing plans now call for start-up and one week of preliminary testing to occur in November 1991. Parametric and Optimized testing will begin in March 1992. Refer to the Project Schedule chart in Appendix A.

B&W is in the process of streamlining the parametric test matrix to reduce costs, yet provide "full" data analysis results. Two avenues are being looked at to accomplish this result. One is to limit the number of variables (i.e. adjust spin vanes, impeler position, etc.) to only those known to have major impact to results. The second method is to run a statistical experiment design matrix using the Taguchi method. Refer to Appendix B for current testing plans.

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, IIA, IIB and III of the Full-Scale Demonstration of Low-NOx Cell™ Burner Project. The period covered by this quarterly report is July 1, 1991 through September 30, 1991. This report is the fourth quarterly prepared for the project.

Under Task 1 - Management & Reporting, final versions of the Environmental Monitoring Plan and Technical Progress Quarterly Reports #1 & #2 were submitted during this period. Under Task 3 - Pre-Retrofit Testing, a draft copy of the Pre- Retrofit Test Report was submitted to DOE PETC. Laboratory Corrosion testing work concluded in August 1991. Formal Reports on the testing will be part of Phase III test results. Activities in Task 2 - Test Plan Development, Task 4 - Functional Engineering, Task 5 - Detailed Design Engineering, and Task 6 - Permitting were concluded in prior quarters. All Phase I work is now complete.

Phase IIA - Procurement and Fabrication work accomplished during this quarter for Task 1 - Management & Reporting centered around submitting the final version of the Continuation Application and updated versions of the Detailed Work Plan and the Management Plan. DOE approved the application for continuation of the project through completion of Phase III. Work under Task 3 - Manufacturing & Fabrication shows all LNCB™ equipment manufacturing completed and shipped to the jobsite. All Phase IIA work is now complete

Phase IIB - Installation work accomplished during this quarter for Task 1 - Management & Reporting involved finalizing start-up and testing schedules. Task 2 - Pre-outage Construction work saw the corrosion test panel fabrication work completed. A set of four (4) furnace tube wall surface chordal thermocouples were also added to the workscope for monitoring boiler operation during the testing work. Task 3 - Installation of Burner Equipment saw the DP&L Stuart Unit #4 six week outage commence at midnight Friday Sept. 20, 1991.

Phase III - Operation work accomplished during this quarter for Task 1 - Management & Reporting involved finalizing the testing matrix.

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 NO2. Replacement of the standard cell burners with Low-NOx Cell™ Burners (LNCB™) 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 NOx in the early stages of combustion. Furthermore, optimum NOx reduction with 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.

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 LNCB™ 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 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 objectives of the full-Scale Low-NOx Cell™ Burner (LNCB™) 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 LNCB™ retrofits are the most cost-effective alterr ative 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 Services Division (ESD) and the Contract Research Division (CRD).

Major subcontractors are Acurex and Enerfab. Acurex has been designated to perform continuous emissions monitoring activities as well as various analytical requirements during the testing program. The installation subcontractor is Enerfab. They are 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 LNCB™ project, which is a $9.796 million project, consists of four separate phases which are planned to occur over a 38-month period. These are:

- Phase I - Design

  During this phase, the Low-NOx Cell™ Burner (LNCB™) 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 LNCB™ 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 LNCB™ 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 LNCB™ 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 #4 is July 1, 1991 through September 30, 1991. Progress will be discussed on a task basis for each of the Phase I, Phase IIA, Phase IIB, and Phase III 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

Monthly reports covering the time period of this report were completed and issued to DOE PETC. Final versions of the Environmental Monitoring Plan and Technical Progress Quarterly Reports #1 & #2 were also submitted during this period.

Negotiations continued with Electric Power Research Institute (EPRI) to finalize an agreement. A signed agreement is expected by mid-October 1991.

4.1.2 Task 2 - Test Plan Development

This task, which involved the identification of all test parameters, sampling instrumentation, equipment location, test data forms, test procedures, and testing matrix for both the baseline pre-retrofit tests and the Low-NOx Cell™ Burner tests, was completed prior to the period covered by this report.

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

Laboratory Testing

The object of this subtask is to conduct corrosion retrofit tests of various candidate alloys by exposing them to simulated low NOx combustion gases at different H_2S concentrations and temperatures. A total of 18 materials, including carbon steel, alloy steels, stainless steels, and coating systems, are being exposed to the simulated LNCB™ mixed gases. The test conditions vary temperature (500, 700, and 900 C) and mixed gas composition (0.05, 0.25, and 0.5% H_2S).

Laboratory Corrosion Retort Testing work concluded in August 1991. Data analysis work is underway and an informal report is expected by years end. Formal report on the testing will be part of Phase III test results.

4.1.3.3 Subtask 3.3 - Pre-Retrofit Test Report

A draft copy of the Pre-Retrofit Test Report complete with the QA/QC Report for Phase I was released this quarter. This completes this task.

4.1.4 Task 4 - Functional Engineering

4.1.5 Task 5 - Detailed Design Engineering

4.1.6 Task 6 - Permitting

Tasks 4, 5, and 6 were completed prior to this report.

PHASE I WORK IS NOW 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

Submitted the final version of the Continuation Application and updated versions of the Detailed Work Plan and the Management Plan. DOE approved the application for continuation of the project through completion of Phase III.

4.2A.2 Task 2 - Procurement

Release of all raw material and sublet fabricated material procurement orders was completed prior to the period covered by this report.

4.2A.3 Task 3 - Manufacturing and Fabrication

All LNCB™ equipment manufacturing is complete.

PHASE IIA WORK IS NOW COMPLETE!

4.2B **PHASE IIB - INSTALLATION**

Activities in Phase IIB include the following tasks: Management & Reporting, Pre-Outage Construction, Installation of LNCB™ Equipment, and Start-up & Shakedown.

4.2B.1 Task 1- Management and Reporting

As a result of the outage shifting from March to September 1991, the testing work schedules for parametric and optimized testing for the LNCB™ project now coincide with the schedules planned for another B&W/DOE Project... Cyclone Reburn. The projects were previously on a 6 month schedule offset which allowed testing equipment to be shared and presented no problems with available manpower from the B&W Testing Group and the testing subcontractor Acurex. Additionally, testing on this semi-outdoor unit would occur in the middle of winter. Besides the obvious concerns with the performance of manpower & equipment in freezing weather, DP&L would have storage/handling problems with the "isolated" test coal. To avoid such conflicts, testing plans now call for start-up and one week of preliminary testing to occur in November 1991. Parametric and Optimized testing will begin in March 1992. Refer to the Project Schedule chart in Appendix A.

4.2B.2 Task 2 - Pre-Outage Construction

Fabrication of the corrosion test panel is complete. All four (4) panel sub-assemblies are on site, ready to be installed. Each 12 foot long sub-assembly is twenty (20) tubes in width. The ten center tubes of a sub-assembly have either 308L stainless weld overlay, 309L stainless weld overlay, external chromizing, or aluminized spray coating. The adjacent 5 tubes are bare SA213T2 material. Refer to Appendix A (figure numbers 3.4 and 3.5) for panel configuration and location in DP&L Stuart Unit #4. The panels are equipped with chordal thermocouples to measure tube metal surface temperatures. The panels are also equipped with openings to extract furnace gases for H_2S measurement.

A set of four (4) chordal thermocouples were also fabricated for installation at various elevations along the furnace sidewall to monitor tube metal temperatures. This is a once through boiler design and low excess air operation for NOx control could expose the furnace tubes to high metal temperatures. These thermocouples will be used to monitor boiler operation during the testing work.

4.2B.3 Task 3 - Installation of Burner Equipment

4.2B.4 Task 4 - Start-up and Shakedown

The DP&L Stuart Unit #4 six week outage commenced at midnight Friday Sept. 20, 1991. The unit is scheduled for start-up on November 4,1991.

4.3 PHASE III - OPERATION

Activities in Phase III include the following tasks: Management & Reporting, Preliminary Testing, Optimization Testing, Long Term Testing, Data Analysis, Final Report, and Disposition.

4.3.1 Task 1- Management and Reporting

B&W is in the process of streamlining the parametric test matrix to reduce costs, yet provide "full" data analysis results. Two avenues are being looked at to accomplish this result. One is to limit the number of variables (i.e. adjust spin vanes, impeller position, etc.) to only those known to have major impact to results. B&W is reviewing earlier LNCB™ study work to help in this determination. The second method is to run a statistical experiment design matrix using the Taguchi method. The Taguchi experiment will hopefully reduce the time involved to get the same results as a straight 3x5 or 2x5 matrix would dictate. Refer to Appendix B for current testing plans.

5.0 PLANNED ACTIVITIES

Planned activities for the next quarter, October, November, and December, 1991 will focus on the following:

Management & Reporting will include submittal of the Final Public Design Report, QA/QC Report for Phase IIA, Retrofit Start-up Plan, Management Plan - Phase III Update, and the Post Retrofit Test Plan. The Third Advisory Committee meeting will be convened at DP&L Stuart Station on October 3, 1991. A Construction Review meeting is also required.

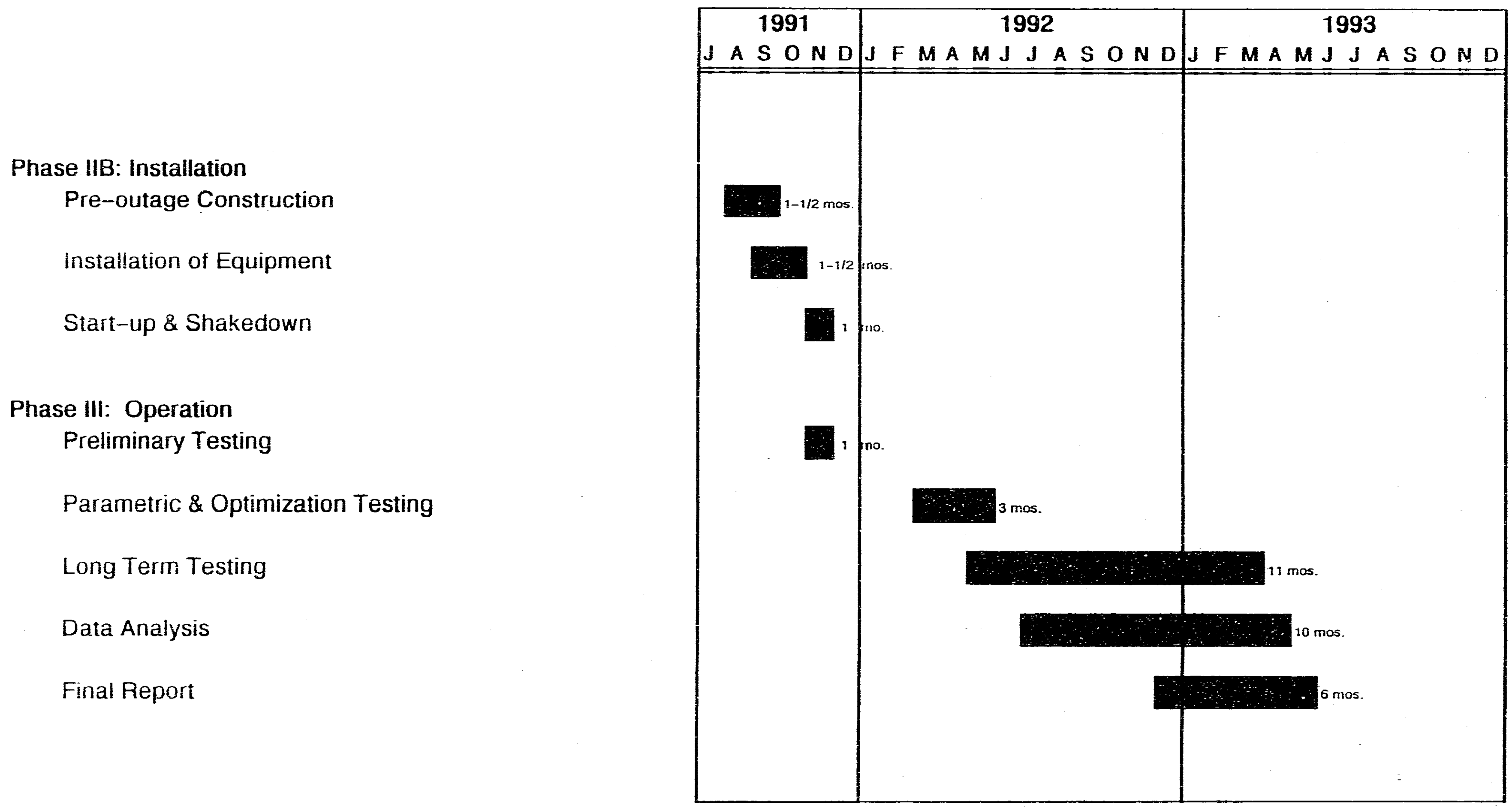
Phase IIB, Task 3 - Installation of LNCB™ equipment work will be completed. Task 4 - Start-up & Shakedown work will also be complete.

Phase III, Task 2 - Preliminary Testing will be completed during this time period.

APPENDIX A

Low NOx Cell Burner Retrofit

Remaining Project Schedule



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Phase III Test Schedule

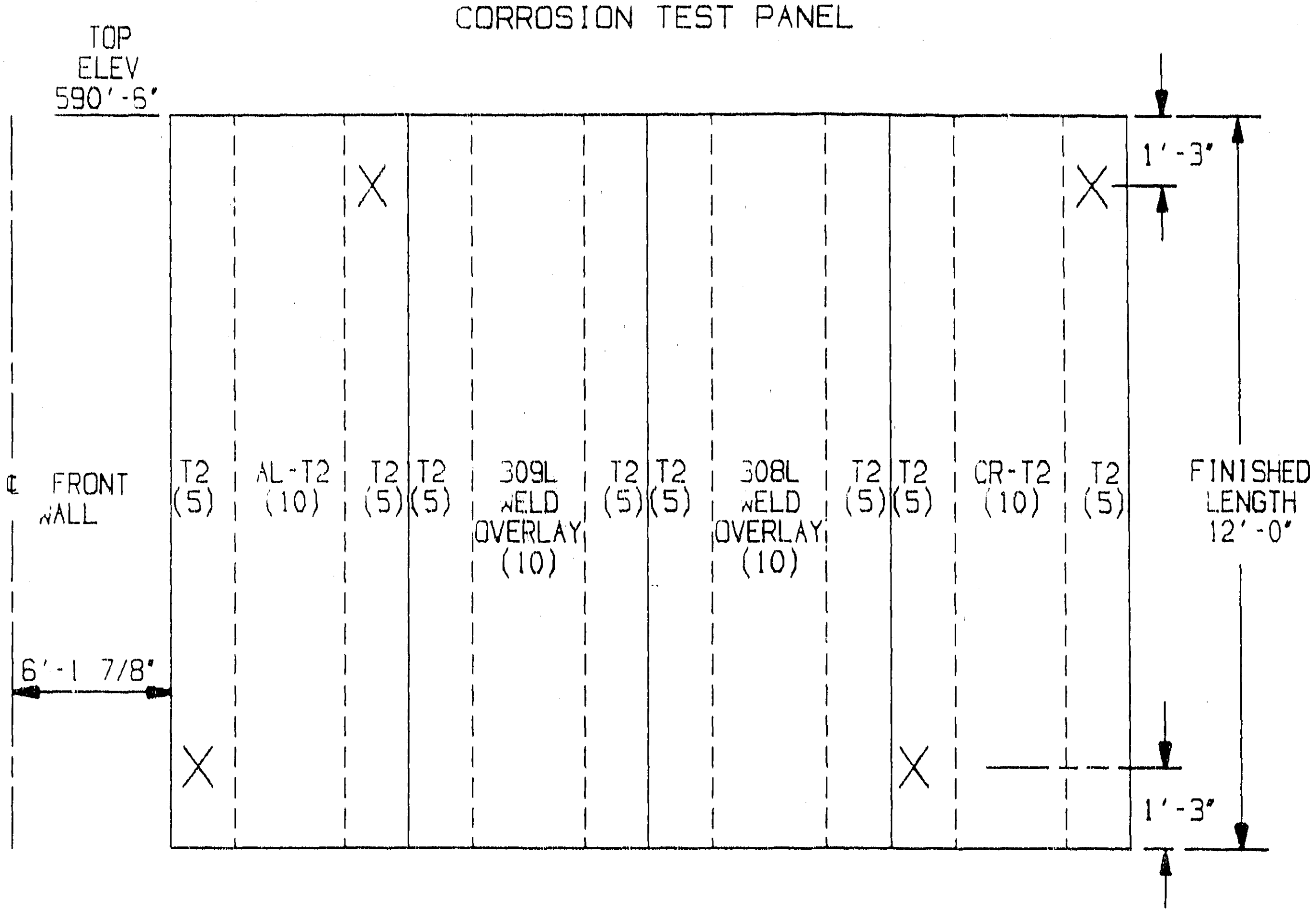
Fall '91 Start-up and Preliminary Testing (B&W manpower only)

Equipment Set-up & Checkout	Oct. 28 - Nov. 1
Boiler Start-up & Shake Down	Nov. 4 - Nov. 15
Preliminary Parametric Tests	Nov. 18 - Nov. 27

Spring '92 Testing (B&W and Acurex manpower)

Equipment Set-up and Checkout	March 2 - March 6
Parametric Testing	March 9 - April 3
Contingency Test Days	April 6 - April 10
Unit 4 Outage	April 12 - April 18
Unloading Facility Maintenance	April 12 - May 3
Optimization Testing	May 4 - May 22
Contingency Test Days	May 25 - May 29
Long Term Testing	May 4 - March 1993

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



X INDICATES H_2S PORT LOCATION. CHORDAL THERMOCOUPLES ARE ADJACENT TO PORT LOCATIONS

( ) INDICATES QUANTITY OF TUBES IN EACH GROUP

T2 SIGNIFIES SA-213T2 BARE TUBE MATERIAL

AL-T2 SIGNIFIES ALUMINIZED SPRAY COATED T2 TUBE MATERIAL

309L, 308L SIGNIFIES STAINLESS WELD OVERLAY ON T2 BASE METAL

CR-T2 SIGNIFIES CHROMIZED T2 TUBE MATERIAL

FIGURE 3.4 - CORROSION TEST PANEL

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

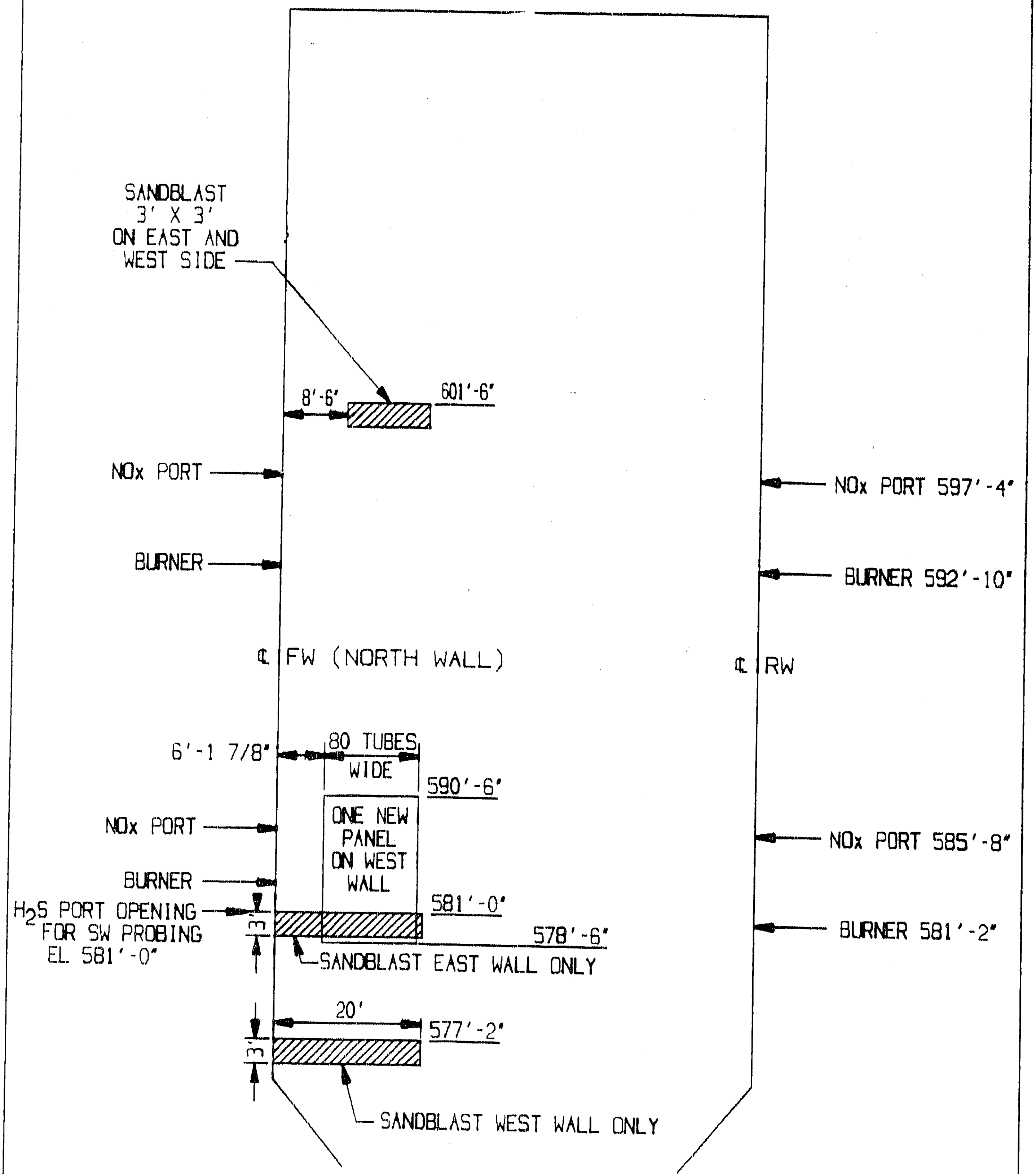

FIGURE 3.5 - AREA TO BE SANDBLASTED TO REMOVE ALUMINIZING

APPENDIX B

POST-RETOFIT TEST MATRIX
ORIGINAL PROPOSAL

TABLE II.1-2 POST-RETROFIT PRELIMINARY TEST MATRIX BURNER CHARACTERIZATION AND OPTIMIZATION TESTS

H-high
I-intermediate
L-low
N-normal
O-optimum
V-vary

				PULVERIZERS			BURNER SETTINGS					EMMISIONS				FEBT's		ASH SAMPLES				
TEST NO.	TEST OBJECTIVE	LOAD	O2	OUT TEMP	MILLS OUT OF SERVICE	FUEL AIR RATIO	LOWER SPIN VANES	LOWER SLIDE DISC	LOUVER DAMPERS	UPPER SLIDE DISC	IMP. POS.	CONT. GASEOUS	N2O	H2S	PM	NEAR BURNERS (HVT)	FURNACE EXIT (HVT)	BOILER BOTTOM	ECON. HOPPER	PRECIP. HOPPER	ECON. OUTLET (SLM)	COAL SAMPLES
1	Optimize burners	H	N	N	NONE	N	V	N	N	N	N	I					I					I
2	Optimize burners	H	N	N	NONE	N	O	V	N	N	N	I										
3	Optimize burners	H	N	N	NONE	N	O	O	V	N	N	I										
4	Optimize burners	H	N	N	NONE	N	O	O	O	V	N	I										
5	Optimize burners	H	N	N	NONE	N	O	O	O	O	V	I										
6	Optimize burners	H	N	N	NONE	N	O	O	O	O	O	I										I
7	Effect of O2	N	N	N	NONE	N	O	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I
8	Effect of O2	H	H	N	NONE	N	O	O	O	O	O	I					I				I	
9	Effect of O2	H	L	N	NONE	N	O	O	O	O	O	I		I			I				I	
10	Effect of O2	I	N	N	N	N	O	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I
11	Effect of O2	I	H	N	N	N	O	O	O	O	O	I										
12	Effect of O2	I	L	N	N	N	O	O	O	O	O	I										
13	Effect of O2	L	N	N	N	N	O	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I

POST-RETOFIT TEST MATRIX
ORIGINAL PROPOSAL

TABLE II.1-2 POST-RETROFIT PRELIMINARY TEST MATRIX BURNER CHARACTERIZATION AND OPTIMIZATION TESTS (CONTINUED)

H-high
I-intermediate
L-low
N-normal
O-optimum
V-vary

TEST NO.	TEST OBJECTIVE	LOAD	O2	PULVERIZERS: OUT TEMP	PULVERIZERS: MILLS OUT OF SERVICE	PULVERIZERS: FUEL AIR RATIO	BURNER SETTINGS: LOWER SPIN VANES	BURNER SETTINGS: LOWER SLIDE DISC	BURNER SETTINGS: LOUVER DAMPERS	BURNER SETTINGS: UPPER SLIDE DISC	BURNER SETTINGS: IMP. POS.	EMMISIONS: CONT. GASEOUS	EMMISIONS: N2O	EMMISIONS: H2S	EMMISIONS: PM	FEBT's: NEAR BURNERS (HVT)	FEBT's: FURNACE EXIT (HVT)	ASH SAMPLES: BOILER BOTTOM	ASH SAMPLES: ECON. HOPPER	ASH SAMPLES: PRECIP. HOPPER	ASH SAMPLES: ECON. OUTLET (SLM)	COAL SAMPLES
14	Effect of O2	L	H	N	N	N	O	O	O	O	O	I										
15	Effect of O2	L	L	N	N	N	O	O	O	O	O	I										
16	Burner turndown	I	N	N	NONE	N	O	O	O	O	O	I			I						I	
17	Characterize burners	H	N	N	NONE	N	V+	O	O	O	O	I	I	I							I	I
18	Characterize burners	H	N	N	NONE	N	O	V+	O	O	O	I										
19	Characterize burners	H	N	N	NONE	N	O	O	V+	O	O	I										
20	Characterize burners	H	N	N	NONE	N	O	O	O	V+	O	I	I	I							I	
21	Characterize burners	H	N	N	NONE	N	O	O	O	O	V+	I										
22	Characterize burners	H	N	N	NONE	N	V-	O	O	O	O	I	I	I							I	
23	Characterize burners	H	N	N	NONE	N	O	V-	O	O	O	I										
24	Characterize burners	H	N	N	NONE	N	O	O	V-	O	O	I										
25	Characterize burners	H	N	N	NONE	N	O	O	O	V-	O	I	I	I							I	
26	Characterize burners	H	N	N	NONE	N	O	O	O	O	V-	I										

POST-RETOFIT TEST MATRIX
ORIGINAL PROPOSAL

TABLE II.1-2 POST-RETROFIT PRELIMINARY TEST MATRIX BURNER CHARACTERIZATION AND OPTIMIZATION TESTS (CONTINUED)

H-high
I-intermediate
L-low
N-normal
O-optimum
V-vary

				PULVERIZERS			BURNER SETTINGS					EMMISIONS				FEGT's		ASH SAMPLES				
TEST NO.	TEST OBJECTIVE	LOAD	O2	OUT TEMP	MILLS OUT OF SERVICE	FUEL AIR RATIO	LOWER SPIN VANES	LOWER SLIDE DISC	LOUVER DAMPERS	UPPER SLIDE DISC	IMP. POS.	CONT. GASEOUS	H2O	H2S	PM	NEAR BURNERS (HVT)	FURNACE EXIT (HVT)	BOILER BOTTOM	ECON. HOPPER	PRECIP. HOPPER	ECON. OUTLET (SLM)	COAL SAMPLES
27	Characterize burners	I	N	N	NONE	N	V+	O	O	O	O	I	I	I							I	I
28	Characterize burners	I	N	N	NONE	N	O	V+	O	O	O	I										
29	Characterize burners	I	N	N	NONE	N	O	O	V+	O	O	I										
30	Characterize burners	I	N	N	NONE	N	O	O	O	V+	O	I	I	I							I	
31	Characterize burners	I	N	N	NONE	N	O	O	O	O	V+	I										
32	Characterize burners	I	N	N	NONE	N	V-	O	O	O	O	I	I	I							I	
33	Characterize burners	I	N	N	NONE	N	O	V-	O	O	O	I										
34	Characterize burners	I	N	N	NONE	N	O	O	V-	O	O	I										
35	Characterize burners	I	N	N	NONE	N	O	O	O	V-	O	I	I	I							I	
36	Characterize burners	I	N	N	NONE	N	O	O	O	O	V-	I										
37	Vary mill out temp.	H	N	L	1-(A)	N	O	O	O	O	O	I									I	I
38	Vary mill out temp.	H	N	H	1-(A)	N	O	O	O	O	O	I									I	
39	Vary fuel air ratio	H	N	N	1-(A)	H	O	O	O	O	O	I			I						I	

POST-RETOFIT TEST MATRIX
ORIGINAL PROPOSAL

TABLE II.1-2 POST-RETROFIT PRELIMINARY TEST MATRIX BURNER CHARACTERIZATION AND OPTIMIZATION TESTS (CONTINUED)

H-high
I-intermediate
L-low
N-normal
O-optimum
V-vary

				PULVERIZERS			BURNER SETTINGS					EMMISIONS				FEBT's		ASH SAMPLES				
TEST NO.	TEST OBJECTIVE	LOAD	O2	OUT TEMP	MILLS OUT OF SERVICE	FUEL AIR RATIO	LOWER SPIN VANES	LOWER SLIDE DISC	LOUVER DAMPERS	UPPER SLIDE DISC	IMP. POS.	CONT. GASEOUS	H2O	H2S	PM	NEAR BURNERS (HVT)	FURNACE EXIT (HVT)	BOILER BOTTOM	ECON. HOPPER	PRECIP. HOPPER	ECON. OUTLET (SLR)	COAL SAMPLES
40	Vary fuel air ratio	H	N	N	1-(A)	L	O	O	O	O	O	I			I						I	
41	Vary mill out temp.	H	N	L	NONE	N	O	O	O	O	O	I									I	
42	Vary mill out temp.	H	N	H	NONE	N	O	O	O	O	O	I									I	
43	Vary fuel air ratio	H	N	N	NONE	H	O	O	O	O	O	I			I						I	
44	Vary fuel air ratio	H	N	N	NONE	L	O	O	O	O	O	I			I						I	
45	Vary BOOS	H	N	N	1-(A)	N	O	O	O	O	O	I									I	I
46	Vary BOOS	H	N	N	1-(B)	N	O	O	O	O	O	I									I	
47	Vary BOOS	H	N	N	1-(F)	N	O	O	O	O	O	I									I	
48	Vary BOOS	H	N	N	1-(D)	N	O	O	O	O	O	I									I	
49	Repeat tests	H	N	N	NONE	N	O	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I
50	Repeat tests	I	N	N	N	N	O	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I
51	Repeat tests	L	N	N	N	N	O	O	O	O	O	I	I	I	I	I	I	I	I	I	I	I

Parametric Testing

Primary Variables

- Boiler Load
- O_2
- NOx Port Louver Position
- Stoichiometry

Secondary Variables

- Burner Spin Vanes
- Impeller Position

Fall '91 Preliminary Testing

Test Two Loads - 100% & 75%

Use DP&L Standard O_2 Levels

Vary Louver Position

Maintain Stoichiometry - full open balance positions for NOx Port & Burner Discs

Maintain Spin Van Position - 50° open

Maintain Impeller Position

Find optimum Louver Position and Re-test

Babcock & Wilcox
A McDermott Company

Spring '92 Parametric Testing

Test Two Loads - 100% & 75%

Two Sets of O_2 Levels

Vary Louver Position ????

Vary Stoichiometry - adjust balance positions for NOx
Port & Burner Discs

Vary Spin Vane Position

Maintain Impeller Position

Perhaps do limited testing with impeller fully retracted for maximum flame length.

Spring '92 Optimization Testing

Duplicate Baseline Testing

- Test Two Loads - 100% & 75%
- Test Two O_2 Levels
- Maintain Optimum Positions Involving
  - NOx Port Louvers
  - Stoichiometry
  - Burner Spin Vanes
  - Burner Impellers

END

DATE FILMED

7 / 1 / 92