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ENHANCING THE USE OF COALS BY GAS REBURNING-SORBENT INJECTION

DE-FC22-87PC 79796

Quarterly Report No. 27
For the Period
April 1 through June 30, 1994

Prepared for
U.S. Department of Energy
Gas Research Institute
State of Illinois Department of
Energy and Natural Resources

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1.0 SUMMARY

The objective of this project is to evaluate and demonstrate a cost effective emission control technology for acid rain precursors, oxides of nitrogen (NO_x) and sulfur (SO_x), on two coal fired utility boilers in Illinois. The units selected are representative of pre-NSPS design practices: tangential and cyclone fired. Work on a third unit, wall fired, has been stopped because of funding limitations. The specific objectives are to demonstrate reductions of 60 percent in NO_x and 50 percent in SO_x emissions, by a combination of two developed technologies, gas reburning (GR) and sorbent injection (SI).

With GR, about 80-85 percent of the coal fuel is fired in the primary combustion zone. The balance of the fuel is added downstream as natural gas to create a slightly fuel rich environment in which NO_x is converted to N_2. The combustion process is completed by overfire air addition. SO_x emissions are reduced by injecting dry sorbents (usually calcium based) into the upper furnace. The sorbents trap SO_x as solid sulfates that are collected in the particulate control device.

This project is conducted in three phases at each site: (1) Design and Permitting, (2) Construction and Startup, and (3) Operation, Data Collection, Reporting and Disposition. Technology transfer to industry is accomplished through the formation of an industry panel. Phase I of the project commenced on June 5, 1987. Phases I and II have been completed and Phase III is now in progress at the CWLP site. Site activities are complete at Hennepin and the Final Report is being prepared.

In phase AIII at Hennepin - Testing, Data Collection, Reporting and Disposition - Gas Reburning runs were made that indicate as high as 77% reduction in NO_x emission using about 18% gas. Gas Reburning - Sorbent Injection test results indicated as high as 62% reduction in SO_2. These results are significantly higher than the project emission reduction goals of 60% NO_x and 50% SO_2 and provided a wide safety margin for maintaining the 60% and 50% emission reductions during long term routine testing. A year of long term testing was completed in October, 1992. During late October and November of 1992, Hennepin Unit 1 was down for

a scheduled outage. Ultrasonic tube thickness measurements were made to determine wear rates in the various areas of the boiler. In December 1992, and January 1993, a series of parametric tests was conducted on three promoted sorbents with significantly improved SO_2 capture and calcium utilization.

Illinois Power chose to retain the gas reburning (GR) system for possible use in meeting regulatory limits in 1995 or subsequent years. A limited restoration of the Sorbent Injection (SI) system was completed in December ,1993. A final project report has been drafted, reviewed, and will be issued the third quarter of 1994.

Phase CIII at Lakeside, Task 1 - Project Management: Project management activities continued throughout the quarter.

Phase CIII at Lakeside, Task 2 - Technology Demonstration: Gas Reburn parametrics, Sorbent Injection parametrics, and GR-SI combined parametric tests were completed in the third quarter of 1993. The start of long term GR-SI demonstration began in October 1993, and will continue through the third quarter of 1994.

Key Words

SO_x	Ash	Emission
SO_2	Coal	Control
NO_x	Gas	Boiler
NO	Sorbent	Precipitator (ESP)
Pond	Construction	Flue Gas
Startup	Instrumentation	Contracts
CEMS	Industry Panel	Ducts
Reburning	Injection	PromiSORB™
Humidification	BPMS	Restoration

2.0 INTRODUCTION

The specific goal of this project is to demonstrate NO_x and SO_x emission reductions of 60 percent and 50 percent, respectively, on two coal fired utility boilers having the design characteristics mentioned above. Host Site Agreements have been signed by EER and utility companies in the State of Illinois: Illinois Power Company (Test Site A, Hennepin Unit 1, 71 MW_{net} tangentially fired boiler in Hennepin), and City Water Light and Power (Test Site C, Lakeside Unit 7, 33 MW_{net} cyclone fired boiler in Springfield).

To achieve the objectives of the project, it is being conducted in the following three phases at each host site.

Phase I: Design and Permitting
Phase II: Construction and Startup
Phase III: Operation, Data Collection, Reporting and Disposition

Phase I is complete
Phase II is complete

Phase III: Phase AIII GR-SI Long Term Testing was completed at Hennepin in 1992, followed by Alternate Sorbents tests. In December 1993, a limited restoration of the Sorbent Injection (SI) system was completed after Illinois Power chose to keep the gas reburning (GR) system. Phase CIII parametric testing of Gas Reburning and Sorbent Injection systems has occurred at the Lakeside site as has the combined gas reburning-sorbent injection (GR-SI) optimization. The long term load following gas reburning-sorbent injection (GR-SI) testing began in early October, 1993.

During the past quarter the principal objectives of the work performed were as follows:

A. Hennepin Unit 1

1. Continue project management activities.
2. Revise drafts and issue Hennepin Final Report.
3. Implement release of escrow funds.

B. Lakeside Unit 7

1. Continue project management activities.
2. Continue long term GR-SI operation under load dispatch conditions. Unit #7 operation is dependent on system demand.
3. Resolve availability of alternate sorbents for demonstration testing.
4. Continue work on the Parametric Test Report.

3.0 PROJECT DESCRIPTION

Within the final phase of the project, the following tasks will be performed to demonstrate the cost effective control of NO_x and SO_x emissions from pre-NSPS coal fired utility boilers:

Phase III: OPERATION, DATA COLLECTION, REPORTING AND DISPOSITION

Task 1 - Project Management

- Continuation of Phases 1 and 2 project management activities.
- Conducting final project review at conclusion of project.

Task 2 - Technology Demonstration

Subtask 2.1 - Optimization Testing

- Evaluation of effects of process variables on emission control performance.
- Determination of operating conditions for optimum overall performance.

Subtask 2.2 - Evaluation of Alternative Coals and Sorbents

- Evaluation of performance of alternative sorbents:
  - Selection of sorbents from modified high surface area hydrated limes.

Subtask 2.3 - Long-Term Testing

- Operation of GR-SI equipment under optimized conditions for approximately one-year duration at each host site.
- Measurement of emission control system performance.
- Determination of boiler impacts.

Task 3 - Evaluation of Demonstration Results

- Analysis of test data.
- Preparation of guideline manuals for application of GR-SI technology, including design recommendations, cost projection and comparisons with competing technologies.

Task 4 - Restoration

- Disposition of GR-SI equipment installation:
  - To be retained by host site or removal and restoration work.

Task 5 - Technology Transfer

- Continuation of technology transfer activities from Phases I and II.
- Meeting with Industry Panel at one host site to review results obtained there and plans for other host sites.
- Meeting with Industry Panel at completion of project.

4.0 PROJECT STATUS

4.1 Task 1 - Project Management

Monthly and other reporting activities were fulfilled according to the reporting requirements of the Cooperative Agreement.

Work Progress was monitored continuously. Coordination with IP and CWLP took place at monthly meetings and by telephone. The project co-funders were apprised of progress and developments through telephone conferences and meetings.

Discussions with CWLP were held to review the details and scheduling of the Long Term testing during the quarter.

4.2 Task 2 - Technology Demonstration

Hennepin - Demonstration, operations and testing were completed in January, 1993.

Lakeside - The emphasis this quarter was on continuous process operation three extended runs were carried out:

1. A 38 hour continuous GR-SI run which was terminated because of a baghouse failure.

2. A 115 hour continuous GR run which was terminated because of cyclone flame scanner failure.

3. A 66 hour GR-SI run which was terminated by a lock hopper problem in the ash silo.

These runs demonstrated that continuous GR and GR-SI operation is quite feasible with a cyclone fired boiler. No significant boiler or ESP deterioration was observed in any of the runs. All of the runs were terminated by boiler controls or ash silo problems, not by failure of the GR-SI process and technology.

The Compliance Tests for Particulate Emission required by the IEPA permit were run on June 2, 1994. The test results were very favorable with average particulate emissions of 0.016 lbs/mmbtu compared to the regulatory limit of 0.1 lbs/mmbtu. The 1989 baseline results gave average emissions of 0.0072 with coal only. Considering that GR-SI operation increases the inlet dust loading to the ESP by a factor of 6-7, this is very good performance indeed and attests to the excellent design of the ESP.

Following the Compliance Tests, a 15 hour SI only test was performed to show that the boiler and ESP could handle the increased dust loading without problems. This run continued until the lime silo was empty as planned. No operating problems were experienced with the boiler or the ESP.

4.2.1 Contracts

Hennepin - None to report.

Lakeside - A contract continues with Johnson Controls to perform calibration of instruments and minor systems modifications as needed.

4.2.2 Construction Drawings

Hennepin - Drawings are being updated to provide "as left" records for Illinois Power's incorporation into the Hennepin plant drawings. These drawings were completed and should be issued during the next quarter.

Lakeside - Vendor record drawings for the dry ash handling system have been received for EER review.

4.2.3 Equipment Purchasing

Hennepin - No equipment was purchased for the Hennepin Site during this quarter.

Lakeside - Purchase orders placed during the quarter were largely in support of the testing program.

4.2.4 Miscellaneous

Hennepin - One third of the Hennepin escrow amount has been received and the remainder has been requested.

Lakeside - The project budget is under increasing scrutiny as the remaining work is being completed.

4.3 Task 3 - Evaluation of Results

Hennepin - A first draft of the Hennepin Final Report was issued for comment on September 8, 1993. As comments have been received, modifications to the report have been made.

Lakeside - NO_x and SO_2 removal results during long term testing exceeded the 60% and 50% reduction goals.

The first draft of the parametric test report has been prepared.

4.4 Task 4 - Restoration

Hennepin - In May 1993, Illinois Power announced a decision to retain the Gas Reburning system, but to remove/restore the Sorbent Injection system. The restoration work was completed during the last quarter of 1993.

Lakeside - Specifications and other documentation were prepared and preliminary pricing obtained for restoration contracts.

4.5 Task 5 - Technology Transfer

A presentation entitled "Reburning on a Cyclone Boiler at Kodak Park" was made to the Gas Research Institute by EER, Eastman Kodak, Amoco Energy Trading Co., Consolidated Natural Gas, Rochester Gas and Electric and Tenneco Gas, April 19, 1994.

A paper titled "Gas Reburning In a Tangentially Fired Coal Boiler" was presented at the NO_x Controls for Utility Boilers EPRI Workshop May 11 - 13, 1994 in Scottsdale, Arizona.

A paper titled "Gas Reburning for NO_x Reduction - An Integrable Cost Effective Technology for International Applications" was presented at the Clean Fuel Technology Conference, May 19, 1994 in London, England.

5.0 PLANNED ACTIVITIES

During the next quarter (April through June, 1994) the following work is planned.

A. Hennepin Unit 1

1. Continue project management activities.

2. Complete and issue final "as left" drawings of the project installation at Hennepin Unit #1.

3. Revise drafts and issue Hennepin Final Report.

4. Implement final release of remaining escrow funds.

B. Lakeside Unit 7

1. Continue project management activities.

2. Begin writing the Lakeside Final Report.

3. Continue the editing of the Lakeside Parametric Test Report.

4. Resolve testing of two alternate sorbents in September, 1994.

6.0 REPORT DISTRIBUTION LIST

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