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ENHANCING THE USE OF COALS BY
GAS REBURNING-SORBENT INJECTION

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LEGAL NOTICE

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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 both sites.

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 SO₂ 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 second 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. Complete SI removal/restoration work.
4. Complete transfer of equipment title to Illinois Power.
5. 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. Continue efforts to remove the ash-lime water aggregated material from the ash silo.
4. Resolve availability of alternate sorbents for demonstration testing.
5. Complete the draft of the Lakeside Unit 7 parametric testing environmental report.
6. 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 the host utilities were held to review the details of the transfer of title of project equipment to Illinois Power Company and release of escrow funds to EER; and to update CWLP on the start of the Long Term testing.

4.2 Task 2 - Technology Demonstration

Hennepin - In mid-April 1993, EER delivered a report to Illinois Power which provided an overview of (Gas Reburn, Sorbent Injection, and GR-SI) performance, operating costs, and impacts on furnace, boiler, ESP, and chimney. Emission control performance and cost comparisons were made for promoted sorbents as well as the standard calcium hydrate.

Lakeside - The GR-SI optimization tests were completed in early October, 1993. Long term GR-SI operation under load dispatch conditions began October 4, 1993. Project goals of 60% NO_x reduction and 50% SO₂ reduction were achievable over the entire load range of boiler operation.

Some long term operation was carried out in February and March, based on CWLP system demand. Lakeside Unit #7 was operated in January, but EER was unable to run GR-SI due to natural gas curtailment caused by the extremely cold weather.

The tedious and expensive process of emptying the ash silo was finally completed on February 15, 1994. The massive tube leak late in November 1993 caused large chunks of aggregated material to form in the silo. This necessitated a lot of manual labor with personnel going inside the silo to remove material, since the large chunks could pass through the normal unloading chutes. The dry unloading into a pneumatic truck commenced on March 3, 1994. Instead of hours or days as previously experienced, it was found that 20 tons could be loaded into a truck in about 4 minutes without dust or flow problems. This method will be used for ash removal in the future unless another massive water incursion takes place.

The unit did not operate in January 1994 due to low system demand. Site personnel were reassigned to other locations returning to Lakeside in expectation of Unit #7 operation in February. However, only 3 days of GR-SI long term testing occurred. No Unit #7 operations were expected before March 25, 1994 so some personnel were reassigned. Beginning March 28, 1994 Unit #7 operation with GR-SI is expected to continue until April 22, 1994.

Review and editing of the draft parametric test report commenced in February. Comments and corrections will be incorporated into the manuscript during the next period.

4.2.1 Contracts

Hennepin - Restoration contracts, completed in December 1993, had final invoices approved.

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 are 85% completed and should be completed and issued during the next quarter.

Lakeside - The "as built" drawings were completed during this past quarter and will be issued to CWLP in early April 1994.

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 - None to report.

Lakeside - None to report.

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 SO₂ removal results during parametric testing exceeded the 60% and 50% reduction goals.

The parametric test report is being 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 are being prepared in order to obtain preliminary pricing for restoration contracts.

4.5 Task 5 - Technology Transfer

None to report.

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.

B. Lakeside Unit 7

1. Continue project management activities.
2. Continue long term GR-SI operation under load dispatch conditions.
3. Conduct a 10 day 24 hour/day continuous GR-SI demonstration to assess the ability of the GR-SI process and the Boiler-ESP system to operate in a sustained manner.
4. An alternate sorbent may also be tested in late April.
5. Operations in May and June are subject to system demand.

6.0 REPORT DISTRIBUTION LIST

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