LRC-IX-36
EVALUATION OF REBURNING FOR NO_X CONTROL
FROM LIGNITE-FIRED CYCLONE BOILERS

CONTRACTORS: North Dakota Lignite Cyclone Users Group

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PARTICIPANTS

Sponsor	**Costs Share**
ND Cyclone User Group (Coyote Generating Station, Leland Olds Generating Station, Milton R. Young Generating Station)	$205,115
ND Industrial Commission	205,115
Total	$410,230

Project Schedule – 11 Months
Contract Date – 7/2/92
Start Date – 5/1/92
Completed – 3/31/93

Projects Deliverables
Status Report – 10/31/92 ✓
Status Report – 12/31/92 ✓
Final Report – 3/31/93 ✓

OBJECTIVE / STATEMENT OF WORK

The objective of this program was to evaluate cyclone reburn technology using lignite to assess the potential for NO_X control. Specific objectives of the test program included:

- Evaluating the major process parameters such as reburning/main combustion zones stoichmeteries, fuel quantity, and reburning/burnout zone residence times;
- Determining effects of reburning on:
  - slagging /fouling in the upper furnace and convection pass,
  - combustion efficiency (based upon unburned combustibles and CO emissions)
  - corrosion potential,
  - changes in furnace exit gas temperature; and
  - maximizing NO_X reduction while maintaining combustion conditions compatible with design and operation of cyclone-equipped boilers.

STATUS

The lignite-fired cyclone reburn tests were done at B & W's research center in Alliance, Ohio. Pilot scale evaluations were done in B & W's small boiler simulator (SBS). The SBS is fired by a single cyclone, a scaled-down version of the B & W commercial cyclone furnace.

Two burners were installed in the rear wall of the SBS just above the centerline of the cyclone furnace. Overfire air was introduced through two ports on the rear wall of the SBS above the reburners. The SBS facility was instrumented for real-time acquisition of combustion air and coal flow data, as well as on-line gas analysis. The pilot-scale study consisted of baseline (no reburning) and reburning tests. The NO_x reduction potential was evaluated by comparison of baseline and reburning results.

The baseline NO_X level while firing the North Dakota lignite (NDL) was 690 ppm at 5-million Btu/hr. Using the NDL in both the cyclone and reburning systems reduced the NO_X emissions to 228-382 ppm depending upon the reburn zone stoichiometry (0.85-0.93). These NO_X emission levels correspond to 45-58% overall NO_X reduction. Adding flue gas recirculation (FGR) to the reburn burners reduced the NO_X further to 202 to 279 ppm while maintaining the same reburn zone stoichiometries of 0.85 to 0.93, respectively. The corresponding overall NO_X reduction with 10% FGR was 59.6 to 70.7 with NDL.

Flyash was sampled from the stack of the SBS during baseline and reburn conditions and analyzed for unburned combustibles. Unburned carbon (UBC) in the flyash was always under 1%. Also, CO emission remained low (< 40 ppm) throughout the various tests conditions. Based on the data, low UBC and CO emissions are anticipated during full –scale reburning applications.

Furnace exit gas temperature (FEGT) was determined at nine positions and three elevations. FEGT was approximately 1800-1850 degrees F for the full-load baseline condition. With reburn, FEGT was + 50 degrees F. It was concluded that FEGT should not adversely impact performance on lignite-fired cyclone boilers.

Currently, approximately 2000 MW of cyclone boilers are in operation using NDL. These units are not using NO_X control technology and are exempt from regulations until 1995. In 1995, these units may be forced to choose a NO_X control technology to comply with Phase II of the CAA. The results of this study indicate that utilities should be able to control NO_X with the reburning technology while maintaining 100% NDL firing.

A recommendation of the study was an engineering and economic evaluation of the retrofit technology to determine reburning potential. Study FY 94-XV-52 is the engineering and economic evaluation study recommended as a follow-up program.