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INVESTIGATION OF TECHNIQUES FOR OBTAINING NO_X REDUCTIONS BY MODIFYING THE COMBUSTION INSIDE A CYCLONE BARREL BURNING LIGNITE

CONTRACTOR: North Dakota Lignite Cyclone Users Group

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PARTICIPANTS

Sponsor	Cost Share
ND Cyclone Users Group (Coyote Generating Station, Leland Olds Generating Station, Milton R. Young Generating Station)	$88,932
ND Industrial Commission	88,938
Total	$177,870

Project Schedule – 4 Months
Contract Date – 3/13/96
Start Date – 4/4/96
Completion Date – 8/15/96

Project Deliverables
Status Report - 8/11/96 ✓
Final Report - 6/9/97 ✓

OBJECTIVE / STATEMENT OF WORK

Title IV of the Clean Air Act Amendments of 1990 established deadlines for NO_x emission limits from utility boilers. Cyclone boilers in North Dakota fall under these regulations. Reburning, selective catalytic reduction and non-catalytic reduction techniques have demonstrated some potential for NO_x reduction in cyclone boilers. All of these techniques either require high cost equipment retrofits, produce high operating costs, cause restrictions in operation capability or flexibility, or a combination of these effects. The objective of the study is to determine if NO_x reductions can be achieved by modifying combustion inside the cyclone barrel without significantly and adversely impacting the operation, maintenance, reliability, or capacity of the cyclone.

The study consists of the following tasks:

- Task 1 – Prepare geometries for the computational fluid dynamic (CFD) model
- Task 2 – Collect gas and temperature data from a utility lignite cyclone
- Task 3 – Validate base case results from CFD model
- Task 4 – Predict effects of different combustion modification techniques and fuel composition
- Task 5 – Prepare reports summarizing the results of the study

STATUS

The reacting CFD computer model was used to predict cyclone behavior under different design and operating conditions. Modeling and boiler testing show that modest NO_x reductions can be made by reducing the amount of air used to burn the coal in the cyclone. The following conclusions were reached:

- Flue gas addition with air staging appears to promise the largest amount of NO_x reduction.
- A minimal increase in cyclone barrel tube corrosion would be experienced with the low air cyclone or flue gas injection operation.
- Bias firing of cyclones burning lignite appears to provide a marginal reduction in NO_x emissions.
- Flue gas injection effectively reduces NO_x by lowering the overall cyclone temperature.
- Firing a high rank coal/lignite blend could be used to reduce NO_x emissions. This could be a new market niche for North Dakota lignite.

The Title IV cyclone boiler final rule limits NO_x emissions to an annual average of 0.86 lbs NO_x/MMBtu. Flue gas injection and air staging demonstrated in the project can provide the necessary NO_x reduction for the North Dakota lignite-fired cyclone boilers to meet that requirement.