Project Status Report for: November 2000

Project Title: Ultra Low NOx Integrated System for Coal-Fired Power Plants

Project Number: 91890460 **Project Manager:** John Marion

Customer Name: U.S. DOE / Performance Projects **Project Leader:** Charles Maney

GOALS AND OBJECTIVES:

Develop low cost, retrofit NO_x control technologies to address current and anticipated, near term emissions control legislation for existing coal fired utility boilers. Specific goals include:

- Achieve < 0.15 lb/MMBtu NO_x for eastern bituminous coals
- Achieve < 0.10 lb/MMBtu NO_x for western sub-bituminous or lignitic coals
- Achieve economics at least 25% less than SCR-only technology
- Validate NOx control technology through large (15 MWt) pilot scale demonstration
- Evaluate the engineering feasibility and economics for representative plant cases
- Provide input to develop commercial guidelines for specified equipment
- Provide input to develop a commercialization plan for the resultant technologies

WORK PLANNED FROM PREVIOUS REPORT:

Task 2.1 – Test Fuels Characterization

- Re-determine high temperature volatile yields for the medium volatile test coal generated chars.

Task 2.4 – Advanced Control System Design

- Begin analysis of the flame scanner data and coal flow meter combustion test data.

Task 3.3 – Combustion Testing and Cleanup

- Begin first test period facility cleanup.
- Dispose of scrubber / solid (ash) waste.

Task 3.5 – Data Reduction and Analysis

- Begin data reduction and analysis from first combustion test period
- Generate preliminary test result data set.

ACCOMPLISHMENTS FOR REPORTING PERIOD:

Task 2.1 – Test Fuels Characterization

- *Re-determine high temperature volatile yields for the medium volatile test coal generated chars.*

Repeat micro-proximate analyses were performed on the chars generated from the three size cuts of the medium volatile bituminous test coal in ALSTOM Power's Drop Tube Furnace System-1 (DTFS-1). The original, parent feedstock size cuts included a 200x400-mesh, X_{mean} ~ 60 μm sample; a 270x400-mesh, X_{mean}~ 45 μm sample; and a 100% -400-mesh, X_{mean} ~ 30 μm sample.

The results of the re-analysis of the DTFS-1 generated chars are shown in Figure 1. As shown, the high temperature DTFS-1 volatile yield for the mvb test coal is, on average, 20% greater than the ASTM result, with no appreciable trend in yield with particle size. Variation in the high temperature result with particle size is most likely associated with the ash tracer technique used for determining DTFS / high temperature yield.

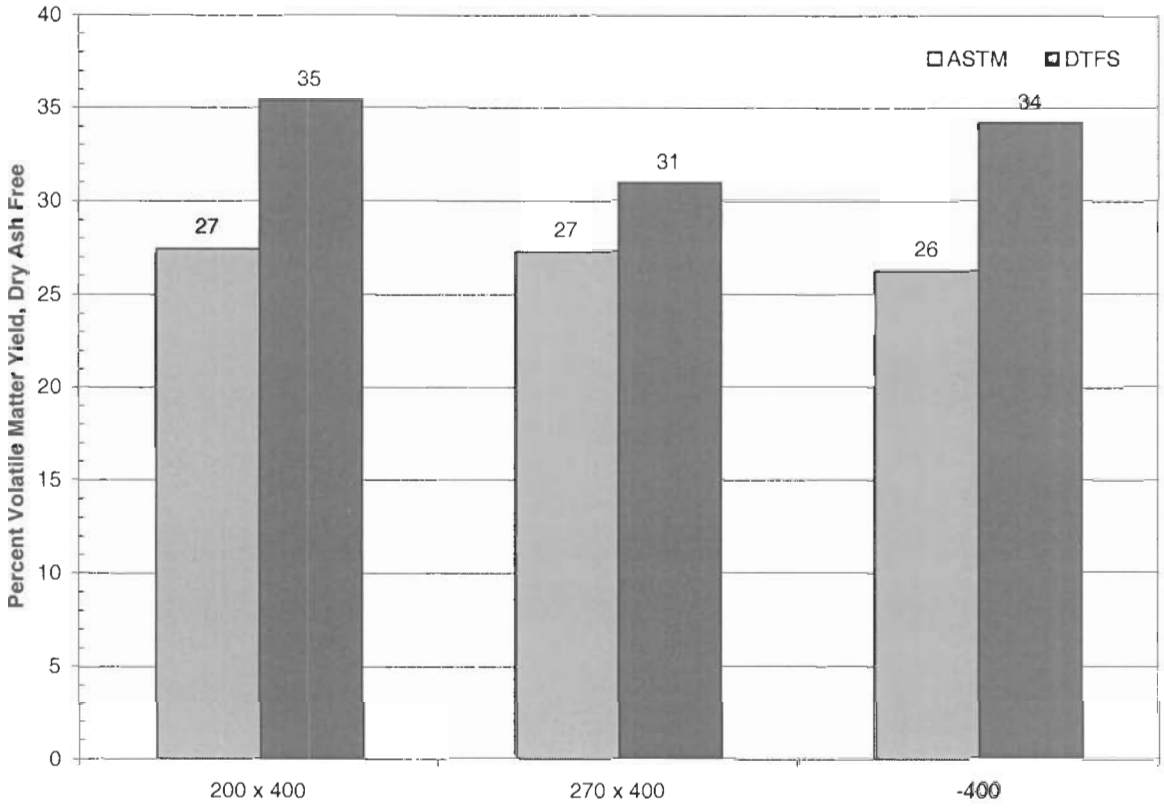

Figure 1 – DTFS-1 / High Temperature Volatile Yield v Test Coal Grind

With regard to the overall (average) high temperature volatile matter yield for the medium volatile test coal, the results are consistent in demonstrating that the test coal is significantly less reactive than typical high volatile bituminous coals (Figure 2), and thus less favorable with regard to inherent NOx reduction under staged combustion conditions.

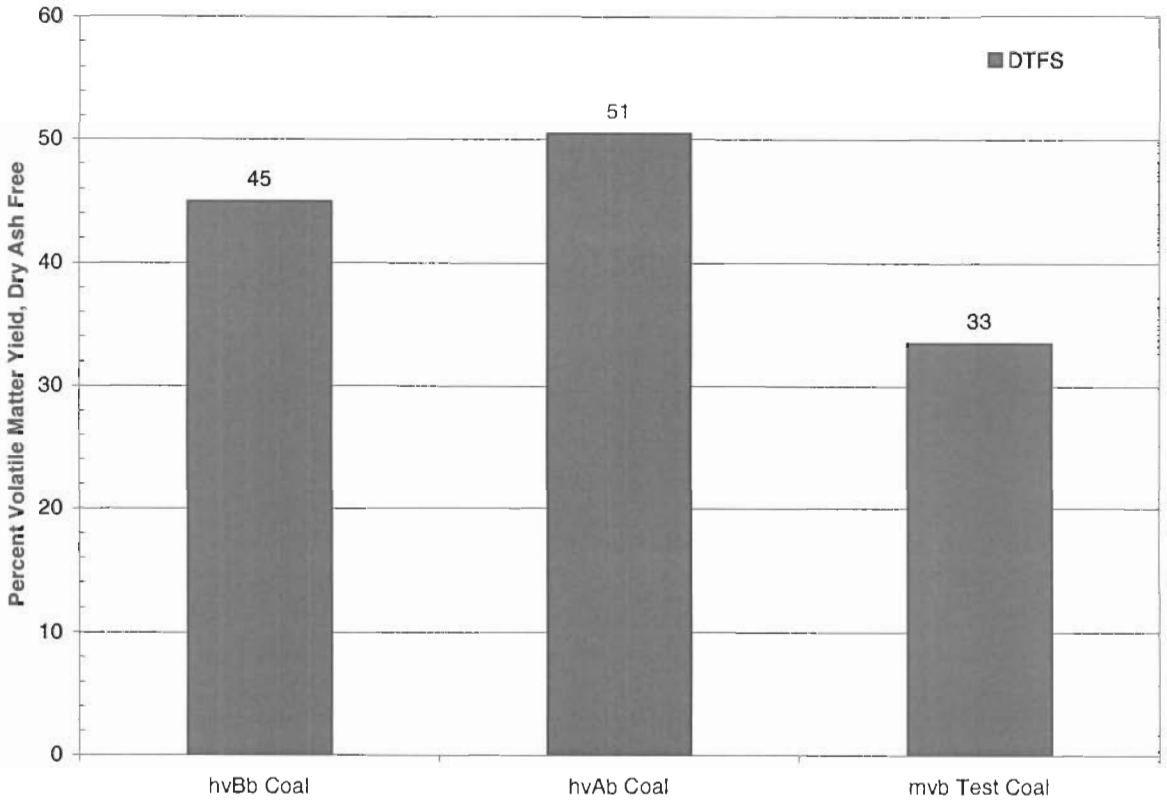

Figure 2 – DTFS-1 / High Temperature Volatile Yield v Coal Type

Task 2.4 – Advanced Control System Design

- *Begin analysis of the flame scanner data and coal flow meter combustion test data.*

Initiation of the flame scanner and coal flow meter data reduction was postponed pending completion of the overall test data set reduction work (see Task 3.5). This will avoid reanalysis of this data once final test condition and emissions performance has been determined for the combustion test effort on which the flame scanner and coal flow meter sensor data depend for the development of performance trends.

Task 3.3 – Combustion Testing and Cleanup

- Begin first test period facility cleanup.
- Dispose of scrubber / solid (ash) waste.

Clean-up of the ALSTOM Power's Boiler Simulation Facility was begun during the month of November. The majority of the clean-up work, including disposal of scrubber effluent and fly ash solid waste was largely completed, with some additional work relating to the disposal of the heavier scrubber solids, and test preparation waste disposal remaining for December.

Task 3.5 – Data Reduction and Analysis

- Begin data reduction and analysis from first combustion test period
- Generate preliminary test result data set.

A medium volatile bituminous coal was fired in the ALSTOM Power's Boiler Simulation Facility (BSF) at a rate of approximately 57 MMBtu/hr from October 29 through November 3, 2000 and November 13 through November 14, 2000 in support of project work. During this time, approximately 50 combustion tests were performed, data reduction for which is on-going and will continue through the month of December in preparation for internal (ALSTOM Power) and external (DOE NETL / Advisory Panel) presentation in January, 2001.

Among the interesting, preliminary results obtained so far from the combustion testing was the effect of coal grind on both the NOx and unburned carbon in the fly ash. During the first combustion test period, two coal grinds were evaluated: a fine grind (commercially available with a Dynamic™ classifier) and a micro-fine coal grind, both of which were fired through all burner elevations. Figure 1 illustrates the impact of coal grind on furnace outlet NOx across a range of main burner zone stoichiometries.

As shown, NOx emissions for the micro-fine grind coal were lower than those of the fine grind coal for a range of main burner zone stoichiometries when firing the medium volatile bituminous test coal. For the fine grind, NOx emissions ranged from a high of 0.80 lb/MMBtu to a low of 0.23 lb/MMBtu. For the mirco-fine grind, NOx emissions ranged from a high of 0.74 lb/MMBtu to a low of 0.19 lb/MMBtu. Average NOx emissions reductions were, thus, approximately 0.04 lb/MMBtu, or 10%, when firing the micro-fine coal under the same conditions as the fine grind coal.

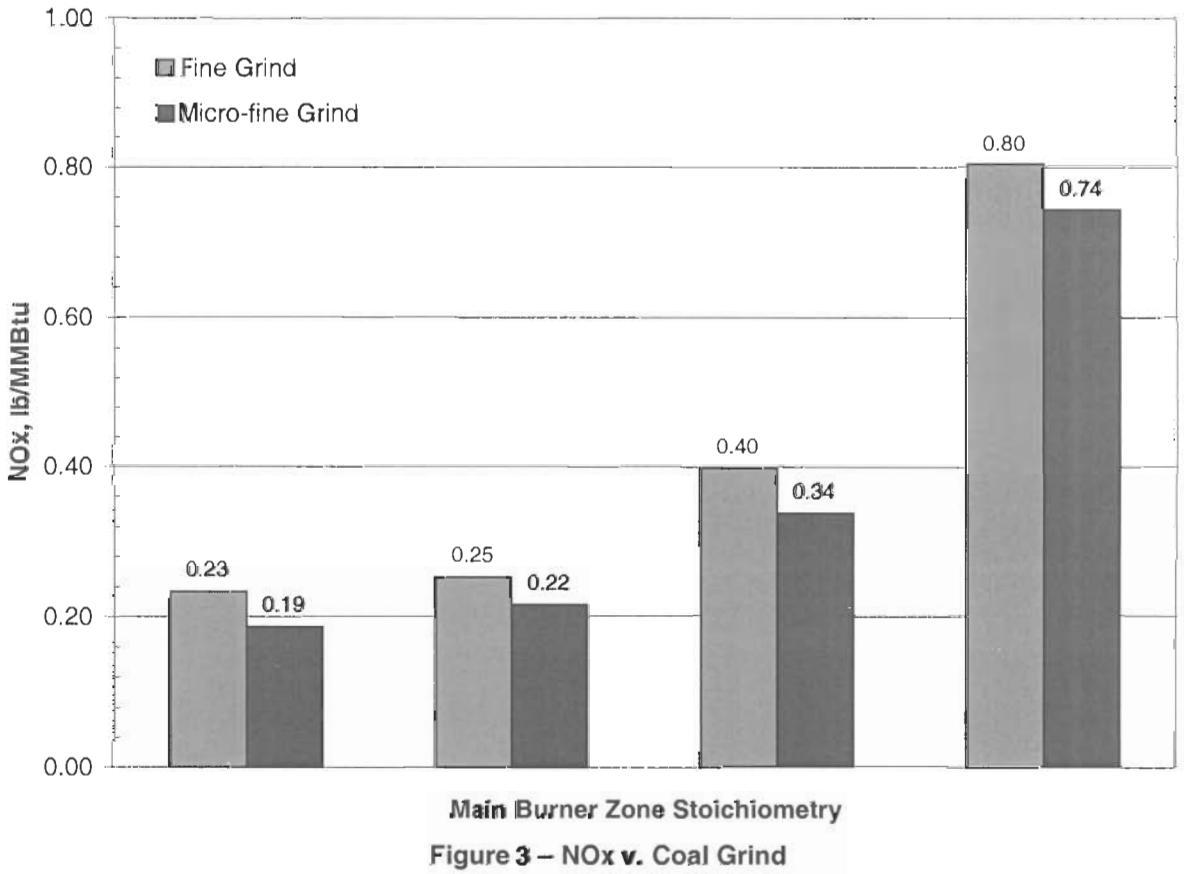

Figure 3 – NOx v. Coal Grind

The impact of coal grind on carbon in the fly ash levels is shown in Figure 4. As shown, utilizing the micro-fine coal instead of the fine grind results in a reduction in carbon in the fly ash of approximately 75% across a range of main burner stoichiometries. These results emphasize the benefit of reductions in coal particle size as a means to improve both combustion efficiency and NOx emissions for low reactivity coals under staged combustion conditions.

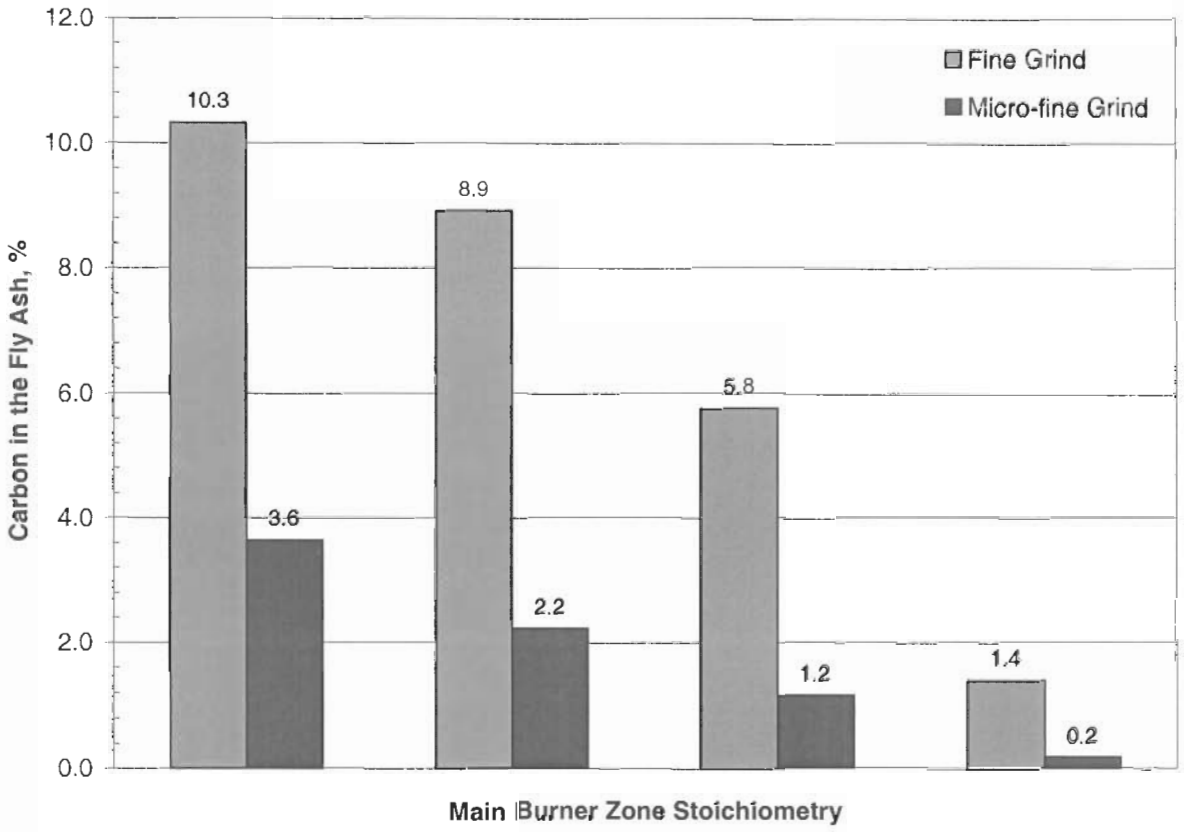

Figure 4 – Carbon in the Fly Ash v. Coal Grind

WORK PLANNED FOR NEXT REPORTING PERIOD:

Task 3.3 – Combustion Testing and Cleanup

- Complete first combustion test period facility cleanup work; reconcile final test costs
- Secure facility for winter / until initiation of second test week preparation activities

Task 3.5 – Data Reduction and Analysis

- Continue first combustion test period data reduction and analysis
- Begin the generation of graphics and summarization of the test results in preparation for internal and external (DOE NETL / Advisory Panel) presentation and review.

Task 6 – Advisory Panel