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Project Summary

Long Term Optimum Performance/Corrosion Tests of Combustion Modifications for Utility Boilers—Host Site: Utah Power and Light Company, Hunter No. 2

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Combustion modifications (e.g., low excess air firing, staged combustion) can decrease NO_x emissions from coal-fired utility boilers. However, these operating conditions may affect the rate of tube wall corrosion by creating chemically reducing environments in the furnace. Therefore, this study was designed to understand the effects of certain combustion modification (CM) techniques for NO_x control and to determine the impact of CM on boiler tube wall corrosion rate. The host site for these tests was Boiler No. 2 at Utah Power and Light Company's Hunter Generating Station in Castle Dale, Utah. Initially, the boiler was characterized to determine the short term effects of CM on boiler emissions and performance. Later, NO_x and other emissions were monitored continuously during several 30-day periods so that longer term operations could be evaluated. Finally, a study of corrosion rates inside the furnace helped to determine the corrosion effects of low-NO_x operation achievable through CM.

At Hunter No. 2, a special Low-NO_x Concentric Firing System (LNCFS) was installed by Combustion Engineering, Inc. The LNCFS deflects some of the combustion air away from the fuel jets and toward the furnace walls to decrease both NO_x emissions and corrosion effects. In these tests, the LNCFS together with other combustion controls were able to decrease full-load NO_x emissions from 460 vppm (0.63 lb/MBtu, 271 ng/J) to about 305 vppm (0.41 lb/MBtu, 176 ng/J) during normal long term operation, and to 180-200 vppm (0.25-0.27 lb/MBtu, 108-116 ng/J) during shorter, well-controlled tests using extreme CM conditions. The long term (2-year) corrosion rate measured in the furnace was less than 1 mil (<0.001 in.) per year.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Results and Conclusions

Boiler Characterization

In the "as found" (pre-LNCFS) condition, NO_x emissions were about 460 vppm (0.63 lb/MBtu, 270 ng/J) at typical full load conditions (~4.5% O_2, no overfire air,

and burner tilts ±5 degrees from horizontal). During these early characterization tests, it was found that, by using the existing boiler controls (i.e., no hardware changes), full load NO_x emissions could be decreased by about 30% to approximately 320 vppm (0.44 lb/MBtu, 188 ng/J) without adversely affecting boiler performance or operability. This was accomplished by decreasing excess oxygen (to about 3.5%), opening the overfire air dampers, and adjusting the overfire air nozzle tilts.

Installation of the LNCFS involved certain hardware modifications to the boiler and produced even greater NO_x reductions than were seen during the baseline (pre-modification) tests. For example, under extreme low-NO_x conditions (not recommended for long-term operation because of boiler operability problems), some tests demonstrated that NO_x emissions of 180 to 200 vppm (0.25 to 0.27 lb/MBtu, 106 to 118 ng/J) were possible when at slightly less than full load. These levels fulfilled the short term, full load, optimized performance goal of 0.30 lb/MBtu (129 ng/J) for this boiler. Over the entire range of boiler operations, short term tests using manual boiler control demonstrated the ability to achieve average NO_x levels of about 265 vppm (0.36 lb/MBtu, 156 ng/J).

Thirty-Day Continuous Emission Monitoring (CEM) Tests

Four times during this program, flue gas emissions (NO, CO, CO_2, and O_2) at the Hunter No. 2 Unit were monitored continuously for 30 days using CEMs. This work permitted an evaluation of boiler emissions over normal load cycles for longer periods than were possible during the earlier characterization tests. The results show that NO_x emissions (as NO_2) averaged about 176 ng/J (0.41 lb/MBtu) (well below the 1979 NSPS limit of 260 ng/J [0.60 lb/MBtu] for bituminous coal) with a maximum daily average (for any day of the four tests) of about 240 ng/J (~0.56 lb/MBtu).

Corrosion Tests

To more fully evaluate the longer term effects of low-NO_x operation, corrosion tests were performed by two different methods so that the metal wastage rates could be measured. In the corrosion probe method, temperature controlled samples of boiler wall material were inserted into the furnace for periods of 30, 300, and 1,000 hours. After removal from the furnace, their weight loss was indicative of the boiler tube walls' short-term corrosion rate. The other method used to measure fireside corrosion was an ultrasonic pulse echo method. In this method boiler tube wall thicknesses were measured on two different occasions (after baseline, and after Modification 2 testing about 2 years apart (during scheduled outages) to determine long-term corrosion rates at hundreds of locations inside the furnace. The long-term corrosion rates measured under this program (less than 1 mil [<0.001 in.] per year on the average) would not be expected to reduce this boiler's useful life below the 30 or more years normally expected.

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The complete report, entitled "Long Term Optimum Performance/Corrosion Tests of Combustion Modifications for Utility Boilers—Host Site: Utah Power and Light Company, Hunter No. 2," (Order No. PB 85-193 159/AS; Cost: $28.00, subject to change) will be available only from:
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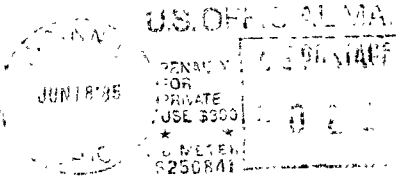

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