Operating Experience with Reburn Systems on Cyclone-Fired Boilers

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Reburn systems have been successfully applied to wall-fired, tangentially-fired and cyclone-fired boilers. Gas reburn systems have been installed on three cyclone-fired utility boilers. The first reburn installation was made on a 330 MWe boiler firing a western fuel blend. The second and third installations are at the same plant on very similar 200 MWe boilers that fire eastern bituminous coals. This paper describes the reburn systems, emissions performance and operating experience.

The Tennessee Valley Authority (TVA) contracted for a GR system for Unit 1 at the Allen Fossil Plant in Tennessee with options for Units 2 and 3. These units are identical 330 MW cyclone units firing a blend of bituminous and Powder River Basin coals through seven cyclone furnaces. TVA will use the reburn system to comply with EPA's Title IV cyclone NO_x limit of 0.86 lb/10^6 Btu. The design goal for this application was to achieve this NO_x limit while minimizing the gas injection rate. Tests have shown that the baseline NO_x varies substantially as the coal blend varies. The NO_x limit can be maintained by varying the gas injection rate.

The GR system is designed to inject natural gas and overfire air into the boiler under automatic control over the load range of 150 to 300 MW. The natural gas injectors were positioned on all four walls of the furnace above the cyclones: three on the front wall, four on the rear wall, and one on each side wall. This arrangement properly distributes the reburn fuel in the highly complex furnace flow field. The overfire air (OFA) system uses heated secondary combustion air from the air heater outlet and is designed to inject up to 25 percent of the total combustion air. The OFA is injected through four injection ports on the front wall and four on the rear wall of the furnace located just above the furnace expansion.

The maximum NO_x reduction achieved was over 65 percent. The Title IV NO_x limit for cyclones of 0.86 lb/10^6Btu was met with about 7 percent gas, meeting all performance guarantees. Operating the reburn system with the OFA only (gas injectors turned off) reduced NO_x emissions by as much as 50 percent with lower cyclone excess air levels. The flexibility of operating the GR system without the reburn fuel provides yet another option for cost-effective control.

Baltimore Gas and Electric (BGE) Crane Station Units 1 and 2 are similar 200 MW units firing bituminous coal through four cyclones each. Unit 1 is a natural circulation boiler with wing walls, while Unit 2 is a sub-critical once-through boiler without wing walls. BGE must comply with Title IV NOx limits for these two units and selected gas reburn as the control method.

The reburn systems for both boilers were designed to operate with up to twenty five percent heat input from gas over the range of 100 to 200 MWe. The reburn systems on the Crane units utilize second generation reburn technology; i.e., no flue gas recirculation is required as a carrier medium when

injecting the natural gas into the boiler. This reduces the capital cost of the equipment and minimizes the reburn fuel requirement. The use of the technology was made possible due to the high pressure available in the gas pipeline which can produce high velocity reburn jets. Four gas injector assemblies were installed on both the front and rear walls. Sootblowers installed in the gas injector assemblies have successfully removed slagging at the injector openings. With the exception of the gas injectors, the design for Unit 1 was identical to that of Unit 2. Four OFA injectors were installed on both the front and rear walls. No overfire air booster fans were required since the combustion air pressures are sufficiently high to produce the required air injection velocities.

On June 1, 1997 EER was awarded a contract by BGE to provide a reburn system for Crane Unit 2. Following detailed design and procurement, the system was installed during a 2-1/2 month fall 1998 outage with startup occurring in December. Parametric testing, designed to optimize the reburn system and develop system control curves, was performed during January and February 1999. The Unit 2 reburn system is currently ready for commissioning pending completion of guarantee testing.

On March 23, 1998 BGE exercised a contract option for a reburn system on Unit 1. Installation was completed during December 1998, and startup began in April 1999 with commissioning at the end of that month.

Reburn systems have been installed on three cyclone-fired utility boilers rated at 200 MWe or greater. These installations confirm that reburning is a commercially viable option for achieving Title IV NO_x limits. Depending on fuel characteristics, the reburn system may be operated without the reburn fuel (OFA only) in conjunction with operation of the cyclones at reduced excess air levels to achieve modest NO_x reductions. Greater NO_x reductions over that possible with reburn systems alone can be achieved with Advanced Reburning. Advanced Reburning is the integration of reburn and SNCR systems.