Project Description

Overfire Air (OFA) Delivery System Upgrade on the No. 3 RDF Boiler
Great River Energy
Elk River, MN

Project Scope

The No. 3 Boiler, originally designed to burn stoker coal, was converted to fire refuse derived fuel (RDF) in 1989. The converted boiler was predicted to generate 173,600 lb/hr of steam at 750°F and 615 psig. Prior to the JANSEN upgrade, the unit's steam generation was restricted to the 130,000 lb/hr to 150,000 lb/hr range by carbon monoxide (CO) and nitrogen oxides (NO_x) emission limits. Periodic natural gas firing was required to achieve CO compliance.

The old OFA system consisted of several small circular ports (made from 4" and 2.5" pipe) arranged in three levels on the rear wall and two levels on the front wall. Due to fundamental design limitations, there was insufficient flow and penetration of the OFA into the furnace, leading to lower volatiles burnout and higher CO emissions. Additionally, the absence of reliable combustion air and oxygen trim controls resulted in frequent spikes in the CO emissions when flue gas oxygen levels in the boiler dropped during short periods of unstable combustion conditions.

The plant had a desire to improve the combustion performance of the No. 3 Boiler by upgrading the OFA system. The goals of the upgrade project were:

- Reduce the reliance on burning natural gas to achieve CO compliance.
- Reliably increase steam generation and RDF firing.
- Maintain CO and NO_x emissions compliance at these higher RDF firing rates.
- Reduce furnace slagging on the front wall.

The new OFA system was installed in April of 2008. Four custom designed Jansen High Energy Combustion Air Nozzles™ were placed on each side wall, arranged in an interlaced pattern. The low pressure drop design of the JANSEN nozzles allowed increased OFA flow capacity while retaining the existing OFA booster fan. A separate low capacity ambient air fan was installed to deliver combustion air to the wind-swept fuel distributors.

Results

Operation with the new OFA system and the implementation of an oxygen trim logic has resulted in the following demonstrated performance improvements:

- A 12% average increase in RDF firing and steam generation rates.
- Ability to operate at lower flue gas oxygen levels while maintaining CO and NO_x compliance.
- Reduced frequency and magnitude of CO emission spikes.
- Reduced need for natural gas co-firing to remain within emissions compliance.

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