

Case Study: December, 2016



Synopsis

NTFB recently converted this customer's D type watertube boiler to meet ever-tightening NOx requirements on a methane gas/hydrogen fuel gas mix while maintaining the efficiency advantages of an existing air preheater for combustion air.

This Sichuan boiler, rated 88,000 PPH steam, was originally equipped with two European designed burners to burn gas and oil. Oil had since been eliminated, but fuel gas containing mostly methane plus ~17% hydrogen fuel remained as a challenging fuel. The goal was to replace these two burners with a single NTFB burner while also utilizing 400 degree preheated combustion air, all while meeting <50 ppm NOx and <25 CO. Boiler steam conditions were unusually high at 610 psig @ 770 Deg F superheat.

NTFB's equipment scope included a new windbox burner unit with multiple gas spud elements designed to attain the required low NOx and CO levels while firing this CH₄/H₂ mix. Burner management, combustion controls, and fuel trains were to be retained and reworked so they were compatible with a single burner solution.

The Technical Challenge

The existing two burners installed on this boiler could only achieve ~75% of maximum boiler capacity, with considerable excess air required to meet only a nominal 200 ppm NOx. The close quarter of these two burners worked adversely to reduce emissions

any lower than this, but seemed to be the correct solution when this boiler was first commissioned. The challenge for NTFB was to come up with a single burner solution to meet emission requirements of <50 ppm NOx and <50 ppm CO when firing this hydrogen rich fuel gas. It should be noted that preheated air will generally *increase* thermal NOx levels, also due to the higher adiabatic flame temperatures associated with this hydrogen rich fuel vs that of ordinary natural gas.

The Solution

NTFB used a single burner approach with their streamlined style GS Low NOx gas burner without the need for induced FGR. NTFB was also able to retain the customer's existing dual burner management and combustion controls system. Minimum system modifications were required to make these controls as well as the existing fuel gas train compatible with single burner operation.

With NTFB's single low NOx burner solution, full boiler load of 132 mm btu/hr input could now be attained. Also the targeted <50 ppm NOx *without* the need for flue gas recirculation, in spite of a combustion air temperature of ~400 degrees F. CO emissions at maximum load are also low at <25 PPM, with excess air at <15%. In addition, 10:1 burner turndown under automatic controls can be easily achieved using parallel positioning combustion controls with O₂ trim and with variable frequency controls (VFD) for the combustion air fan.



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Hidden Benefits

NTFB has met their customer's and the local air district requirements <50 PPM NOx when firing this hydrogen rich fuel gas. As NOx emissions tighten in future years, this petrochemical company can add induce flue gas recirculation (FGR) can for further NOx reduction with minor modifications to the NTFB low NOx burner and to their existing combustion air delivery system.

NTFB has again helped an important customer set the challenge for other industrial and commercial facilities to meet current and potential future NOx emission standards in various provinces of China.

Boiler and Burner Performance at Maximum Boiler Load (MCR)

Boiler capacity – 88,000 PPH (+10% MCR)
Heat Release Rate – 132 MM Btu/hr at MCR
Operating Pressure - 610 PSIG
Superheated Steam Temp – 770 Deg F
Feedwater Temp - 262 Deg F
Combustion Air Temp - ~400 Deg F
NOx at MCR - < 50 PPM
CO at MCR - < 25 ppm
O2 Level at MCR - <3%
Gas Supply Pressure – 25 PSIG

Burners, Combustion Controls, Burner Management, Gas Piping

- Low NOx Burners – NTFB Model GS
- Burner Windboxes – NTFB Model AO3
- Fuel Piping – NTFB per NFPA 85
- Controls (CCS) – Parallel Positioning / O2 Trim / VFD Control
- Burner Management – Existing system retrofitted to single burner operation with Honeywell scanners



BMS Panel - Stainless Steel, Explosion Proof
With Internal Air Purge System

