5 Turnberry Lane
Newtown, CT 06482
tel 203.270.0337
www.stepcombustion.com
www.eescorp.com

Case Study: Vibrations and Taper Pins

Background

A package boiler at a refinery had a long history of vibration issues. Previous service reports from the burner OEM claimed that the older control system utilizing Moore 353 controllers, was unable to sufficiently control the FGR flow. Subsequently, the windbox O2 would dip below stable ranges (<16.5%) and **vibrations** from combustion were significant enough to shear the bolts off the burner front plate, cause tears in the boiler casing, and create cracks in the outlet ductwork. Service reports also indicated that once the FGR was under control, the vibrations were under control. However, additional reports from plant personnel contradicted the OEM report and stated that even with FGR in the target range, the harmful vibrations persisted. After years of extensive tuning efforts, plant engineers ultimately decided their only option was to lock out the FGR and elevate the O_2 to 6% in order to mitigate the vibrations while they waited to upgrade the control system and change out the burner. This also increased the NOx from ~30 to 125 ppm.

Figure 1: Taper Pins Installed

Solution

In lieu of burner replacement, STEP suggested an **engineering first approach** beginning with a holistic system review. The original 200 MMBtu/hr burner was a typical Low-NOx, staged fuel, venturi style gas burner. This 'tried-and-true' technology has been used successfully for decades with thousands of applications. The burner OEM proposed to replace the burner with and Ultra-Low NOx burner technology that would require new valve trains and control system. Upon thorough engineering review of all reports, the burner gas port design, and site visit, STEP proposed minor modifications to the existing burner to achieve the desired result. STEP determined that the main issue with the burner was the excessive ratio of center fired gas to staged gas, which contributed to incomplete or delayed combustion, and potentially exacerbating the vibration issues.

STEP designed custom **taper pins** to plug off key center gas ports to adjust the center to staged gas ratio and to allow for additional air to penetrate the center flame. This **engineered**, targeted, reversable, and cost-effective change remedied the design flaw of the existing burner and mitigated unnecessary spending on a new burner, fuel skids, demo, and installation. In general, Low-NOx burners provide a consistent, robust, and reliable performance that is vital to a plant focused on production.

Conclusion

The STEP Combustion modifications were installed in parallel with the new control system. The system was commissioned and is successfully operating at ~4% O2, <25ppm NOx, and <50ppm CO. O2 was reduced from 6% to 4% improving boiler efficiency and NOx was reduced from 100ppm to 25ppm. Stability and flame characteristics were improved throughout the load range and vibration issues were eliminated.