ETEC Proprietary
Induced Flue Gas Recirculation Systems
For NOx Control

Flue Gas Recirculation Background

Recirculating flue gas back to the combustion zone has been one of the most effective methods of reducing NOx emissions from gas and oil fired units since the early 1970's. Flue gas recirculation (FGR) acts to reduce NOx formation by reducing peak flames temperatures. In conventional applications, the recirculated flue gas is typically extracted from the outlet duct upstream of the air heater. The flue gas is then returned through a separate duct and hot gas fan to the combustion air duct that feeds the windbox. The recirculated flue gas is mixed with the combustion air via air foils or other mixing devices in the duct. This technology is known as windbox FGR (WFGR). WFGR systems require installation of a separate hot gas FGR fan to move flue gas from the exit to the air supply ducting at the windbox inlet, where mixing of the air and flue gas must be uniformly achieved by installation of appropriate mixing devices.

Figure 1

ETEC IFGR Technology Description

Entropy Technology & Environmental Consultants, Inc. (ETEC) offers a far less costly FGR technology, which eliminates the need for a separate FGR fan and windbox mixing device. This technology, known as induced flue gas recirculation (IFGR), utilizes the FD fan to pull (induce) flue gas from the exhaust duct into the combustion air at the fan inlet. The fan also serves as the mixing device. IFGR is, thus, a very cost-effective method to achieve significant NOx reductions (50% to 80%). IFGR requires very minor modifications and has relatively little or no impact on unit performance and operation. The ETEC IFGR System for a typical application includes ducting between the exhaust flue and the FD fan inlet ducts, and the necessary flow control dampers to achieve the desired degree of flue gas recirculation over the operating load range of the unit. Figures 1-3 show typical exhaust duct IFGR extraction point, IFGR ducting, and forced draft fan inlet ducting.

Figure 2

Subsequent to IFGR installation, ETEC optimizes the combustion process in conjunction with IFGR utilization, and then prepares operational guidelines and procedures to be followed to ensure safe and efficient operation throughout the unit's load range.

Figure 3

ETEC IFGR System Costs

The ETEC IFGR technology is a very cost effective application of FGR due to elimination of auxiliary FGR fan and combustion air duct modification requirements for proper mixing of the flue gas with the combustion air. The cost of IFGR is a small fraction of the cost of other available NOx control technology systems, i.e., LNB, WFGR. The actual cost, however, depends on unit and site specific considerations that must be defined on a case by case basis.

IFGR Application Considerations

Since IFGR may impact forced draft fan capacity and reheat steam temperature controls, the applicability must be carefully evaluated during the initial design phase. Subsequent to installation, the IFGR system must be optimized throughout the units operating load range. The following summarizes the advantages and disadvantages of IFGR.

IFGR Advantages:

- Fractional cost of alternate technologies
- Highly Effective NOx reduction (50-80%)
- Energy efficiency increase in many cases
- Combustion performance is improved as illustrated in Figures 4 and 5
- Minimal downtime required for installation
- IFGR may be used with existing burners, as well as Low NOx Burners
- IFGR does not result in excessive pressures as LNB/WFGR systems may

IFGR Disadvantages:

- IFGR operation at full load may be limited by forced draft fan capacity
- Reheat steam temperature controls may limit IFGR operation

ETEC FGR Experience

ETEC engineers have a long history of addressing and solving NOx emission problems. ETEC engineers were instrumental in providing the original testing and analytical work (in the 1970's), which defined the combustion processes by which NOx emissions were generated and the operational and equipment modifications necessary to reduce emissions. Among the NOx reduction technologies pioneered by ETEC engineers was Flue Gas Recirculation (FGR). Based largely upon the initial work of ETEC engineers, FGR has been implemented on scores of boilers in the electric utility industry. In the past these installations have relied on dedicated FGR fans to provide the required exhaust gas recirculation.

ETEC engineers have more recently developed proprietary IFGR technology for utility and industrial applications. These proprietary developments have resulted in elimination of expensive CFD modeling while providing the means for precision system design to meet our clients' specific requirements. As a result, the ETEC IFGR System has been judged by many of our clients to be the most cost-effective retrofit NOx control technology available today for both electric utility and industrial applications.

To date, ETEC has been responsible for ~80% of all IFGR system installations on electric utility boilers in the country.

Figure 4 Pre IFGR Operation

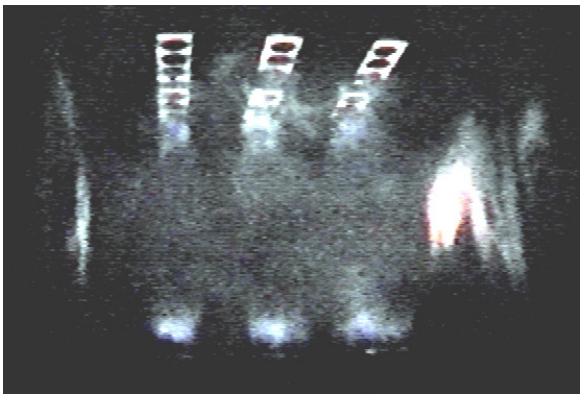

Figure 5 IFGR Operation

For more information on the ETEC IFGR system and its applicability for your plant, please contact us at (281) 807-7007 or visit us at; **http://www.etecinc.net**