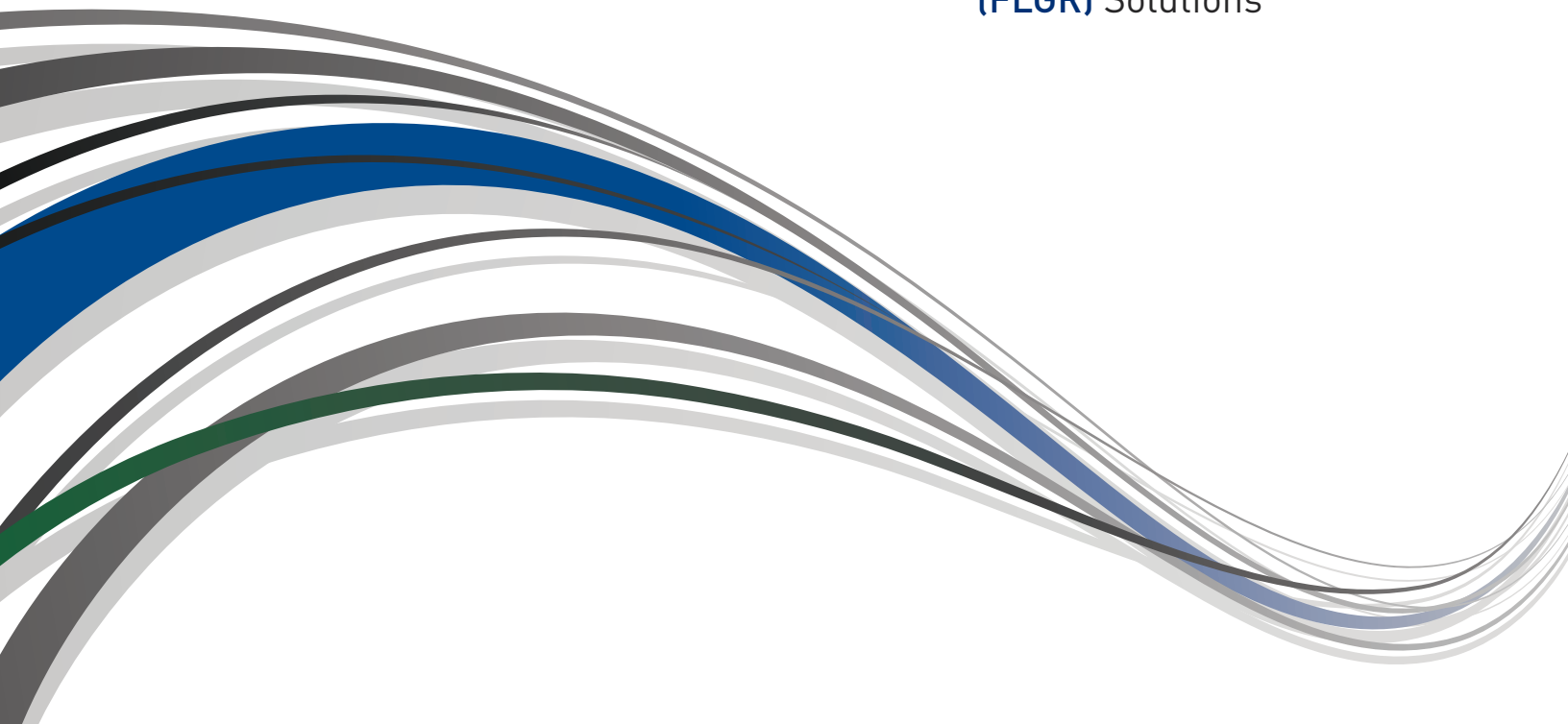
BREEN®

SMART SCIENCE • CLEANER ENERGY

Fuel Lean Gas Reburn (FLGR) Solutions



INTRODUCTION TO FLGR

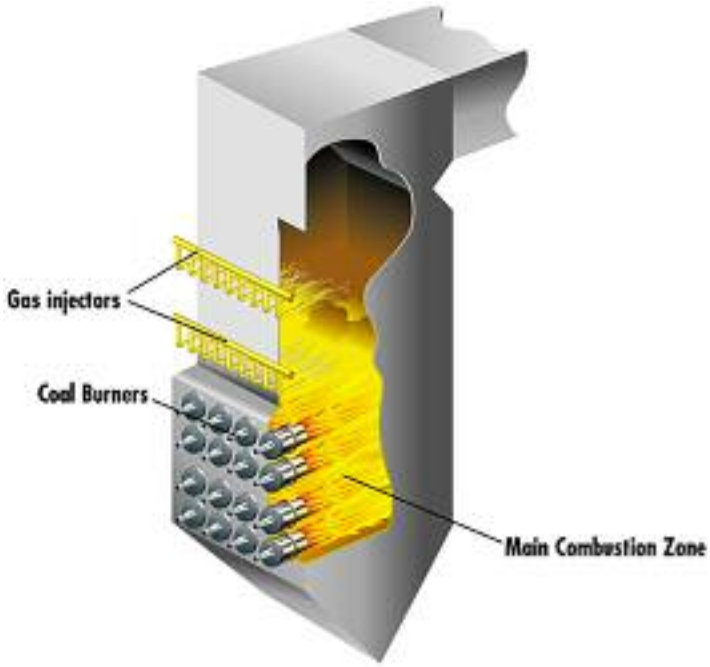
Fuel Lean Gas Reburning (FLGR) injects natural gas above the main combustion zone of a coal-fired furnace to reduce NOx to harmless nitrogen. Since FLGR does not require a physical change to the main combustion system, it requires a relatively low capital cost, typically less than $8/kW.

Low capital cost coupled with operating costs based on gas/coal price differentials and gas use of 5-15% makes FLGR an option for utilities requiring additional NOx reductions. Utilities must further reduce NOx and SO_2 to comply with CSAPR. FLGR can provide up to 30% NOx reduction and generate SO_2 allowance credits in direct proportion to the amount of Natural Gas that displaces Coal, which could be up to 15%.

For boilers limited in generating capacity by either fans or mills, FLGR offers a potential increase of up to 7% in generating capacity.

AEFLGR (Amine Enhanced FLGR)

By adding Urea to the FLGR system, utilities can get NOx reduction from an SNCR reaction in addition to the FLGR reaction. NOx reduction rates of 40 to 60% can be achieved using Amine Enhanced FLGR.



BREEN UNDERSTANDS THE ENVIRONMENTAL, ECONOMIC AND REGULATORY PRESSURES THAT COAL-FIRED GENERATION PLANTS FACE.

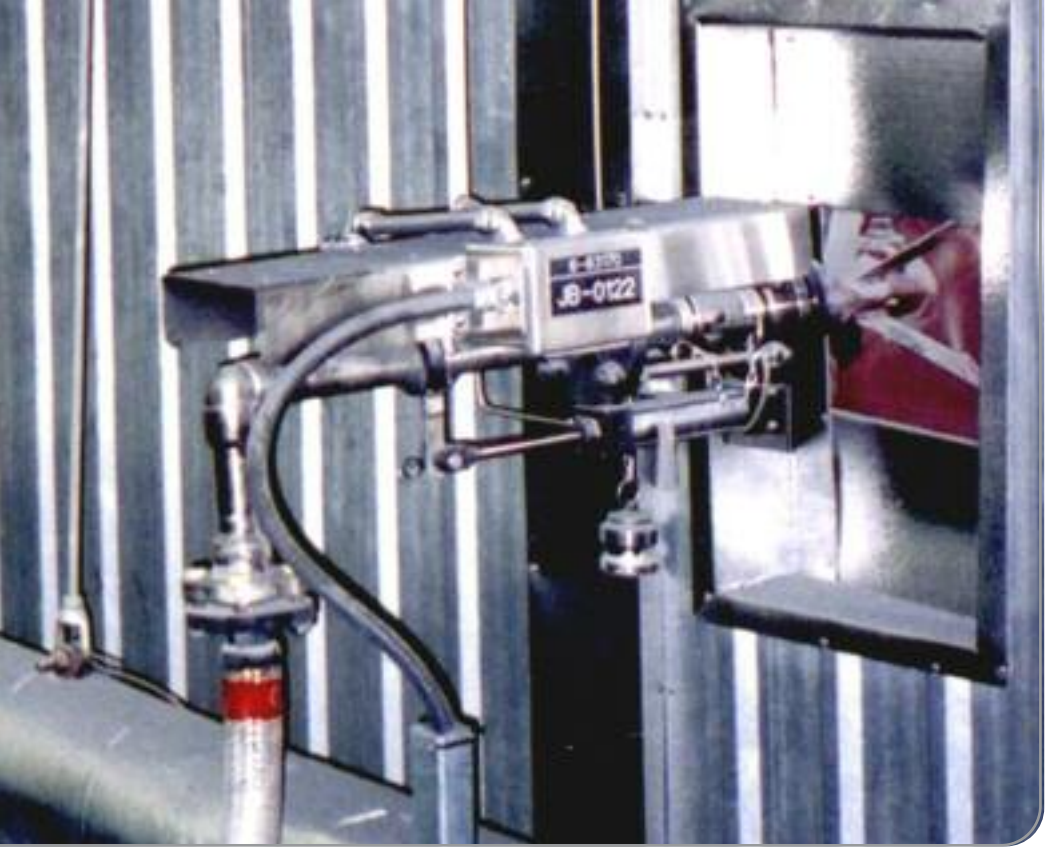
How FLGR Works

FLGR is different from conventional gas reburning systems because gas is injected in a manner that optimizes the furnace's stoichiometry on a very localized basis. The process avoids creating a fuel-rich zone and maintains overall fuel-lean conditions.

Natural gas injection is carried out at a low furnace temperature, between 2000 and 2300 deg F. This is done using multiple, high-velocity turbulent gas jets that penetrate into the upper furnace to the areas with the highest NOx concentration. FLGR can also maintain acceptable emissions of carbon monoxide (CO) without overfire air, which must be added in conventional gas reburning systems to ensure that all the reburn fuel and other combustibles burn out completely. This makes the FLGR technology less expensive than conventional reburning.

Installation with Existing NOx Equipment

FLGR has been installed on units with no NOx controls, low NOx burners (with and without overfire air) and selective non-catalytic reduction (SNCR) equipment. NOx reductions with FLGR are in addition to reductions achieved with other NOx controls. Fuel Lean Gas Reburning complements other NOx controls, so previous investments in NOx control equipment aren't lost because the existing controls can still be used effectively with FLGR installed.



The Experience to Analyze
Breen understands the environmental, economic and regulatory pressures that coal-fired generation plants face. Our experience allows us to analyze your situation, including furnace design, existing NOx controls, operational impacts, coal quality and process conditions to maximize the effectiveness of a FLGR system.

We use Computational Furnace Modeling (CFM), an advanced form of computational fluid dynamics technology, to produce a working simulation of the furnace to see distributions of properties such as temperature or stoichiometry and gain insights that can't be achieved with conventional boiler testing. CFM employs software to automatically solve finite difference equations for the conservation of mass, momentum and energy at each grid point. The CFM program then includes models for furnace-specific conditions such as radiative heat transfer, combustion and NOx kinetics.

Models are constructed and validated to the specific characteristics of each individual boiler. A parametric study of design options is then carried out to identify the best FLGR design.

We analyze the findings and submit a full report and recommendations for design of your FLGR system.

Commercial Installations
With over 13 commercial installations, FLGR is a proven technology. Installation sites include ElRama, Mercer, Hudson, Joliet, Pleasant Prairie, Riverbend, Asheville and Nanticoke.

Breen provides a variety of solutions for acid gas management to match your situation. From dry sorbent injection to testing and measurement, Breen applies the best solutions for mitigating and managing acid gas. Contact us to discuss a demonstration program at your facility.

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BREEN TOTAL SOLUTIONS:

- Blue Plume Mitigation and Control
- Dry Sorbent Injection for Acid Gas Mitigation
- Ammonia Slip Mitigation and Control
- Air Heater Fouling Mitigation and Control
- SO_3/HCL Measurement and Control
- HCL Testing Services
- FLGR and AEFLGR for NOx Control
- Sulfur Condensables (SO_3) Testing Services
- Air Heater Sootblower Controls (Dynamic Speed Controlled - DySC)
- Heat Rate Improvement System
- Magnesium Oxide injection for Slag Control
- SCR/SNCR Tuning and Optimization

REGULATORY COMPLIANCE

- CSAPR
- U-MACT
- MATS