

TODAY'S BOILER

TRENDS, TECHNOLOGIES & INNOVATIONS

THE RIGHT TRACK

This old steam locomotive is proving that it's hardly the end of the line for sustainable boiler technologies on the rails, thanks to advances in torrefied biomass.

Innovative NOx Reduction Technology Helps Major Energy Provider Meet Local Regulations

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NRG Energy Center San Francisco supplies energy-efficient district heating services to over 170 customer buildings in a 2-square-mile area within the central business district of San Francisco. Steam is used for space heating, domestic hot water, air conditioning, and industrial processes, representing more than 37 million sq ft of space.

NRG's central district heating plant includes two 55,000 lb/hr (71.4 MMBtu/hr) natural gas fired boilers that are required to comply with the Bay Area Air Quality Management District's (BAAQMD) Reg. 9 Rule 7 NOx emission requirement of 9 parts per million (ppm). Overall, total NOx emission reductions of 90% (at all conditions) were to be achieved. The project requirements consisted of an easy to operate, reliable, and energy efficient space saving solution that would meet or exceed the BAAQMD emission requirements.

The company solicited Nationwide Boiler (Fremont, CA) to assist in developing an innovative ammonia-free selective catalytic reduction (SCR) solution that would eliminate the need to retrofit both boilers with Ultra Low NOx (ULN) burners. Compared to ULN burner technology, SCR technology would not increase force draft fan horsepower electrical requirements or require the use of flue gas recirculation, while providing more efficient boiler operation.

The NRG San Francisco plant management team and Nationwide Boiler engineers determined that a single ammonia-free SCR system that utilized Combustion Components Associates (CCA) patented TRIM-NOX® LT urea injection system would meet all the requirements of the project. Unlike traditional SCR systems that required on site storing and handling of ammonia, this new ammonia-free SCR system used a common and readily available 32% urea solution called DEF (diesel exhaust fluid) that eradicated the use of ammonia and the need to invest in hazardous material compliance safety plans and procedures.

The ammonia-free SCR system easily met NOx requirements and successfully reduced NOx emissions from 30 ppm to 1 ppm NOx throughout the entire firing range of the boiler. The system still operates dependably without any performance issues or concerns about meeting future NOx emission limits.

OLD TECH DRIVES NEW INNOVATION

SCR technology has been used for many decades and was developed by Japan and the United States in the early 1950s. The first large-scale SCR was installed over 30 years ago, and since then, SCR technology has come a long way to dramatically reduce emissions.

An ammonia-free SCR introduces a new approach to SCR technology that represents a fundamental shift in standard design and opera-

tional philosophy. It has the potential to reduce operating costs and enhance boiler performance, operation, and safety through system-level integration and redesign of both in-furnace and post-combustion NOx control to achieve the lowest NOx levels and the highest operational efficiencies compared to front-end burner technology (ULN burners).

For users adverse to ammonia handling and storage, an ammonia-free SCR system combines the advantages of highly successful SCR technology without using any ammonia. Standard SCR technology consists of injecting ammonia (NH₃) into boiler flue gas and passing it through a catalyst bed where nitrogen oxides (NOx) and NH₃ react to form nitrogen and water vapor. This requires storing ammonia in bottles or tanks that need to be replenished based on system demands, in addition to costly ammonia storage and/or handling and safety program compliance.

The urea-injection based SCR system utilizes the internal temperature of the boiler for optimum decomposition of urea to ammonia for the same conversion of NOx. Boiler owners and operators adverse to ammonia can economically obtain the superior performance of SCR technology and are now not limited to the poorly operating and energy-intensive performance of ULN burners.

CHALLENGES FACED & FUTURE PLANS

This project demonstrates an energy-efficient and simple method of dramatically reducing greenhouse gas emissions without the use of the industry's standard ammonia-based selective catalytic reduction system technology. The ammonia-free SCR has been proven to work effectively for both firetube and watertube package boilers, overcoming the challenges of external urea to ammonia conversion and presenting a new innovative option for SCR emission control technology.

Facilities — such as colleges, universities, hospitals, and district heating plants — that are adverse to handling and storing anhydrous ammonia (due to public safety concerns and costly HazMat and safety training programs) have been limited to select ultra low-NOx burner technology in lieu of SCR technology. These users have suffered the consequence of increased energy consumption and decreased efficiency due to FD fan requirements, plus high excess air and limited turndown indicative of ULN burner operation.

A new innovative choice for NOx control has entered the market. Its success is not only dependent on educating plant owners and operators about the benefits of urea injection, but also on demonstrating the opportunity costs associated with selecting one emission control solution over the other when analyzing efficiency and overall greenhouse gas emissions. Once this is accomplished, major emission reductions will be realized without a decrease in efficiency. **TB**