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Project Summary

Low NO_x Firing System for Tangentially Coal-Fired Boilers: Applications Guideline Manual

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This applications manual, a concise user's guide of Combustion Engineering's Low NO_x Concentric Firing System, is based on extensive pilot-scale and small and large utility-scale demonstrations, in particular, a demonstration program completed in May 1984 at Utah Power and Light Company's 400-MWe Hunter Unit 2 station.

The manual addresses six points for the user to evaluate to determine the applicability, feasibility, and cost of installing the concentric firing system to a particular steam generating unit: (1) rationale, (2) applicability, (3) predesign evaluation, (4) design, (5) performance optimization and evaluation, and (6) economic analysis.

The manual follows the final project report (a case study example of retrofitting this technology) for the Hunter Unit 2.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

This applications manual is a concise user's guide of Combustion Engineering's Low NO_x Concentric Firing System. This guide has resulted from extensive pilot-scale and small and large utility-scale demonstrations, in particular, a demonstration program of this system, completed in May 1984 at the 400 MWe Hunter Unit 2 station of Utah Power and Light Company.

The applications manual addresses six points for the user to evaluate to determine the applicability, feasibility, and cost of installing the concentric firing system to a particular steam generating unit.

The first two sections of the manual develop the general rationale and applicability of the process. This is done by presenting the areas of boiler performance and emissions potentially affected by the concentric firing system and permitting the potential user to ascertain the applicability of the technology to particular needs. Additionally, the general requisites of the concentric firing process have been developed with respect to the firing system and auxiliary equipment systems design. This allows the designer to evaluate the technical feasibility of applying the process to a particular steam generator.

The third and fourth sections of the manual extend and develop more detailed system requirements and the design details for the concentric firing system. Included in these sections is the requirement to establish a unit characterization that would be necessary for both new and retrofit applications of this technology. It would be used to determine existing or design load patterns, excess air levels, mill operating patterns, windbox damper operation, slagging tendencies, boiler turndown, steam temperature control, actual or anticipated unit emissions, and fan and unit performance.

Then, based on this characterization, the various options or arrangements available with the concentric firing system are considered. These options include modifications to windbox compartment free areas, coal compartment and nozzle

configuration, and fixed versus variable horizontal offset.

The fifth section of the guideline manual discusses the recommended procedure for optimizing the system when installed. The optimization would involve recharacterizing the unit's performance and emissions by conducting a short series of parametric tests and closely observing the longer term operating trends.

The final section addresses the economic viability of the concentric firing system. The analysis is conducted using the Electric Power Research Institute's (EPRI's) economic premises. It covers new and retrofit applications for utility size steam generators. The analysis can be directly applied to bituminous coal firing plants, and appropriate factors have been developed for applications of the cost analysis to lignites and subbituminous coals.

Conclusions

Major conclusions resulting from the field work and subsequent feasibility/economic studies are:

- NO_x emissions from tangential coal-fired boilers may be reduced by upwards of 40 percent by a combination of overfire air, flame retention, and concentric firing. To achieve NO_x reductions with concentric firing it may be necessary to fire in conjunction with overfire air to reduce the bulk lower windbox (furnace) stoichiometry.
- Boiler performance has been shown to be minimally affected with concentric firing. The only appreciable effect has been a reduction in the slag accumulation rate and/or a drier more friable slag deposit on some boilers. Also, on some boilers a reduction in the superheat and reheat spray flows has been seen. These two effects appear to be very coal dependent and should be evaluated on a case-by-case basis.
- The concentric firing system is technically retrofittable on most tangential coal-fired or multifuel boilers. In many cases it can be applied as part of a normal windbox maintenance program.
- The cost of installing a concentric firing system will depend on the unit size, coal type, and existing firing system configuration. The total capital requirements (1985 dollars) have been estimated to be $1-4/kW.

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The complete report, entitled "Low NO_x Firing System for Tangentially Coal-Fired Boilers: Applications Guideline Manual," (Order No. PB 85-246 973/AS; Cost: $9.95, subject to change) will be available only from:
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