NOx CONTROLS FOR EXISTING UTILITY BOILERS

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The Northeast States for Coordinated Air Use Management (NESCAUM) requested assistance from the CTC in the development of a technical support document that would discuss the feasibility, performance and costs of retrofit nitrogen oxides (NOx) controls for utility boilers operating in the eight Northeast states that comprise the NESCAUM region. Section 182 of the Clean Air Act Amendments of 1990 (CAAA) requires the NESCAUM States to develop reasonably available control technology (RACT) standards for utility boilers and ' other NOx sources. This document will also assist OAQPS in developing alternative control techniques (ACT) documents for NOx controls for utility boilers. The ACT documents are required under Section 183 (c) of the CAAA for stationary source categories that emit or have the potential to emit 25 tons per year of NOx. The report titled "Evaluaton and Costing of Nox Controls for Existing utility Boilers in the NESCAUM Region", (EPA-453/R-92-010) is now available.

This document discusses:

-Utility boiler population profile in the NESCAUM region.
-Uncontrolled NOx emissions as a function of boiler designs, fuels, and age and current estimates of total NOx emissions.
-Available NOx, control technologies and their performance for coal-and oil/gas fired boilers.
-Cost methodology for determining the costs of 21 scenarios for NOx controls.
-Costs and cost effectiveness of controls as a function of several design and operating characteristics of boilers.
-Impacts of NO, controls on combustible emissions (CO, HC, and carbon in flyash).

Because the applicability, ease of retrofit, NOx reduction performance, and costs are very much influenced by site-specific factors that cannot be taken fully into account without a site-by-site retrofit analysis, results and conclusions presented in this report should be interpreted on the basis of the limited NOx retrofit experience reported to date. Site-specific analyses are recommended to ascertain whether the emission levels, percent NOx reductions, and costs cited in this report can be achieved on a long term basis by a given site. NOx emissions from utility boilers are a function of fuel properties and many boiler design and operating variables. Among the most important variables are the fuel nitrogen content, the excess air, the heat release rate per unit of waterwall area in the burner zone, the amount of air preheat and the burner spacing and stoichiometry.

NOx combustion modification technologies such as low Nox burners (LN B), overfire air (OFA), burners out of service (BOOS) and flue gas recirculation (FGR) are the principal methods for controlling Nox from existng and new utility boilers. Flue gas treatment controls including selective catalytic reducton (SCR) and selective noncatalytic reduction (SNCR) can provide additonal NOx reductions from combustion controlled levels or can be used without combustion modificatons. Both of these processes have seen very limited application in the United States for utility boilers, but SCR is being used extensively in Japan and Germany with reported successes on all fuels.

Table 1 summarizes the NOx emission levels and cost effectiveness for various control technologies for 200 MW units. For PC- wall fired boilers the bulk of the retrofit experience is limited to low NOx burners. Overfire air (OFA) is generally not installed because of additional expenses and possible adverse impacts on the operation and efficiency of the boiler. For tangential fired boilers LNB always has close coupled OFA or, in more advance systems, separate OFA. The range in control efficiency for LNB and/or OFA is 15-6001. Cost effectiveness is typically in the range of $200-1,000 per ton of NOx removed.

Natural gas reburning (NGR) for Coal-firing boilers can achieve 45 to 6501 NOx reductions. The technical and economic feasibility of NGR are currently under study. Cost effectiveness is under $800/ton NOx removed when applied to high NOx emitting cyclone units.

For coal fired utility boilers, SNCR can achieve similar emission reductions at slighty higher cost effectiveness as combustion modifications ($590-1300/ton) . SCR can achieved 80 percent NOx reductions from uncontrolled boilers at a cost effectiveness of $1700-5000/ton. However due to limited full scale experience, the cost estimates for SNCR and SCR have a high degree of uncertainty.

Combustion modification controls for oil/gas fired utility boilers have been used since the early 1970s primarily in California. Estimated emission levels for these controls are 0.1 to 0.35 lb/MMBtu or a NOx reducton of 15-80%. The cost effectiveness varies from $100 to $5100/ton. SNCR is estimated to achieve a 35 to 50 percent Nox reduction at a cost effectiveness of $670-2200/ton. SCR is estimated to achieve 65-8506 reduction at cost effectiveness of $2600-7400/ton.

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TABLE 1.

SUMMARY OF NOX CONTROLS - PERFORMANCE AND COST EFFECTIVENESS

Boiler Type	NOX Control Levels (lb/MMbtu)	NOX Control Control Eff.	% Nox Effect.	Cost ($/ton)
PC-Wall	OFA	0.70 - 0.80	15 - 30	410 - 1100
PC-Wall	LNB	0.45 - 0.60	35 - 55	160 - 450
PC-Wall	LNB+OFA	0.35 - 0.55	40 - 60	270 - 800
PC-Tang	LNB-CCOFA	0.40 - 0.45	25 - 50	500 - 1300
PC-Tang	LNB+SOFA	0.30 - 0.45	25 - 50	420 - 1600
PC-Wall	SNCR	0.50 - 0.65	30 - 50	590 - 1100
PC-Wall	SCR	0.15 - 0.25	75 - 85	1700 - 3200
PC-Tang	SNCR	0.30 - 0.40	30 - 50	630 - 1300
PC-Tang	SCR	0.10 - 0.15	75 - 85	2600 - 5000
Cyclone	NGR	0.50 - 0.70	45 - 65	500 - 800
O/G Wall	BOOS	0.30 - 0.35	15 - 50	230 - 510
O/G Wall	FGR	0.25 - 0.35	30 - 50	320 - 1000
O/G Wall	LNB	0.25 - 0.30	25 - 50	750 - 1700
O/G Wall	LNB+OFA+FGR	0.10 - 0.20	30 - 80	900 - 2600
O/G Tang	BOOS	0.20 - 0.25	15 - 35	340 - 740
O/G Tang	LNB	0.15 - 0.25	15 - 50	1000 - 5100
O/G Wall	SNCR	0.25 - 0.30	35 - 50	670 - 1100
O/G Wall	SCR	0.10 - 0.15	70 - 80	2600 - 4900
O/G Tang	SNCR	0.15 - 0.20	35 - 50	800 - 2200
O/G Tang	SCR	0.05 - 0.10	65 - 85	3600 - 7400