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NESCAUM Stationary Source Committee Recommendation On NOx RACT for Industrial Boilers, Internal Combustion Engines and Combustion Turbines

September 18, 1992

The NESCAUM Stationary Source Review Committee is one of nine technical Committees established by the NESCAUM Board of Directors. The purpose of the committee is to provide an opportunity for engineers who review permits for new and existing sources to discuss common technical issues and provide some measure of consistency in the review of permits in the region. This recommendation has been developed in response to Sections 182(f) and 182(b)(2) of the Clean Air Act Amendments of 1990 (CAAA), which require states to impose Reasonably Available Control Technology (RACT) for sources that have the potential to emit nitrogen oxides (NOx) in excess of specified threshold amounts and are located in ozone nonattainment areas or in the ozone transport region. RACT is defined as follows:

> "the lowest emission limit that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility"

The CAAA requires states to develop and submit NOx RACT regulations to the US EPA by November 15, 1992. All regulated sources must be in compliance with the NOx RACT regulations by May 31, 1995.

In the Northeast, approximately 40 percent of the annual NOx emissions are from stationary sources and 60 percent are from mobile sources. NOx emissions react photochemically with volatile organic compounds (VOC) to form ground-level ozone. NOx emissions also react to form gaseous and particulate acids and other toxic air pollutants. Large portions of the NESCAUM region are currently in nonattainment for ozone, and up to 35 million people are exposed to unhealthy ozone levels each summer in the Northeast. The US EPA's Regional Oxidant Modeling for Northeast Transport (ROMNET) Report (June 1991), which is regarded as the most sophisticated analysis of the regional ozone problem, indicates that a NOx emission reduction of more than 55%, in conjunction with substantial VOC emission reductions, will be necessary to achieve the ozone health standard. In 1987, NOx emissions from all sources in the NESCAUM region totaled approximately 1.6 million tons. NOx emissions from the three source categories addressed in this recommendation constitute a large fraction of total NOx emissions in the NESCAUM region (ranging from 10 to 15% of total NOx emissions for individual states).

Based on this information and the requirement of 1990 CAAA, the committee has developed NOx RACT recommendations for: (1) Industrial Boilers, (2) Internal

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Combustion Engines, and (3) Combustion Turbines. The NOx RACT limits presented here attempt to account for variations in fuel type, design of combustion units and heat input rate.

For all units (industrial boilers, internal combustion engines, and combustion turbines) with high uncontrolled emission rates, which make a clear technical demonstration that NOx RACT emission limits are not feasible, states may set higher unit-specific alternative emission limitations. Such limitations would be based on the capabilities of all available and applicable technology for combustion modification.

NOx RACT for Industrial Boilers

Industrial boilers are steam-generating units that supply electric power and/or heat to an industrial, institutional or commercial operation, excluding boilers used by electric utilities to generate electricity.

The recommendation for NOx RACT for industrial boilers takes into account the maximum heat input rate of the boilers (in million of Btus/hour) and is as follows.

1. Small Boilers (Boilers < 50 MMBtu/hr)

NOx RACT for small boilers will require appropriate adjustment of combustion process to minimize NOx emissions. The requirements for combustion adjustment will be developed by the individual states.

2. Medium-Size Boilers (Heat Input Rate ≥ 50 MMBtu/hr but less than 100 MMBtu/hr)

   a. For boilers in this size range burning wood, coal or some fuel other than oil or gas, NOx RACT will be determined by the individual states on a case-by-case basis.

   b. For boilers in this size range burning natural gas, the recommended NOx RACT limit is a performance-based standard of 0.10 lb/MMBtu, to be met on a 1-hour averaging basis.

   c. For boilers in this size range burning #2 oil, the recommended NOx RACT limit is a performance-based standard of 0.12 lb/MMBtu, to be met on a 1-hour averaging basis.

   d. For boilers in this size range burning #4, #5, or #6 oil, the recommended NOx RACT is a technology-based standard requiring joint application of low-NOx burners and flue gas recirculation (with minimum circulation of 10 percent). In addition, sources will be required periodically to provide the states with data on nitrogen content of #4, #5 or #6 oil (percent weight basis).

   e. For b) and c) above, the performance-based standards are to be met on an annual, one-hour source test basis at steady state, maximum load conditions (average of three, one-hour stack tests).

3. Large Boilers (Boilers ≥ 100 MMBtu/hr)

The Committee recommends that all large industrial boilers, burning oil, gas coal or other fuels (for example wood), be treated the same as electric utility boilers and must

comply with NOx RACT for electric utilities boilers, as published by NESCAUM ("NESCAUM Stationary Source Committee Recommendation on NOx RACT for Utility Boilers," August 12, 1992).

NOx RACT for Internal Combustion Engines

The emission standards for internal combustion engines are for the control of NOx from existing internal combustion engines with a maximum heat input rate exceeding 3 MMBtu/hr. All proposed levels are based on a one-hour averaging period. Lean-Burn engines are those in which the amount of oxygen in the engine exhaust gases is 1.0% or more, by weight. Rich-burn engines are those in which the amount of oxygen in the engine exhaust gases is less than 1.0%, by weight. Rated brake horsepower (bhp) is as specified by the manufacturer and listed on the nameplate.

1. Rich-Burn Engines

    a. 1.5 grams per bhp-hr for gas-fired units

2. Lean-Burn Engines

    a. 2.5 grams per bhp-hr for gas-fired units

    b. 8 grams per bhp-hr for oil-fired units

The Stationary Source Review Committee believes that these NOx RACT limits are achievable through the application of three-way catalysts for rich-burn engines, and through the use of retarded engine timing or separate circuit after-cooling for lean-burn engines.

NOx RACT for Combustion Turbines

The emission standards outlined below are for the control of NOx from existing combustion turbines. The recommendation applies to combustion turbines rated at 25 MMBtu/hr or above (maximum heat input rate).

The proposed levels are based on a one-hour averaging period.

1. Simple Cycle Combustion Turbines

    a. 55 parts per million volume dry (ppvmd) (corrected to 15% oxygen) for gas-fired turbines without oil back-up.

    b. 75 ppmvd (corrected to 15% oxygen) for oil-fired turbines

    c. for gas-fired turbines with oil back-up:
        1. 55 ppmvd (15% oxygen) when operating on gas
        2. 75 ppmvd (15% oxygen) when operating on oil

2. Combined Cycle Combustion Turbines

    a. 42 ppmvd (corrected to 15 % oxygen) for gas-fired turbines without oil back-up

b. 65 ppmvd (corrected to 15% oxygen) for oil-fired turbines

c. For gas-fired turbines with oil back-up:
   1. 42 ppmvd (15% oxygen) when operating on gas
   2. 65 ppmvd (15% oxygen) when operating on oil

The Stationary Source Review Committee believes that these NOx RACT limits are achievable through the application of water or steam injection and dry low-NOx combustion technology. Higher emission limits may be specified for an individual unit, on a case-by-case basis, if the owner of the stationary combustion turbine can make a demonstration that water injection is not feasible or that low-NOx combustors are not available for the make and model of turbine. Water injection not being feasible refers to either the unavailability of water (i.e., restrictions placed on water use), excessive costs associated with purifying the water (i.e., cleaning up salt water) or other factors associated with either the turbine or the location of the turbine, at the discretion of the states and the US EPA.

These recommendations were adopted by the NESCAUM Board of Directors on September 17, 1992.