SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Preliminary Draft Staff Report
Proposed Amended Rule 1146 - Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters

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Rule 1146 – Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters was originally adopted in September of 1988. This rule applies to existing boilers, steam generators, and process heaters with maximum rated heat input capacities greater than or equal to 5 million BTU per hour. Rule 1146 establishes NOx and CO emission limits, and provides compliance options for units that meet low fuel usage thresholds.

The rule does not apply to electric utility boilers, refinery boilers and process heaters with a rated heat input greater than 40 million BTU per hour, sulfur plant reaction boilers, or waste heat recovery boilers serving combustion turbines. These sources are subject to other rules. In addition, the NOx limits of Rule 1146 do not apply to NOx RECLAIM facilities. Instead, these facilities are subject to NOx limits established through the RECLAIM program.

The proposed amendment to this rule would reduce the allowable emission limits of NOx from boilers based on rated heat input capacity. It is also the intent of this proposed amendment to harmonize the NOx compliance limits with those limits proposed for Rule 1146.1. Group I boilers, those rated at greater than 75 mmBtu/hr, will be required to met a lower emission limit than Group II boilers (those rated between 20 and 75 mmBtu/hr) and Group III boilers (those rated between 5 and 20 mmBtu/hr). This can be accomplished through the use of selective catalytic reduction (SCR) and other control technologies such as EMx™ Catalyst. The proposed emission limits for Group II and Group III boilers can be met through the use of ultra-low NOx burners. The following tables present the proposed emission limits and compliance dates:

Table ES-1
Standard Proposed NOx Limits and Compliance Dates

Rule Reference	Category	Limit	Compliance Plan	Permit to Construct	Full Compliance
(c)(1)(A)	All Units Fired on Gaseous Fuels	30 ppm or 0.036 lbs/10^6 Btu	-	-	(date of adoption)
(c)(1)(B)	Any Units Fired on Non-gaseous Fuels	40 ppm	-	-	(date of adoption)
(c)(1)(C)	Any Units Fired on Landfill Gas	25 ppm	-	-	January 1, 2015
(c)(1)(D)	Any Units Fired on Digester Gas	15 ppm	-	-	January 1, 2015
(c)(1)(E)	Group I Units, 75 mmbtu/hr or greaters	5 ppm or 0.0062 lbs/10^6 Btu	-	January 1, 2012	January 1, 2013

Table ES-1 (continued)
Standard Proposed NOx Limits and Compliance Dates

<table>
<tr><th>Rule Reference</th><th>Category</th><th>Limit</th><th>Compliance Plan</th><th>Permit to Construct</th><th>Full Compliance</th></tr>
<tr><td>(c)(1)(F)</td><td>Group II Units
20 to less than 75 mmbtu/hr - 75% or more of units (by heat input)</td><td rowspan="2">9 ppm or 0.011 lbs/10^6 Btu</td><td>January 1, 2010</td><td>January 1, 2011</td><td>January 1, 2012</td></tr>
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100% of units (by heat input)</td><td>January 1, 2010</td><td>January 1, 2013</td><td>January 1, 2014</td></tr>
<tr><td>(c)(1)(H)</td><td>Group III Units
5 to less than 20 mmbtu/hr, schools and universities - 75% or more of units (by heat input)</td><td rowspan="2">9 ppm or 0.011 lbs/10^6 Btu</td><td>January 1, 2011</td><td>January 1, 2012</td><td>January 1, 2013</td></tr>
<tr><td>(c)(1)(I)</td><td>Group III Units
100% of units (by heat input)</td><td>January 1, 2011</td><td>January 1, 2014</td><td>January 1, 2015</td></tr>
</table>

Table ES-2
Enhanced Proposed NOx Limits and Compliance Dates

<table>
<tr><th>Rule Referenc e</th><th>Category</th><th>Limit</th><th>Compliance Plan</th><th>Permit to Construct</th><th>Full Compliance</th></tr>
<tr><td>(c)(2)(A)</td><td>Group II Units
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<tr><td>(c)(2)(B)</td><td>Group II Units
100% of units (by heat input)</td><td>January 1, 2013</td><td>January 1, 2015</td><td>January 1, 2016</td></tr>
</table>

The proposed rule amendment also introduces:

- A weighted average formula for duel fueled co-fired units
- Recognition of energy efficient units
- Compliance testing frequency compatible with RECLAIM sources in the same size range
- Monitoring NOx emissions with a portable analyzer

- Ending the derating of existing units
- Compliance with the 30 ppm NOx limit for low fuel usage units by January 1, 2015 or burner replacement, whichever occurs later
- Extending the compliance date for health facilities complying with seismic safety requirements

The compliance schedule is staged over a four-year period taking into consideration size range and unit operation. Also taken into consideration within the compliance schedule are facilities with multiple units and an option for a later compliance date at a more stringent limit.

The proposed rule amendment is estimated to reduce 1.3 tons per day of NOx by 2016. Preliminary cost effectiveness estimates range from $13,200 to $26,400 per ton for units complying with the 9 ppm NOx limit (ultra low-NOx burner) and $15,900 to $37,600 per ton for units complying with the 5 ppm NOx limit (SCR). The preliminary incremental cost effectiveness ranges from $30,200 to $83,000 per ton (ultra low-NOx burner compared to SCR).

CHAPTER 1: BACKGROUND

INTRODUCTION

Rule 1146 applies to existing boilers, steam generators, and process heaters with maximum rated heat input capacities greater than or equal to 5 million BTU per hour. The rule does not apply to electric utility boilers, refinery boilers and process heaters with a rated heat input greater than 40 million BTU per hour, sulfur plant reaction boilers, or waste heat recovery boilers serving combustion turbines. These sources are subject to other rules. In addition, the NOx limits of Rule 1146 do not apply to NOx RECLAIM facilities. Instead, these facilities are subject to NOx limits established through the RECLAIM program.

REGULATORY HISTORY

Rule 1146 was originally adopted in September of 1988. The rule applies to new and existing boilers, steam generators, and process heaters with a maximum rated heat input of 5 million (MM) BTU per hour and greater. The rule established a 40 ppm NOx emission limit for units with an annual heat input greater than 90,000 therms. For units that did not exceed an annual heat input of 90,000 therms, options were provided to either maintain stack gas oxygen at 3 percent (on a dry basis), operate with a stack gas oxygen trim system, or tune the unit at least twice a year. In addition, for units with a rated heat input of 40 MMBtu/hr and greater, installation and operation of a continuous in-stack NOx monitor was required if annual heat input exceeded 2,000,000 therms. Since original adoption, the rule has been amended four times.

The first amendment occurred in January 1989 and established a 30 ppm NOx emission limit for units burning gaseous and/or non-gaseous fuels if the following applies: the unit has a maximum rated heat input greater than or equal to 40 million BTU per hour; and annual heat input has exceeded 25 percent of the maximum annual fuel consumption rated for the unit. This emission limit made the Rule 1146 NOx emission limit consistent with Rule 1109 – Emission of Oxides of Nitrogen from Boilers and Process Heaters in Petroleum Refineries. This amendment was deemed appropriate because the two categories of applicable equipment were considered similar and should therefore be subject to the same emission limit.

In May of 1994 a second amendment to Rule 1146 was made which added a tune-up procedure for natural-draft combustion units. The rule already included a tune-up procedure for forced-draft combustion units.

In June 2000, Rule 1146 was amended to incorporate a one-time exemption from the NO_x emission limit. This amendment was very narrow in scope. It allowed a facility that exceeded the 90,000 therm fuel usage threshold in 1996 to remain exempt from the NO_x emission limit, provided that specific administrative requirement were met. This amendment only affected one facility and had minimal emissions impact.

The rule was amended a fourth time in November of 2000. This amendment affected emissions testing, NOx limits, and fuel metering requirements. The emission testing requirement was increased to an annual frequency, and the use of hand-held portable monitors was added as a valid test method. For units burning gaseous fuels only, NOx limits were lowered to 30 ppm (at 3% O_2) if the annual fuel combustion met or exceeded 90,000 therms per year. For units burning a combination of gaseous and non-gaseous fuels, NOx limits were lowered to a weighted average emission factor between 30 and 40 ppm (at 3% O_2), if annual fuel combustion met or exceeded 90,000 therms per year. These units also were required to install and operate totalizing fuel meters for each fuel line at each unit. If the permit holder agreed to a NOx limit of 30 ppm for units burning a combination of gaseous and non-gaseous fuels, then the totalizing fuel metering requirement was waived.

TYPES OF BOILERS, STEAM GENERATORS, AND PROCESS HEATERS

There are many of types of boilers, water heaters and process heaters subject to AQMD Rule 1146. Boilers and steam generators produce hot water or steam for office buildings, commercial establishments, hospitals, schools and universities, hotels and industrial operations. Process heaters are used to heat material streams for industrial operations. Process heaters can heat process fluids directly or use a heat exchange fluid. For each application there may be several designs of boilers or heaters available. Boilers and heaters can be classified in several ways including the way heat is transferred, the material used in the heat exchanger, and the engineering and safety codes for which the unit is designed to comply.

A unit is classified as a boiler if it is designed to meet the safety standards of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. While many boilers are used to produce steam, others provide hot water for a variety of purposes. The components and the entire system of a boiler must meet additional standards including those from Underwriters Laboratories (UL), federal and state energy efficiency standards and local building codes.

Boilers

Historically, boilers have been built using one of three basic designs: fire tube, water tube or cast iron sectional. In a fire tube boiler, the combustion gasses pass through banks of narrow tubes that are surrounded by a pressure vessel (tank) which contains water. The combustion gasses may pass through one set of tubes in one direction (one pass) or make multiple passes by alternating the direction through each set of tubes. Multiple passes of the hot combustion gasses through the pressure vessel increase efficiency and increase the temperature and pressure of the water or steam. This type of boiler can be built using a horizontal pressure vessel and horizontal tubes or a vertical pressure vessel and tubes.

In a water tube boiler, the combustion gasses pass over and through banks of tubes containing water. Increasing the number and surface area of water tubes will increase the temperature and pressure of water in the tubes and increase the boiler efficiency. Steel water tube boilers can produce very high temperature water or high pressure steam.

Cast boilers pass combustion gasses over the surface of one or more water containing sections made of cast iron. Cast boiler sections can also be made from brass or bronze. This type of boiler can only be used to produce low temperature water or low pressure steam.

A newer type of boiler based on the water tube design uses a heat exchanger made of copper tubes with heat exchange fins. This type of boiler is typically constructed in a factory while the older designs may be constructed at the factory or at the location where the unit will be used.

TECHNOLOGY ASSESSMENT

For gaseous fuels, thermal NOx is generally the largest contributor of NOx emissions. High flame temperatures trigger the disassociation of nitrogen molecules from combustion air and a chain reaction with oxygen follows to form oxides of nitrogen. Factors that minimize the formation of thermal NOx include reduced flame temperature, shortened residence time, and an increased fuel to air ratio.

For gaseous fuels, the formation of fuel NOx is not significant. Fuel NOx results when nitrogen that is bound in fuel combines with oxygen present in combustion air. Because gaseous fuels typically have low nitrogen levels, this mechanism does not play a significant role in NOx formation during natural gas combustion. Similarly, fuel NOx formation does not play a significant role in the combustion of diesel fuel. This fuel is the only non-gaseous fuel used in significant quantities within the South Coast Air Basin. California has stringent low sulfur standards for diesel fuel. The process used for removing sulfur also removes nitrogen, resulting in diesel fuel with low nitrogen levels.

Prompt NOx forms quickly and is a reaction of free radicals that primarily occurs in a fuel rich flame zone within the early stages of combustion. Although prompt NOx is generated in small quantities, it can play a significant role when attempting to achieve single-digit NOx levels.

To reduce NOx emissions, combustion parameters can be optimized, control techniques can be applied downstream of the combustion zone, or a combination of the two approaches can be utilized. Common types of combustion modification include: lowered flame temperature; reduced residence time at high combustion temperature; and reduced oxygen concentration in the high temperature zone.

Ultra Low-NOx Burner Systems

Often, fuel and air are pre-mixed prior to combustion. This results in a lower and more uniform flame temperature. Some premix burners also use staged combustion with a fuel rich zone to start combustion and stabilize the flame and a fuel lean zone to complete combustion and reduce the peak flame temperature.

Burners can also be designed to spread flames over a larger area to reduce hot spots and lower NO_x emissions. Radiant premix burners with ceramic, sintered metal or metal fiber heads spread the flame and produce more radiant heat. When a burner produces more radiant heat, it results in less heat escaping the boiler through the exhaust gases.

Most premix burners require the aid of a blower to mix the fuel with air before combustion takes place (primary air). Flue gas recirculation (FGR), which recycles a portion of the exhaust stream back into the burner, is also commonly used. Increasing the amount of primary air and/or use of FGR can reduce flame temperature but it also reduces the temperature of combustion gases through dilution and can reduce efficiency. To maintain efficiency a manufacturer may have to add surface area to the heat exchanger. Increasing the primary air may also destabilize the flame. Low NO_x burners require sophisticated controls to maintain emissions levels and efficiency, to stabilize the flame, and to maintain a turndown ratio that is sufficient for the demands of the particular operation.

Ultra Low NO_x burner systems for boilers and process heaters can achieve less than 9 ppm NO_x (at 3% oxygen). NOx formation results primarily from thermal NOx and fuel NOx, and to a lesser extent from prompt NOx.

Ultra Low NOx Burners have been applied by the San Joaquin Valley Unified APCD (SJVUAPCD) in their Rule 4306 *Boilers, Steam Generators, and Process Heaters – Phase III*. The compliance limit when applying this technology to equivalent boilers and heaters ranges from 9 to 15 ppm, depending on equipment size and operation. Most of the ensuing source test data indicates that most of the NOx emissions from these regulated units are at or below 9 ppm.

SJVUAPCD is proposing to amend Rule 4306 and add a new Rule 4320 *Advanced Emission Reduction Options for Boilers, Steam Generators, and Process Heaters Greater than 5.0 mmbtu/hr*. As of March 17, 2008 their proposal is 9 ppm (or 6 ppm for compliance at a later date) for equipment greater than 5 mmbtu/hr but less than or equal to 20 mmbtu/hr. Depending on the equipment size and selected NOx limit, the proposed compliance date extends from January 1, 2011 to January 1, 2013. In lieu of complying with the proposed limits the owner or operator has the option of paying into an annual emissions fee.

In addition to SJVUAPCD Rule 4306, Sacramento Metropolitan Air Quality Management District (SMAQMD) Rule 411 limits boilers from 9 to 15 ppm, depending on equipment size and operation. The Bay Area Air Quality Management District (BAAQMD) is proposing similar limits for units greater than 10 mmbtu/hr.

Selected Catalytic Reduction (SCR)

As indicated previously, another technique to reduce NOx emissions is to apply controls downstream of the combustion zone, but before NOx is released into the atmosphere. The three main methods of post-combustion treatment are Selective Catalytic Reduction (SCR), EMx™ Catalyst, and Selective Noncatalytic Reduction (SNCR). In SCR and SNCR methods, urea or ammonia is injected or sprayed into the exhaust stream to chemically reduce the NOx into N_2. Both treatments operate within limited temperature ranges. Recent advancements in catalyst have widened the available temperature ranges for effective operation.

EMx™ Catalyst is a multi-pollutant technology in a single system reducing emissions of NOx, SOx, CO, VOC, and PM. This control technology has been in operation in excess of seven years with the U.S. EPA declaring this technology as "the Lowest Achievable Emission Rate" (LAER) for NOx abatement. EMx™ is an ammonia free reduction technology available for industrial boilers and process heaters. Consequently there is no need for ammonia storage, transportation or safety issues. EMx™ is a continuous process designed to achieve the required emissions reduction at the maximum NOx flowrate. This system does not require a complex feedback control loop.

Based on the following information, Selective Catalytic Reduction (SCR) as applied to Rule 1146 boilers can achieve NOx concentrations from 5 to 6 ppm for units greater than or equal to 75 mmbtu/hr. This appears to be the most effective and cost-effective alternative for this subcategory of Rule 1146 units. Consequently, the control assessment will focus on SCRs.

SCR for equipment at power producing facilities subject to Rule 2009 was considered as part of the year 2001 RECLAIM amendments and subsequent rule implementation. Under Rule 2009, a case-by-case technical and cost-effectiveness evaluation was performed for each boiler. Permit information showed that BARCT for the majority of equipment under Rule 2009 ranges from 5 to 9 ppm. The weighted average for all utility boilers, including those higher than 9 ppm, after the Rule 2009 retrofits is 7 ppm.

As part of the January 2005 RECLAIM amendment, a 5 ppm NOx concentration limit for refinery boilers and heaters greater than 110 mmBtu/hr SCR was determined to be cost-effective and technologically feasible.

SJVUAPCD has a more stringent limit than AQMD rules for this subcategory of Rule 1146 refinery boilers/heaters. The SJVUAPCD Rule 4306 limits emissions from units with greater than 20 mmBtu/hr input rating to 6 ppm. Application of SCR is an option if the equipment owner or operator opted to achieve compliance at later of two dates. Source data indicates that several owners or operators opted for the more stringent 6 ppm requirement. According to the available source data from the SJVUAPCD showed that the NOx emissions from the equipment controlled with SCR were at or below 4 ppm.

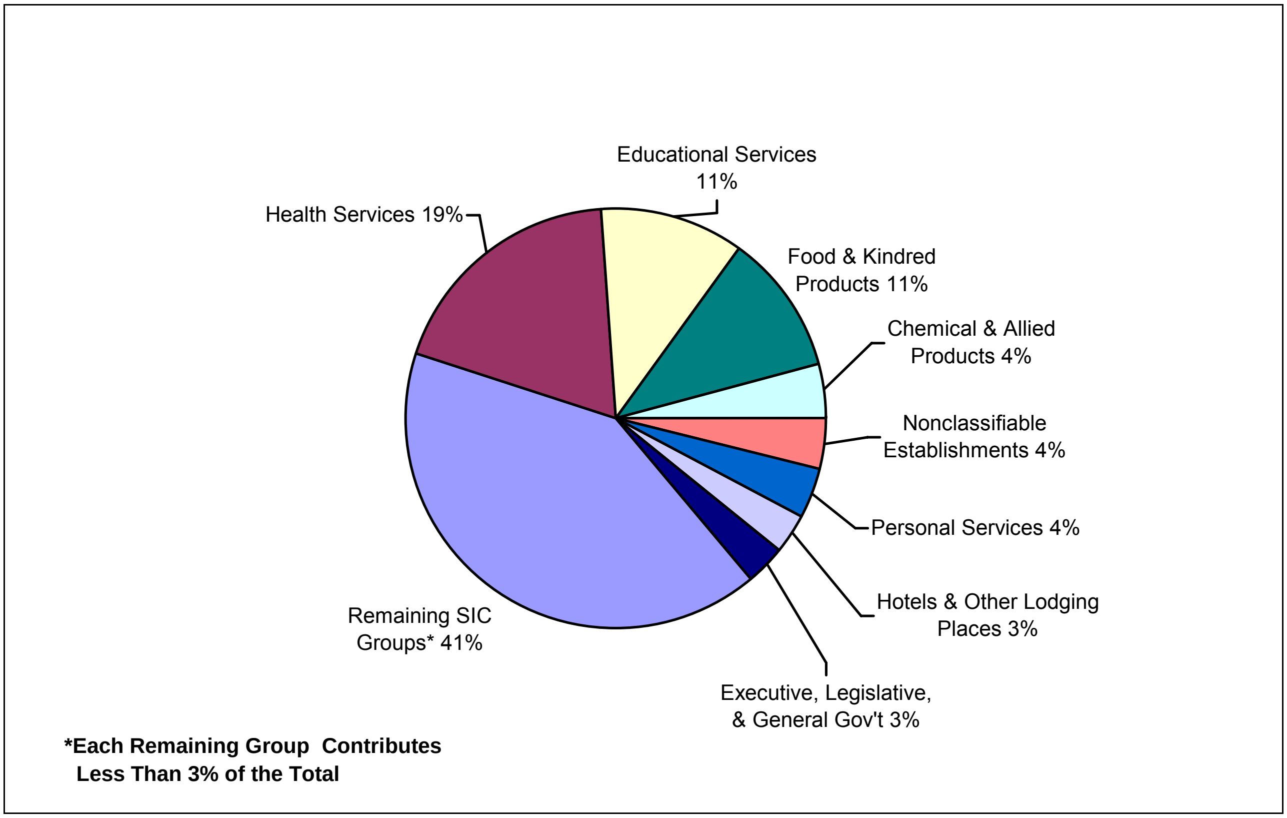
As previously mentioned, SJVUAPCD is proposing to amend Rule 4306 and add a new Rule 4320. As of March 17, 2008 their proposal for units greater than 20 mmbtu/hr would be a NOx compliance limit of 6 ppm (or 5 ppm for compliance at a later date). Depending on the equipment size and selected NOx limit, the proposed compliance date extends from January 1, 2011 to January 1, 2015. In lieu of complying with the proposed limits the owner or operator has the option of paying into an annual emissions fee.

AFFECTED INDUSTRIES

Rule 1146 affects a wide variety of operations within the South Coast Air Basin. When grouped according to the Standard Industrial Classification (SIC), the health services industry has approximately 19% of the units that are subject to Rule 1146, the largest single group. Next, educational services and the food industry each contribute about 11% of the total. Chemicals and allied products; nonclassifiable establishments; and personal services each comprise approximately 4% of the units that are affected by Rule 1146. Hotels and other lodging places and then executive, legislative, and general government each contribute about 3%. Each single remaining group comprises less than 4% of the total. Remaining SIC groups include, but are not limited to, textile mill products; justice, public order, and safety; fabricated metal product; and real estate.

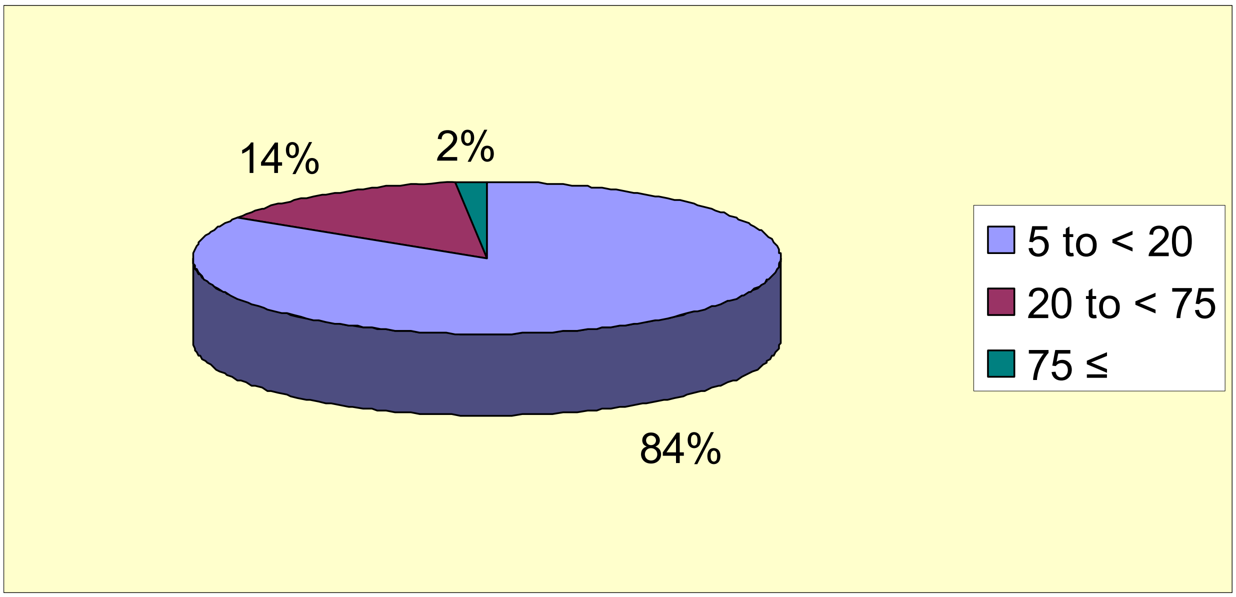
Figure 1

Industries Affected by Rule 1146



At rule adoption in October 1990, staff estimated that there were over 1,000 active permitted units in the District in the size range affected by this rule ($\geq$ 5 MM Btu/hr). The distribution of boilers by size ranges are shown in the following pie-chart:

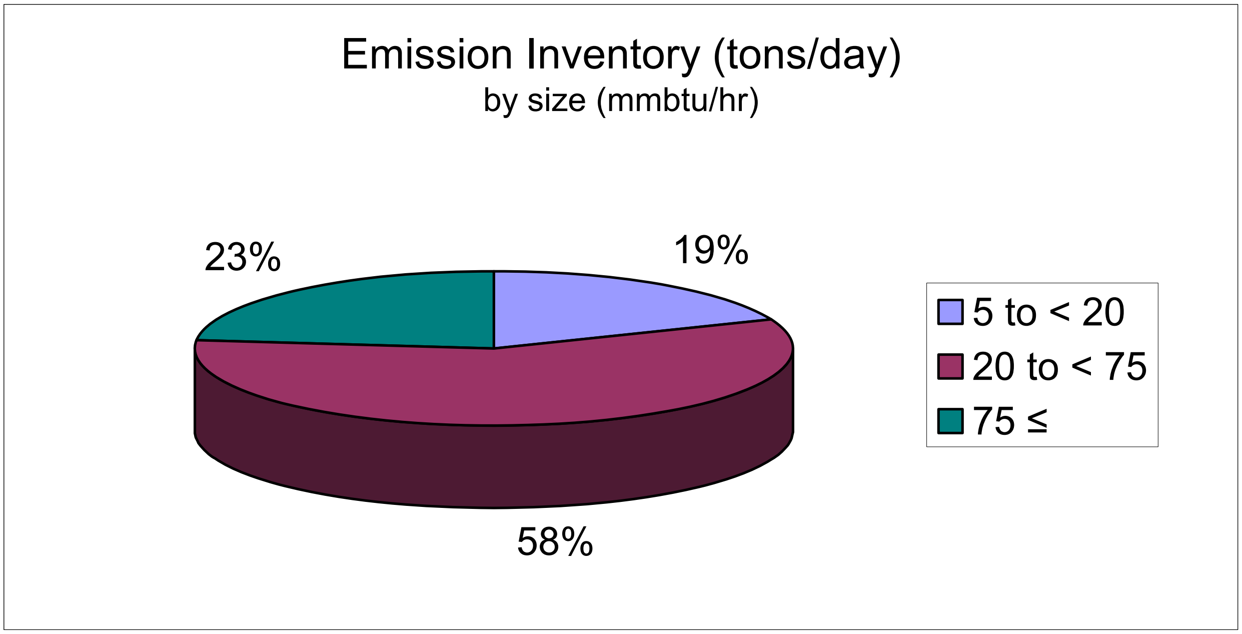
Figure 2
Number of Equipment



EMISSIONS

The total NOx inventory for the units affected by Rule 1146 is estimated to be 1.85 tons per day. This estimate was taken from an AQMD data base for the year 2002. The distribution among the size ranges is as follows:

Figure 3



PUBLIC PROCESS

The rule development effort for PAR 1146 is part of an ongoing process to assess low NO_x technologies for boilers, steam generators, and process heaters. For this rule development, staff initially held public consultation meetings on January 18, 2006 and December 12, 2007 and a public consultation/CEQA scoping meeting on February 22, 2008. Subsequently, a series of task force meetings were held on August 16, 2007, October 31, 2007, November 30, 2007, and January 29, 2008. These meetings included representatives from the manufacturers, trade organizations, permit holders for units subject to Rule 1146, and other interested parties. At these meetings low NO_x technology, equipment useful lives, and proposed emission limits were discussed. Staff also held individual meetings with manufacturers of boilers, steam generators, and process heaters.

CHAPTER 2: SUMMARY OF PROPOSED AMENDED RULE 1146

PROPOSED AMENDED RULE 1146 REQUIREMENTS

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Existing Rule

Rule 1146 applies to new and existing industrial, institutional and commercial boilers, steam generators, and process heaters with a maximum rated heat input of 5 MMBtu/hr and greater.

The rule does not apply to electric utility boilers, petroleum refinery boilers and process heaters with a rated heat input greater than 40 million BTU per hour, sulfur plant reaction boilers, or waste heat recovery boilers serving combustion turbines. These sources are subject to other rules. In addition, the NOx limits of Rule 1146 do not apply to NOx RECLAIM facilities. Instead, these facilities are subject to NOx limits established through the RECLAIM program.

Under Rule 1146, units burning gaseous fuels only are required to meet a NOx limit of 30 ppm limit and a CO limit of 400 ppm, if annual fuel usage exceeds 90,000 therms per year. Units burning non-gaseous fuels only are required to meet a NOx limit of 40 ppm and a CO limit of 400 ppm, if annual fuel usage exceeds 90,000 therms per year.

Units burning a combination of gaseous and non-gaseous fuels are required to meet a weighted average emission factor between 30 and 40 ppm, if annual fuel combustion meets or exceeds 90,000 therms. Further, units with a maximum rated heat input of 40 MMBtu/hr or more and which exceed an annual heat input of 200,000 therms are subject to continuous in-stack NOx monitoring requirements.

For units that are subject to NOx limits, annual emissions testing requirements apply. Rule provisions allow for the approval of hand-held portable monitoring for emissions testing. Fuel metering requirements apply to units burning a combination of liquid and gaseous fuels, and to units exempt from NOx limits due to low fuel usage. Units that are exempt from NOx limits are also required to either maintain stack gas oxygen concentrations at 3% or less (on a dry basis), or tune the unit(s) at least twice per year according to specified tuning procedures.

All NOx limits are specified in ppm by volume at 3% oxygen. An alternative to meeting a 30 ppm NOx limit is to meet 0.036 pounds per 10^6 Btu of heat input, and an alternative to meeting a 40 ppm NOx limit is to meet 0.052 pounds per 10^6 Btu of heat input.

Proposed Rule Amendments

Applicability - Subdivision (a):
Other than placing this subdivision ahead of the "Definitions" subdivision, there are no changes proposed for this subdivision.

Definitions - Subdivision (b):
In order to address proposed changes to the rule, definitions will be added. These definitions include, Group I, II and III Units, and Schools. There was also added a definition of health facilities. This definition was added to take into consideration an extension in the compliance date for health facilities complying with seismic safety requirements.

Requirements - Subdivision (c):
There is a carryover of the current NOx compliance limit of 30 ppm or 0.037 lb NOx per 10^6 Btu for units fired on gaseous fuels and 40 ppm for units fired on non-gaseous fuels. At the time of rule adoption this limit would apply to all units, except low fuel usage units (i.e., less than or equal to 90,000 therms per year). The proposed NOx compliance limits and schedule are presented in Tables 1 and 2.

Table 1
Standard Proposed NOx Limits and Compliance Dates

Rule Reference	Category	Limit	Compliance Plan	Permit to Construct	Full Compliance
(c)(1)(A)	All Units Fired on Gaseous Fuels	30 ppm or 0.036 lbs/10^6 Btu	-	-	(date of adoption)
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(c)(1)(C)	Any Units Fired on Landfill Gas	25 ppm	-	-	January 1, 2015
(c)(1)(D)	Any Units Fired on Digester Gas	15 ppm	-	-	January 1, 2015
(c)(1)(E)	Group I Units, 75 mmbtu/hr or greaters	5 ppm or 0.0062 lbs/10^6 Btu	-	January 1, 2012	January 1, 2013
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(c)(1)(C)	Any Units Fired on Landfill Gas	25 ppm	-	-	January 1, 2015
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Table 1 (continued)
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Rule Reference	Category	Limit	Compliance Plan	Permit to Construct	Full Compliance
(c)(1)(F)	Group II Units 20 to less than 75 mmbtu/hr - 75% or more of units (by heat input)	9 ppm or 0.011 lbs/10^6 Btu	January 1, 2010	January 1, 2011	January 1, 2012
(c)(1)(G)	Group II Units 100% of units (by heat input)		January 1, 2010	January 1, 2013	January 1, 2014
(c)(1)(H)	Group III Units 5 to less than 20 mmbtu/hr, schools and universities - 75% or more of units (by heat input)	9 ppm or 0.011 lbs/10^6 Btu	January 1, 2011	January 1, 2012	January 1, 2013
(c)(1)(I)	Group III Units 100% of units (by heat input)		January 1, 2011	January 1, 2014	January 1, 2015

Table 2
Enhanced Proposed NOx Limits and Compliance Dates

Rule Reference	Category	Limit	Compliance Plan	Permit to Construct	Full Compliance
(c)(2)(A)	Group II Units 75% or more of units (by heat input)	5 ppm or 0.0062 lbs/10^6 Btu	January 1, 2013	January 1, 2013	January 1, 2014
(c)(2)(B)	Group II Units 100% of units (by heat input)		January 1, 2013	January 1, 2015	January 1, 2016

As noted in the Introduction section on SCRs there still remains some questions on the application of a 5 or 6 ppm compliance limit. Staff will continue to examine the impacts associated with these limits and solicit any feedback on this determination.

The proposed NOx limits for landfill and digester gas fired units are 25 and 15 ppm, respectively. These limits are based on source data of units operating in the district, allowing for a certain amount of buffer to assure compliance. The compliance schedule took into consideration compliance deadlines for recently amended Rule 1110.2 *Emissions from Gaseous- and Liquid- Fueled Engines*. This rule requires equipment operated by the same facilities to comply with requirements by July 1, 2012. The intent was not to require compliance limits from two different rules during the same time period for the same facilities.

It is important to note that PAR 1146 for the smaller size units reflects the proposed NOx limits specified in Rule 1146.1 (units between 2 and 5 mmbtu/hr). Staff feels that these limits would help harmonize the compliance limits for the Rules 1146.1 and 1146.

The proposed rule amendment also introduces a weighted average formula for duel fueled co-fired units. The formula for calculating the weighted average compliance limit is as follows:

$$\text{Weighted Limit} = \frac{(CL_A \text{ x } Q_A) + (CL_B \text{ x } Q_B)}{Q_A + Q_B} \qquad \text{Equation 2-1}$$

Where:

CL_A = compliance limit for fuel A

CL_B = compliance limit for fuel B

Q_A = heat input from fuel A

Q_B = heat input from fuel B

This is an optional approach in determining a compliance limit. Other units with a primary and standby fuel may not want to utilize this approach. Instead owners or operators of these units would need to demonstrate compliance with the corresponding limit for each fuel.

In addition to recognizing fuel efficiency in the optional "lbs per 106 Btu of heat input" limit, an enhanced fuel efficiency formula to adjust allowable emission limits has been proposed. Advanced technology fuel efficient boilers may encounter difficulties controlling NOx emissions. The enhanced fuel efficiency formula will allow facilities to operate these efficient boilers while still achieving NOx emission reductions. The proposed fuel efficiency equations are as follows:

$$CL_a = CL \text{ x } ECF \qquad \text{Equation 2-2}$$

Where:

CL_a is the adjusted concentration, ppm

CL is the concentration limit specified in the rule for natural gas fired units, ppm

ECF is the efficiency correction factor.

The ECF must be 1.0 unless:

(i) The unit's operator has measured the unit's specific efficiency (EF_a), in compliance with ASME Performance Test Code PTC 4 – 1998, at the average firing rate of the unit; and

(ii) The ECF-corrected emission limit is made a condition of the unit's Permit to Operate.

The ECF is calculated as follows:

$$ECF = \frac{[\text{Measured } EF_a, \%]}{[\text{Benchmark}, \%]} \qquad \text{Equation 2-3}$$

ECF must not be less than 1.0.

It should be noted that staff is soliciting input for recognizing fuel efficiency. For example, staff is requesting recommendations for a Benchmark value or values along with supporting documentation. At stakeholder meetings there were comments raised on the limitations of ASME Performance Test Code PTC 4 – 1998 for certain categories of units. Staff requested the identification of other replacement performance criteria for assessing efficiency. If such information is not identified it is likely that this enhanced fuel efficiency option will be removed from the proposal.

Criteria for the previously mentioned compliance plan have been added to the rule. These criteria include:

- Owner/operator contact information (company name, AQMD facility identification number, contact name, phone number, address, e-mail address).
- Number and size (mmbtu/hr) of natural gas fired units subject to the requirements.
- Selection of the compliance limit for each of the natural gas fired.

There is a special consideration for those units that had complied with the NOx BACT requirement of less than or equal to 12 ppm. Thus, for those units in lieu of complying with the 9 ppm NOx limit for Group II units according to the schedule specified in Table 1 the owner or operator may opt to comply with the 9 ppm or 0.011 lbs/10^6 Btu NOx level within 15 years of the unit's burner(s) date of installation or modification.

Other proposed changes include clarification on the tune-up schedule for low fuel usage units and the use of a non-resettable totalizing fuel meter for each of the fuels in which the weighted average is applied.

Compliance Determination - Subdivision (d):

Language is added requiring boilers subject to this rule to conduct an emission determination at least 250 operating hours or at least 30 days after tuning or servicing of the unit, unless it is an unscheduled repair. In this same paragraph, pre-tests for emission determinations were prohibited.

Additional test methods, *Conditional Test Method CTM-030, Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Emissions from Natural Gas-Fired Engines, Boilers and Process Heaters Using Portable Analyzers* and *ASTM D6522-00(2005) Standard Test Method for Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Concentrations in Emissions from Natural Gas-Fired Reciprocating Engines, Combustion Turbines, Boilers, and Process Heaters Using Portable Analyzers*, have been added to the rule. These methods allow the owner or operator of a subject boiler to use a portable analyzer to determine emission compliance. Another alternative to source tests is the use of a continuous in-stack NOx monitor.

Compliance determination with the NOx and CO emission sources test requirements must be conducted once every three years for units 10 to less than 40 mmbtu/hr and once every five years for units 5 to less than 10 mmbtu/hr. The current rule required an annual source test to demonstrate. This requirement was added to match the same type of requirement for similar size units in the RECLAIM program (ref: Rule 2012 - (d)(1)(ii), (e)(1)(ii), (j)(2) and (j)(4)).

Under the proposed amendment the owner or operator must check emissions with a portable NOx, CO and oxygen analyzer according to the *Protocol for the Periodic Monitoring of Nitrogen Oxides, Carbon Monoxide, and Oxygen from Units Subject to South Coast Air Quality Management District Rules 1146 and 1146.1*. This monitoring must be conducted monthly or every 750 unit operating hours, whichever occurs later. If a unit is in compliance for four consecutive emission checks, without any adjustments to the oxygen sensor set points, then the unit may be checked quarterly or every 2,000 unit operating hours, whichever occurs later, until there is a noncompliant emission check.

Records of all monitoring data must be maintained for a rolling twelve month period of two years and made available to District personnel upon request. Any emission check conducted by District staff that finds excess emissions would be a violation.

If the source test or emission check finds NOx or CO emissions in excess of those allowed by the rule or a permit condition, the owner or operator must correct the problem and demonstrate compliance with another emission check, or shut down the unit by the end of an operating cycle, or within 72 hours from the time the owner or operator knew of excess emissions, or reasonably should have known, whichever is sooner.

Compliance Schedule - Subdivision (e):
The proposed schedule for compliance limits is presented in subdivision (c) “Requirements” (See Table 1 in this report). Schedule for other rule requirements are as follows:

- Owners and operators will have the option to derate their equipment. The lower rated capacity would be based on the manufacturer’s rating plate or permit condition. The deadline for derating equipment extends from July 1, 2010 or July 1, 2011, depending on unit size and application.

- Boilers with an annual heat input less than or equal to 90,000 therms per year will be exempt from the proposed emission limits. However, these units would need to meet the 30 ppm or 0.037 lbs per 10^6 Btu NOx emission limit by January 1, 2015 or when the unit has its burners replaced, whichever occurs later.
- The requirement related to the loss of exemption for low fuel usage was moved from subdivision (f) of the current rule to this subdivision and modified to reflect reference to the proposed NOx compliance limits.
- A time extension would be granted to the full compliance date with the applicable NOx compliance limits for any natural gas fired units for any health facility as defined in Section 1250 of the California Health and Safety Code that can demonstrate that the Office of Statewide Health Planning and Development has approved an extension of time to comply with seismic safety requirements pursuant to Health and Safety Code Sections 130060 and 130061.5. The extension of time granted must be consistent with the time extension granted pursuant to Health and Safety Code Section 130060 but not to exceed January 1, 2015 and must be consistent with the time extension granted pursuant to Health and Safety Code Section 130061.5 but not to exceed January 1, 2020. Those health facilities granted a time extension must submit a compliance plan to the Executive Officer on or before January 1, 2010

Exemptions:
The 90,000 therm exemption will no longer apply to future units. On this basis, this subdivision has been removed.

Attachment 1:

Figures 1 and 2 have been re-introduced to Attachment. These example Oxygen/CO and Oxygen/Smoke characteristic curves were in the original adopted rule. Also some clarifying language was added to A.8 and B.1.e.ii.

Throughout PAR 1146 there are minor amendments to improve the clarity and enforceability of the rule. Compliance dates that have passed have been removed from the rule and equipment now subject to the same requirements has been consolidated into a single paragraph.

CHAPTER 3: IMPACT ASSESSMENT

IMPACT ANALYSIS

COST EFFECTIVENESS

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) ANALYSIS

SOCIOECONOMIC ASSESSMENT

DRAFT FINDINGS UNDER CALIFORNIA HEALTH & SAFETY CODE SECTION 40727

INCREMENTAL COST-EFFECTIVENESS

COMPARATIVE ANALYSIS

IMPACT ANALYSIS

Staff has prepared a preliminary analysis of the impacts of PAR 1146. The proposed rule is estimated to reduce approximately 1.3 tons per day of NO_x emissions by 2017. Emission reductions were calculated using the difference between the emission factor for the existing emission limit and the table presents the proposed NOx compliance limits for the various categories of boilers and heaters.

Emission on operating data was taken from SCAQMD Permit database. Control efficiency was provided by venders. Capacity factor (usage factor) was varied to estimate emission reductions for the category. The estimated emission reductions also take into account units that may be exempt due to low fuel usages, units that already meet BACT, the number of units within each size category.

Table 4 shows the number of boilers in the District subject to Rule 1146 by rated heat input.

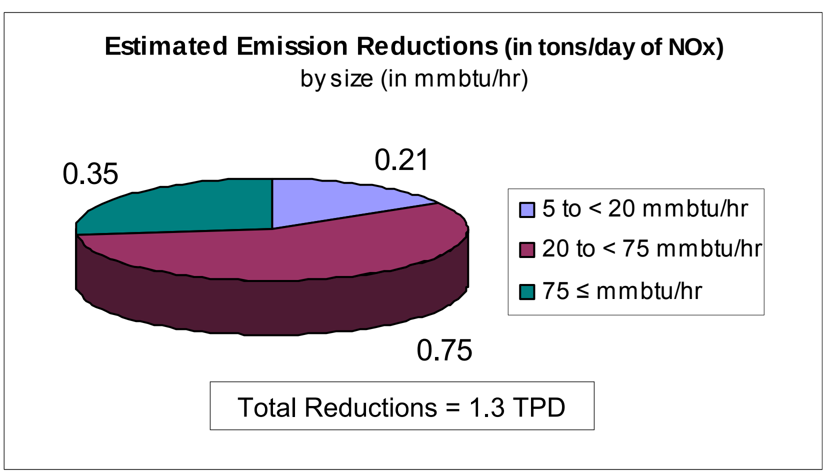
Table 3

Estimated Rating Distribution for Natural Gas-Fired Boilers

Rating (MMBtu/hr)	Approximate Number of Boilers
5 to < 20	867
20-75	148
>75	18

Based on staff analysis, the estimated emission reductions are presented in Figure 4.

Figure 4



COST EFFECTIVENESS

Cost-effectiveness is defined as the cost to comply with the new regulatory requirements, expressed in terms of dollars per ton of pollutant reduced. Determination of cost-effectiveness is required by section 40440(c) of the California Health and Safety Code. Costs can include equipment, materials, energy, or any other costs associated with meeting new regulatory requirements.

The approach for estimating cost-effectiveness is as follows:

$$CE = \frac{(\$\text{ Meet New Limits} - \$\text{ Continue w/ Existing Limits} + \$\text{ Early Retirement})}{\text{Emission Reductions from Existing to New Limits over Equipment Useful Life}}$$

This approach utilizes the Discount Cash Flow (DCF) Methodology at 4% real interest rate in current dollars. The assumed useful life for ultra-low NOx burners used in this cost effectiveness calculation is fifteen years. Fifteen years was applied in the recent amendments to Rule 1146.2 (May 2006).

The costs to meet the proposed emission limits were estimated from information obtained through manufacturers and vendors of units for the size range affected by Rule 1146. These estimates incorporate capital costs (including installation) for retrofitting equipment subject to this rule, and costs for any additional fuel and/or electricity use that are associated with meeting the more stringent NOx limits. For instance, some ultra low NOx burner systems require the use of additional excess air and/or flue gas recirculation. This reduces fuel efficiency and also requires the use of additional electricity for operation of the air blower. These additional costs were estimated using vendor data for excess air and flue gas recirculation.

In addition to the above operational parameters, costs for selective catalytic reduction (SCR) included ammonia injection and complete regeneration of the catalyst every 5 years. Most of the cost data was obtained from Appendix C to SJVUAPCD Rule 4306 Staff Report. A useful life of twenty five years was applied in the calculation for SCRs. The 25 year useful life was applied to SCRs in the January 2005 amendment to RECLAIM.

In addition to the cost elements mentioned above, staff has also included incremental costs associated with the proposed monitoring and testing requirements in determining total cost for meeting the new rule requirements. Proposed Amended Rule 1146 includes provisions for periodic monitoring of NOx emissions using a portable analyzer, and source testing requirement every three or five years depending on the unit’s rated heat input.

In estimating the cost of continuing to meet the existing rule requirements, staff used equipment, operating and maintenance costs data obtained from various manufacturers and vendors for units that meet the current 30 ppm NOx limit. This cost is deducted from the total cost of meeting the new limits in determining cost effectiveness of Proposed Amended Rule 1146.

The proposed rule amendment is estimated to reduce approximately 1.3 tons per day of NO_x emissions by 2017. Based on staff analysis, the cost effectiveness values vary depending on unit size, type of burner, and the unit's operation and load. The table below shows the estimated cost effectiveness values for the size range affected by Proposed Amended Rule 1146.

Table 4
Cost Effectiveness Estimates by Category

Category	Control Technology	Operating Capacity	Cost Effectiveness ($/ton of NOx reduced)
75 MMBtu/hr or greater	SCR	100%	13,600
		75%	15,900
		50%	20,900
		25%	37,600
20 MMBtu/hr but less than 75 MMBtu/hr	Ultra-Low NOx Burners	100%	14,200
		75%	14,900
		50%	16,100
		25%	19,800
5 MMBtu/hr but less than 20 MMBtu/hr	Ultra-Low NOx Burners	100%	11,600
		75%	13,200
		50%	16,500
		25%	26,400

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) ANALYSIS

Pursuant to the California Environmental Quality Act (CEQA) and AQMD Rule 110, the AQMD staff has prepared a Notice of Preparation/Initial Study (NOP/IS) for the proposed amendments to Rule 1146. The Initial Study identified "air quality" and "hazards and hazardous materials" as the only areas that may be adversely affected by the proposed project. Impacts to these environmental areas will be further analyzed in the Draft Environmental Assessment (EA). One comment letter was received relative to the NOP/IS and responses to the comments received will be prepared and incorporated into the Draft EA that will be subsequently prepared and circulated for a 45-day public review and comment period. Copies of the NOP/IS and the Draft EA for Rule 1146, upon its release, can be obtained by calling the AQMD's Public Information Center at (909) 396-2039 or by downloading it from the AQMD's website at: http://www.aqmd.gov/ceqa/aqmd.html.

SOCIOECONOMIC ASSESSMENT

A socioeconomic analysis of the Rule 1146 amendments will be performed. The socioeconomic report will be released no later than 30 days prior to the Board hearing.

DRAFT FINDINGS UNDER CALIFORNIA HEALTH & SAFETY CODE SECTION 40727

California Health and Safety Code Section 40727 requires that prior to adopting, amending or repealing a rule or regulation, the AQMD Governing Board shall make findings of necessity, authority, clarity, consistency, non-duplication, and reference based on relevant information presented at the public hearing and in the staff report. In order to determine compliance with Sections 40727, 40727.2 require a written analysis comparing the proposed amended rule with existing regulations.

The draft findings are as follows:

Necessity: A need exists to amend Rule 1146 to reduce emission limits for small boilers and large water heaters in order to meet federal and state ambient air quality standards.

Authority: The AQMD obtains its authority to adopt, amend, or repeal rules and regulations from California Health and Safety Code Sections 39002, 40000, 40001, 40440, 40440.1, 40702, 40725 through 40728, 41508, and 41700.

Clarity: PAR 1146 has been written or displayed so that its meaning can be easily understood by the persons affected by the rule.

Consistency: PAR 1146 is in harmony with, and not in conflict with or contradictory to, existing federal or state statutes, court decisions or federal regulations.

Non-Duplication: PAR 1146 does not impose the same requirement as any existing state or federal regulation, and is necessary and proper to execute the powers and duties granted to, and imposed upon the AQMD.

Reference: In amending this rule, the following statutes which the AQMD hereby implements, interprets or makes specific are referenced: Health and Safety Code sections 39002, 40001, 40702, 40440(a), and 40725 through 40728.5.

INCREMENTAL COST-EFFECTIVENESS

Health and Safety Code Section 40920.6 requires an incremental cost-effectiveness analysis for Best Available Retrofit Control Technology (BARCT) rules or emission reduction strategies when there is more than one control option which would achieve the emission reduction objective of the proposed amendments, relative to ozone, CO, SOx, NO_x, and their precursors. Incremental cost effectiveness is defined as the difference in control costs divided by the difference in emission reductions between two potential control options that can achieve the same emission reduction goal of a regulation.

For incremental cost effectiveness analysis, the option is to use selective catalytic reduction (SCR) to meet the more stringent 5 ppm NOx limit for units with rated heat input of 5 MMBtu/hr to 75 MMBtu/hr, and compare the cost and emission reduction to those same units using ultra low-NOx burners meeting the 9 ppm NOx limit.

For SCR, staff considered various cost factors such as equipment and installation, electricity, ammonia injection, other operating and maintenance costs, and recurring catalyst replacement cost in determining total cost. A 25-year useful life is assumed for SCR and 15 years for ultra low-NOx burners.

The table below shows the incremental cost effectiveness values for two unit size ranges affected by PAR 1146.

Table 5
Incremental Cost Effectiveness Estimates

Category	Capacity	Incremental Cost Effectiveness ($/ton of NOx reduced)
5 MMBtu/hr but less than 75 MMBtu/hr	100%	23,900
	75%	30,200
	50%	45,300
	25%	83,000

COMPARATIVE ANALYSIS

Under Health and Safety Code Section 40727.2, the AQMD is required to perform a comparative written analysis when adopting, amending, or repealing a rule or regulation. The comparative analysis is relative to existing federal requirements, existing or proposed AQMD rules and air pollution control requirements and guidelines which are applicable to industrial, institutional, and commercial water heaters, boilers, steam generators, and process heaters. This analysis will be prepared for the proposed rule amendment's set hearing package.

REFERENCES

REFERENCES

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