

PROPOSED NEW RULE 247

NATURAL GAS-FIRED WATER HEATERS, SMALL BOILERS AND PROCESS HEATERS

STAFF REPORT

Background

Placer County Air Pollution Control District has made a commitment in the 8-hour Ozone State Implementation Plan (SIP) to adopt a new rule to regulate oxides of nitrogen (NOx) emissions for all natural gas fired large water heaters and small boilers with rated input sizes in the range of 75,000 up to 1,000,000 Btu/hr, by 2015. Currently, water heaters and boilers in this size range are unregulated. Smaller water heaters, less than 75,000 Btu/hr (residential water heaters), are regulated by Rule 246, Natural Gas-Fired Water Heaters. This rule limits NOx emissions for new equipment to 40 nanograms per joule (55 ppmv @ 3% O₂). Larger heating equipment is currently regulated by Rule 231, Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters. Rule 231 applies to heating equipment of 5 million Btu/hr and larger and limits NOx emissions of new and existing gaseous fueled equipment to 30 ppmv (parts per million by volume).

Proposed new Rule 247, Natural Gas-Fired Water Heaters, Small Boilers and Process Heaters, will cover the entire unregulated size range from 75,000 Btu/hr up to less than 5 million Btu/hr and limit NOx emissions for new boilers and water heaters to 20 ppmv. The new rule will apply to the sale or installation of new equipment; existing equipment will not be affected. Proposed Rule 247 will limit NOx to lower levels than allowed by either current Rule 246 or Rule 231. Amendment of Rules 246 and 231 to lower allowable NOx levels will be considered in future SIP planning.

Discussion of Proposed Rule 247

Neighboring air districts, Sacramento Metropolitan Air Quality Management District and Yolo Solano Air Quality Management District that are also in the Sacramento Federal Ozone Nonattainment Area, currently have rules in effect that limit NOx emissions from natural gas fired small water heaters and boilers to 20 ppmv. Both Districts limit NOx to 20 ppmv for boilers from 75,000 up to 1 million Btu/hr for new boilers (new boilers will be referred to as Point of Sale (POS)). For boilers and water heaters from 1 million up to less than 5 million Btu/hr, Sacramento requires retrofit of all boilers in this range to no more than 30 ppmv. Yolo Solano does not currently have an emission limit for boilers and water heaters in the 1 million up to 5 million Btu/hr range, but has a SIP commitment to do so.

Most of the large air districts in the state, including South Coast and San Joaquin, also have rules that limit NOx emissions in natural gas water heaters and boilers for POS to 20 ppmv or even less in some size ranges. Equipment is clearly available in California that meets the NOx limit proposed in the District's new Rule 247. The 20 ppmv requirement is so common in California, that some manufacturers don't offer anything for sale that has higher emissions. Even though Placer does not currently have emissions limits for thermal equipment of this size range, all boilers and water heaters permitted in 2013 voluntarily meet the 20 ppmv level of emissions. This applies to equipment in the range of 1 million up to less than 5 million Btu/hr. Smaller rated equipment is unknown because equipment below 1 million Btu/hr does not normally require a permit.

Large water heaters and small boilers in the range of 75,000 up to 400,000 Btu/hr are commonly used to provide hot water and steam for large residences, or small industrial and commercial operations. Such applications consist of uses for space heating, food processing, garment laundering, or equipment sterilization. Water heaters and boilers greater than 400,000, but less than one million Btu/hr are more commonly found in larger industrial facilities, small schools, and large buildings to provide hot water or steam. Thermal equipment over one million, but less than five million Btu/hr can be found in some larger schools, industrial facilities, large swimming pools at schools, clubs, and public recreational facilities, very large

Rule 247, Natural Gas-Fired Water Heaters, Small Boilers, and Process Heaters

Staff Report

Board Date: October 10, 2013

commercial buildings, and large buildings in the Tahoe area such as ski resorts, hotels, and residential complexes that have a high heating demand.

Exemptions

The proposed rule lists several exemptions which include:

- Water heaters used in recreational vehicles
- Water heaters used to heat pools/spas with a rated heat input capacity less than or equal to 400,000 Btu/hr

Water heaters for use in recreational vehicles are typically designed for use of multiple types of fuels and usually are smaller than the lower threshold of applicability of this rule.

Pool/spa heaters less than 400,000 Btu/hr are typically used for small residential pools and spas. Equipment in this size range for pools and spas is not well developed to meet the 20 ppmv emission limit of this rule. Other California districts usually don't have a 20 ppmv limit in this size range.

Emissions Impacts

Staff used the CARB Emissions Inventory to obtain NOx emissions inventory information for natural gas consumption by various unit types for 2010. The unit types included boilers, process heaters, water heating, and "other" in the following processes: Manufacturing and Industrial, and Service and Commercial. NOx emissions were found to be 2.00 tons per day (tpd). Future inventory emissions were projected for the years 2015 and 2020 using the CARB Emissions Inventory Database and found to be 2.13 and 2.19 tpd of NOx respectively. Manufacturers reported that the typical life of this type of equipment is about 15 years before replacement, so estimated emissions are needed for 2025 to have a 15 year period in which the existing equipment will all be replaced. The rate of increase in emissions between 2015 and 2020 is extrapolated to 2025, giving estimated NOx emissions of 2.25 tpd.

This inventory includes the heating equipment size range from just above residential water heaters up to the largest boilers used in industry. Rule 247 covers a smaller size range, only going up to 5 MMBtu/hr. To estimate what part of the CARB emissions inventory applies to equipment subject to Rule 247, the entire Placer County APCD permitted base of this equipment was listed by input thermal rating and it was found that approximately 60% of the equipment capacity was under 5 MMBtu/hr. If the CARB inventory numbers are factored by 60%, that should give a good estimate of the NOx inventory subject to Rule 247.

Heating equipment meeting the 20 ppmv NOx emission limit is currently available and District permitting staff has been seeing increasing optional use of this low-NOx equipment since 2010. Therefore, it is reasonable to assume that over the course of the 15 years from 2010 to 2025, all existing heating equipment subject to this rule will be replaced in a linear fashion, with about 6.7% replaced per year.

The existing inventory of affected equipment types can be characterized by NOx emissions similar to the EPA AP-42 Compilation of Emission Factors for uncontrolled small boilers, which is 80 ppmv (100 lb/MMCF). This will result in new equipment complying with 20 ppmv having only 25% of the NOx emissions of the old equipment. Therefore, for each 5-year period, 1/3 of the equipment inventory will have been replaced with 20 ppmv equipment, for a reduction of 0.33 times 0.75 which is a reduction of 25% of the total NOx emissions inventory at the end of each 5 year period. This then yields for the years 2015, 2020, and 2025:

YEAR	CARB NOx (tpd)	CARB NOx Subject to Rule 247 (tpd)	RULE 247 Implementation (tpd)	REDUCTION (tpd)
2010	2.00	1.20	1.20	0.0

Rule 247, Natural Gas-Fired Water Heaters, Small Boilers, and Process Heaters

Staff Report

Board Date: October 10, 2013

2015	2.13	1.28	0.96	0.32
2020	2.19	1.31	0.66	0.66
2025	2.25	1.35	0.34	1.01

Cost Effectiveness

The California Health and Safety Code (CH&SC) Section 40703 requires the District, in the process of the adoption of a regulation, to consider and make public its findings related to the cost effectiveness of a control measure. Cost effectiveness for rule-making purposes is calculated by dividing the cost of air pollution controls required by the rule by the amount of air pollution reduced.

A number of equipment manufacturers and California distributors were contacted and cost information was requested for comparable size heating equipment both with, and without low-NOx capability. Only a few responded with the requested cost information. Of those that responded, the increased cost for low-NOx ranged from 7 to 71%. For different size units, the increased cost ranged from \$69 to \$25,535. There is a considerable cost difference between commercial grade and industrial grade equipment. See Attachment A for details.

In Attachment A, cost effectiveness is calculated for three different size water heaters or boilers based on the above costs. The examples were selected to illustrate the full range of cost effectiveness. Cost effectiveness ranges from \$704 to \$12,069 dollars per ton of NOx reduced.

Comparison with Other Applicable Regulations and Requirements

CH&SC Section 40727.2 requires districts to perform a comparative alternative analysis of any new control standard. Specifically, the District is required to prepare a written analysis (usually in the form of a matrix) that identifies all existing federal air pollution control requirements, including, but not limited to emission control standards constituting best available control technology (BACT) that applies to the same equipment or source type as the rule or regulation proposed for adoption or modification by the District. In addition, the analysis shall identify any other District rule or regulation that applies to the same equipment or source type.

There are no federal regulations, such as National Emission Standards for Hazardous Air Pollutants (NESHAPs) or New Source Pollution Standards (NSPSs) that apply to this source category. In addition, by the BACT applicability thresholds of Rule 502, New Source Review (10 pounds per day of NOx), units which are subject to this rule will never emit as much as 10 pounds per day of NOx, thus being subject to BACT. Therefore, the Section 40727.2 analysis cannot be performed.

However, for reference, several other air districts have rules that are, or will be, in effect in 2014 that apply to similar sources were compared below. For the larger rated equipment, some districts require retrofit of the existing equipment to the emission limits of their rule. Other districts have a point of sale (POS) strategy that relies on equipment replacement as it wears out to proliferate the lower emitting equipment. POS requirements are noted in the following table with (POS) under the emission limit.

	SIZE RANGE (BTU/HR)			
	>75,000 to 400,000	400,000 to <1MM	1MM to 2MM	>2MM to 5 MM
South Coast Rule 1146.1 and 1146.2	20 ppmv (POS)	20 ppmv (POS)	20 ppmv (POS)	9 and 12 ppmv (POS)
San Joaquin Rules 4307 and 4308	20 ppmv (POS)	20 ppmv (POS)	20 ppmv (POS)	9 and 12 ppmv (POS)
Bay Area	20 ppmv	30 ppmv	30 ppmv	30 ppmv

Rule 247, Natural Gas-Fired Water Heaters, Small Boilers, and Process Heaters

Staff Report

Board Date: October 10, 2013

Rules 9-6 and 9-7	(POS)	(POS)	(POS)	
Sacramento Rules 411 and 414	20 ppmv (POS)	20 ppmv (POS)	30 ppmv	30 ppmv
Yolo Solano Rule 2.37	20 ppmv (POS)	20 ppmv (POS)	N/A	N/A
Placer Rule 247	20 ppmv (POS)	20 ppmv (POS)	20 ppmv (POS)	20 ppmv (POS)

Fiscal Impact

The adoption of Rule 247 will have a fiscal impact on purchasers of new water heaters, boilers and process heaters. New equipment meeting the emission limits of Rule 247 costs slightly more than equipment with higher emissions. This increased cost ranges from 7% to 71%, depending on the size of the equipment and the supplier (see Attachment A for cost data).

Permit applicants frequently are telling staff that they are replacing their water heaters and boilers before the old equipment is worn out in order to get more efficient heaters to save on fuel costs. The more efficient heaters usually come with the low-NOx emissions. While the high efficiency and low-NOx equipment costs more, businesses are justifying replacing equipment early on a return on investment (ROI) basis.

Other businesses are motivated to replace water heaters and boilers with high efficiency units due to the reduction of greenhouse gases provided by the higher combustion efficiencies of the new equipment.

Cost effectiveness of Rule 247 is calculated for several examples in Attachment A. For these examples, cost effectiveness ranges from 704 to 12,069 \$/ton.

The fiscal impact on the District of implementing Rule 247 should be neutral. The Rule does not require businesses to replace their equipment. But when they choose to replace equipment, they must purchase the low-NOx units. Businesses that replace water heaters and boilers subject to obtaining an air emission permit pay for the cost of issuing the permit through the application fee and the engineering analysis fee. A permit is required for thermal equipment with an input rating of 1 million Btu/hr and greater, or for multiple smaller units feeding the same load where the combined thermal rating adds up to 1 million Btu/hr.

Outreach

The public was notified of the proposed adoption of Rule 247 through a newspaper notice and direct mailer of the proposed rule to equipment manufacturers and Northern California distributors.

The draft rule and staff report were sent to EPA and ARB for comment. (NO RESPONSE YET)

Analysis and Findings

The following Analysis and the subsequent Findings are intended to address the requirements set forth in the Health and Safety Code relating to adoption of a new or amended District Rule, as well as other State statutes referenced herein.

Rule 247, Natural Gas-Fired Water Heaters, Small Boilers, and Process Heaters

Staff Report

Board Date: October 10, 2013

Cost-Effectiveness of a Control Measure

California Health & Safety Code (H&S) Section 40703 requires a District to consider and make public “the cost-effectiveness of a control measure”. The cost-effectiveness of the proposed rule is addressed above.

Socioeconomic Impact

H&S Section 40728, in relevant part, requires the Board to consider the socioeconomic impact of any new rule if air quality or emission limits are significantly affected. However, Districts with a population of less than 500,000 persons are exempted from the socioeconomic analysis. In 2012, the population of Placer County was approximately 355,000 persons. Therefore, the District is not required to consider the socioeconomic impacts of the proposed rule amendment.

California Environmental Quality Act (CEQA)

Proposed adoption of Rule 247 is not an activity that may cause a direct or reasonably foreseeable indirect physical effect in the environment therefore not considered a “project”, as defined by Section 21065 of the California Public Resource Code and Section 15378(b)(4)&(5) of the CEQA guidelines.

According to the above conclusion, Staff finds that the proposed rule is exempt from the California Environmental Quality Act (CEQA) because 1) it can be seen with certainty that there is no possibility that the activity in question may have a significant adverse effect on the environment (CEQA Guidelines §15061(b) (3)) and 2) it is an action by a regulatory agency for protection of the environment (Class 8 Categorical Exemption, CEQA Guidelines §15308). A CEQA analysis is therefore not necessary.

Findings

- A. **Necessity** – The adoption of Rule 247 is necessary in order to fulfill a District commitment in the 8-hour Ozone State Implementation Plan to promulgate a control measure to regulate NOx emissions from natural gas fired boilers and water heaters.
- B. **Authority** – California Health and Safety Code, Sections 40702, 41511, and 42303 are provisions of law that provide the District with the authority to adopt this new Rule.
- C. **Clarity** – There is no indication, at this time, that the proposed Rule is written in such a manner that persons affected by the Rule cannot easily understand them.
- D. **Consistency** – The regulation is in harmony with, and not in conflict with or contradictory to, existing statutes, court decisions, or state or federal regulations.
- E. **Non-duplication** – The regulation does not impose the same requirements as an existing state or federal regulation.
- F. **Reference** – All statutes, court decisions, and other provisions of law used by PCAPCD in interpreting this regulation is incorporated into this analysis and this finding by reference.

Attachment A Cost Effectiveness Estimate

Added Cost of Low-NOx Burners

Staff requested cost information from manufacturers for standard water heaters and boilers (non-low-NOx) and low-NOx units of the same manufacturer and thermal rating. The low-NOx models are almost always combined with higher efficiency. While the added cost comes from both the low-NOx burner and the changes to increase efficiency, the relative contributions of each cannot be determined. If you buy the low-NOx, you also get the higher efficiency. Not many manufacturers responded with comparative cost information. Below are costs for a range of thermal ratings, including one residential water heater below the lower size applicability of the rule:

NOx Type	Btu Rating	Description	Retail Cost (\$)	Low-NOx Increase (\$), (%)
Standard	38,000	Residential, 50 gal tank	418	
Low-NOx	40,000	Residential, 48 gal tank	487	\$69, 17%
Standard	200,000	Commercial, 100 gal tank	5,538	
Low-NOx	200,000	Commercial, 100 gal tank	6,199	\$661, 12%
Standard	200,000	Tankless water heater	999	
Low-NOx	200,000	Tankless water heater	1199	\$200, 20%
Standard	1,000,000	Boiler	14,000	
Low-NOx	1,000,000	Boiler	17,500	\$3,500, 25%
Standard	2,000,000	Commercial Boiler	21,430	
Low-NOx	2,000,000	Commercial Boiler	22,930	\$1,500, 7%
Standard	2,000,000	Industrial Boiler	36,095	
Low-NOx	2,000,000	Industrial Boiler	61,630	\$25,533, 71%
Standard	5,000,000	Industrial Boiler	62,630	
Low-NOx	5,000,000	Industrial Boiler	82,940	\$20,310, 32%

Cost Effectiveness Calculations

Cost-effectiveness = (Annualized Cost of Abatement System (\$/yr)) / (Reduction in Annual Pollutant Emissions (ton/yr))

The reduction in annual pollutant emissions is the expected decrease in the source's NOx emissions from its baseline uncontrolled level, achieved by the installation of the low-NOx system under review. This annual reduction can be calculated as the difference in emissions between standard equipment and low-NOx equipment. Since this is a point of sale rule, only the added cost of low-NOx is used that is above replacement with a standard non-low-NOx unit.

The annualized added cost of the low-NOx equipment can be estimated from the added capital cost of the low-NOx equipment and its expected added annual indirect costs which are a percentage of the added capital cost.

Annualized cost = Direct Costs + Indirect Costs

Rule 247, Natural Gas-Fired Water Heaters, Small Boilers, and Process Heaters

Staff Report

Board Date: October 10, 2013

where Direct Cost is the added capital cost of the low-NOx option and Indirect Costs (Sum of the Following):

- Property Tax (1% of Added Capital Cost)
- Insurance (1% of Added Capital Cost)
- General & Administrative (2% of Added Capital Cost)

Capital Recovery (CRF x Added Capital Cost)

The capital recovery factor (CRF) recognizes the time value of money and converts the up-front capital cost (the installed equipment cost) to an annualized cost.

The capital recovery factor (CRF) is given by:

$$\text{CRF} = \frac{i (1 + i)^n}{(1 + i)^n - 1}$$

where i = interest rate (assume i = 0.05),
and n = lifetime of abatement system (assume n = 15 years),
then, the capital recovery factor **CRF = 0.096**

**Annualized Cost =
Installed Equipment Cost x
[Capital Recovery Factor + Tax Factor + Insur. Factor + G & A Factor]**

The added capital cost of equipment varies depending on the size of the equipment, so a range of costs from small to large can be examined over the entire installed base being replaced over 15 years.

The annualized cost is then [added equipment cost] x [0.096 + 0.01 + 0.01 + 0.02] = 0.10 x added equipment cost.

From the comparative equipment costs in the above table, cost effectiveness is calculated for three examples. Annual emission reductions are calculated for equipment operating eight hours per day and 365 days per year.

Unit	200,000 Btu/hr Tankless	1 MMBtu/hr Boiler	2 MMBtu/hr Indust. Boiler
Added Cost (\$)	200	3500	25,553
NOx Reduction (ppmv)	60	60	60
Lb/hr Reduction	0.0145	0.0725	0.145
Lb/day Reduction	0.116	0.58	1.16
Annual NOx Reduction	42.34	211.7	423.4
CRF+Ins+Tax+G&A	0.10	0.10	0.10
Annualized Cost (\$)	20	350	2,555
Cost Effectiveness (\$/ton)	945	3,307	12,069