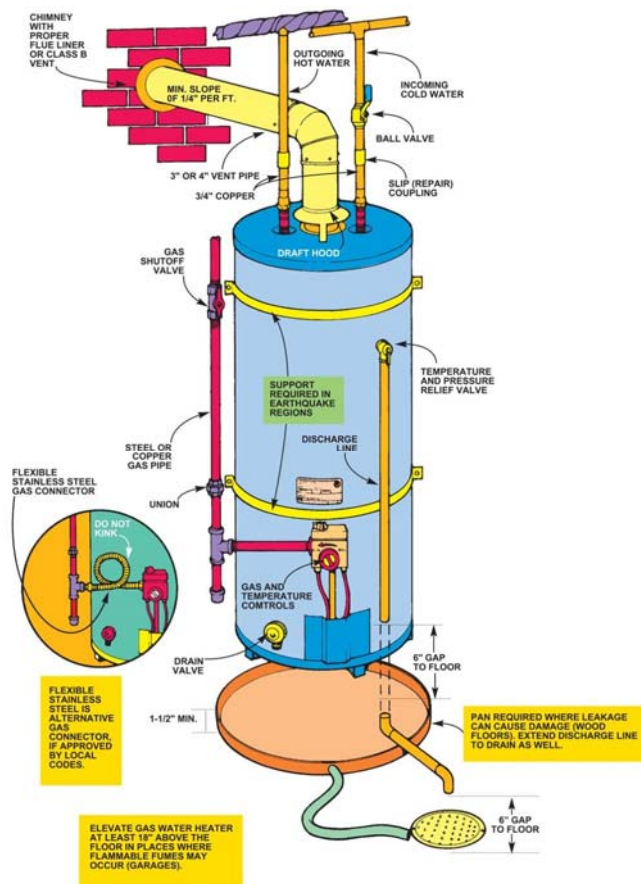


Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109

Bay Area Ozone Strategy
Control Measure SS 13

BAAQMD Regulation 9, Rule 6:
Nitrogen Oxides from Natural Gas-Fired Water Heaters



Workshop Report
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Prepared by:
Guy A. Gimlen
Air Quality Engineer
Planning, Rules and Research Division

REGULATION 9, RULE 6
Nitrogen Oxides from Natural Gas-Fired Water Heaters
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I. INTRODUCTION

This Workshop Report provides information regarding proposed amendments to Bay Area Air Quality Management District (“BAAQMD” or the “Air District”) Regulation 9, Rule 6: *Nitrogen Oxides from Natural Gas-Fired Water Heaters* (“Regulation 9-6”). The Air District proposes these amendments to Regulation 9-6 to reduce emissions of nitrogen oxides (NO_x) by updating the NO_x emissions requirements for residential water heaters and thus implementing Control Measure SS-13 in the Air District’s 2005 Ozone Strategy. Control Measure SS-13 proposes to reduce NO_x emissions from commercial water heaters and small boilers larger than those currently regulated by Regulation 9-6. NO_x compounds are precursors in the formation of ground level ozone. The Air District is in non-attainment status for both the State 1-hr and 8-hr ozone standards and the federal 8-hour ozone standard, and has committed to implement all feasible measures to reduce emissions of ozone precursors, including NO_x.

Regulation 9, Rule 6 is a “point of sale” type regulation, currently limiting sale and installation of new water heaters to only those that achieve NO_x emissions of less than 40 nanograms NO_x per joule of heat output. Regulation 9, Rule 6 applies to water heaters with a rated heat input capacity of 75,000 Btu/hr or less. These water heaters are conventional tank water heaters typically found in single-family residences. A typical home water heater is a 40 gallon tank water heater with a 40,000 Btu/hr heat input rating.

Larger water heaters are also tank type water heaters, similar in appearance, design, and construction to the smaller water heaters. These larger water heaters range in size from 75,000 to 400,000 Btu/hr and are used in small hotels, apartment buildings, office buildings, and industrial and commercial facilities to supply hot water. Units larger than 400,000 Btu/hr are typically small boilers and are different in appearance, design, and construction from water heaters. These small boilers are generally sold as “package boilers” that are prefabricated, equipped and shipped complete with burners and control systems. Boilers in this size range generally rely on natural draft rather than mechanical draft equipment. They are used in office buildings, hotels, schools, and industrial facilities to supply heat, steam, or hot water. These units are not currently regulated by an Air District rule.

The Air District estimates that residential water heaters with heat input of 75,000 Btu/hr or less currently emit 3.29 tons of NO_x per day in the Bay Area. Current NO_x emissions from larger water heaters from 75,001 Btu/hr up to 400,000 Btu/hr are estimated to be 0.1 tons per day. Current NO_x emissions from small boilers ranging from 400,001 Btu/hr up to 2,000,000 Btu/hr are estimated to be 0.4 tons per day.

Regulation 9, Rule 6 draft amendments are similar to the standards and implementation timetable established by SCAQMD for residential water heaters. Emissions reductions are based on lower emissions for each water heater sold starting in 2009 and an estimated 12 year life expectancy for a typical water heater. NO_x reductions are estimated to be 0.2 tpd in mid-2009 and accrue to a total reduction of 2.4 tpd by 2021.

In addition to the South Coast, the Santa Barbara, Ventura, and San Joaquin Valley air districts have enacted regulations that limit the sale of new large water heaters and small boilers. Expected NO_x reductions from extending this regulation to the larger water heaters and small boilers ranging in size from 75,001 to 2,000,000 Btu/hr are estimated at 0.4 tpd when the proposed amendments are fully implemented. Implementation is proposed as replacement of existing high emission water heaters and small boilers when they reach the end of their useful life. These larger water heaters and small boilers typically have a long life expectancy – estimated at 25 years.

The Air District is proposing lower NO_x limits on pool and spa heaters that are not found in other district's regulations. Residential pool heaters are seldom used for any significant periods so will remain exempt, but commercial pools in hotels, schools and fitness facilities heat their pools all year. Pool and spa heaters should be able to implement the same technology that successfully reduces NO_x in other large commercial water heaters.

Industry impact is expected to be minimal. The technology to achieve these proposed limits is available. New low-emissions water heaters will replace higher emission water heaters at the end of their useful life. Low-emission water heaters cost 20 - 30% more than existing designs, but also achieve higher efficiency and more stringent safety standards.

II. BACKGROUND

Background and Regulatory History

The Air District regulates NO_x emissions from water heaters under Regulation 9, Rule 6, (“Regulation 9-6”) which imposes a NO_x limit of 40 nanograms NO_x per joule of heat output on water heaters with a rated heat input capacity of 75,000 Btu/hr or less. The regulated water heaters are conventional tank water heaters typically found in single-family residences. This rule was adopted April 1, 1992.

Larger water heaters and boilers are regulated under three separate rules. Two rules apply to large industrial boilers at refineries and power plants (Regulation 9, Rules 10 and 11 respectively). The third rule, Regulation 9, Rule 7 (“Regulation 9-7”), imposes a 30 ppm NO_x limit on industrial, institutional, and commercial boilers with a rated heat input of 10 million Btu/hr or more. Regulation 9, Rule 7 was adopted September 15, 1993. Control Measures SS-12 and SS-13 in the Air District's 2005 Ozone Strategy propose to review each regulation, and close the gap that currently exists between Regulation 9-6 and Regulation 9-7, by amending each rule so that together they regulate all water heaters and boilers with a rated heat input of less than 10 million Btu per hour. Control Measure SS-12 committed the Air District to consider extending coverage of Regulation 9-7 to smaller boilers (less than 10 million Btu/hr heat input) that are currently exempt. Control Measure SS-13 committed the Air District to review NO_x emission limits for residential water heaters, and consider extending coverage of Regulation 9-6 to larger water heaters (heat input greater than 75,000 Btu/hr) and some small boilers.

Water heaters between 75,001 and 400,000 Btu/hr heat input are usually tank type water heaters similar in appearance, design, and construction to the smaller water heaters subject to Regulation 9, Rule 6. Units larger than 400,000 Btu/hr are typically small boilers and are different in appearance, design, and construction from water heaters. The small boilers to which this measure applies are generally sold as “package boilers” that are prefabricated, equipped and shipped complete with burners and control systems. Boilers in this size range generally rely on natural draft rather than mechanical (fan assisted) draft. They are used in office buildings, hotels, schools, and commercial and industrial facilities to supply heat, steam, or hot water. Regulation 9-6 does not apply to any other kind of space heaters, process fluid heaters or other industrial heaters in this size range.

The South Coast Air Quality Management District (“SCAQMD”) adopted Rule 1121 as a “technology forcing” regulation, requiring water heaters to meet 20 ng/joule by 2002, and 10 ng/joule by 2005. This regulation has subsequently been amended twice since 1995 as delays in development of technology to meet the standards occurred. Discussions with SCAQMD staff and water heater manufacturers validate that water heaters of up to 50 gallons now appear to be able to meet the 10 ng/joule NO_x limit and will be commercially available by late 2007. Similarly, manufacturers are on track to produce water heaters of greater than 50 gallons that meet the 10 ng/joule NO_x limit by 2009. They also appear to be on track to produce water heaters with fan assisted draft that meet the 10 ng/joule limit by 2010.

SCAQMD Rule 1146.2 – *Emissions of Oxides of Nitrogen from Large Water Heaters and Small Boilers*, adopted on January 9, 1998, established NO_x emission limits for large water heaters and small boilers ranging from 75,001 Btu/hr up to and including 2 million (MM) Btu/hr. at various dates from 2000 to 2006 with future reductions between 2010 and 2012. The Santa Barbara, Ventura, and San Joaquin Valley air districts have subsequently enacted similar regulations that reflect the South Coast interim limits.

III. Technical Review

Emissions Subject to Control

Emissions from residential water heaters along with emissions from larger residential, commercial and industrial combustion equipment are included in the BAAQMD inventory in three different categories. Emissions from residential water heaters are included in the emission inventory Source Category 284, called Fuels Combustion – Domestic. NO_x emissions from residential water heaters in this category are estimated to be 3.29 tons of NO_x per day based on estimated volumes of natural gas burned for water heating from Pacific Gas & Electric (PG&E).

Estimated emissions from larger residential, commercial and industrial combustion equipment that are not permitted as point sources are captured as area source emissions in Category 1590, Fuels Combustion – Other External Combustion. Emissions from this category are 7.03 tons per

day, including emissions from devices with input heat ratings less than 2 MM Btu/hr. An inspection of boiler population data provided by the San Francisco Department of Building Inspection (DBI) for 2003 shows that devices rated less than 2 MM Btu/hr constitute one third of the total number of devices rated less than 10 MM Btu/hr. We expect this information to be representative of other commercial installations throughout the Bay Area. However, because devices rated less than 2 MM Btu/hr have a maximum fuel consumption that is one fifth of the largest devices (10 MM Btu/hr), the NO_x emissions from these devices will be assumed to be only 20% of that suggested by their population:

$$(7.03 \text{ ton/day})(0.33)(0.20) = 0.46 \text{ ton/day NO}_x$$

Emissions from permitted point sources are captured in Category 307. Category 307 NO_x emissions are estimated to be 3.49 tpd from “other” natural gas combustion – some of which may be water heating. Staff analyzed these point sources using source codes for Industrial – Other, and Commercial / Institutional. Expansion of the rule will include a small number of large water heaters whose emissions appear to be relatively small – no more than 0.01 tpd. Similarly for the small boilers, emissions appear to be no more than 0.07 tpd.

The conclusion from the above data is that the NO_x emissions subject to control from water heaters in the 75K to 2 MM Btu/hr range is approximately 0.5 tons per day.

Types of Water Heaters

There are a wide variety of products available to provide hot water in residential and commercial applications. The current Regulation 9, Rule 6 only regulates gas-fired water heaters less than 75,000 Btu/hr. The four companies making equipment subject to this rule and other manufacturers produce boilers; electric and gas-fired storage tank water heaters; electric and gas-fired instantaneous water heaters; and hot water storage tanks where water is heated by another source such as a boiler or by solar heating. Water heater manufacturing companies also make combination solar and electric water heater tanks. In other countries, combination solar and gas-fired water heaters are also available.

Within the category of gas-fired storage tank water heaters, there are four types which differ in the way combustion air and combustion exhaust gases are handled. In conventional gas-fired storage tank water heaters, combustion air enters at the bottom of the unit and combustion products are vented through an exhaust duct to the outside of the building. These are known as atmospheric (natural draft) water heaters. There are also water heater designs that use fan assist to draw air in, or exhaust gases out of the water heater. These designs have various names: power-vent; direct-vent; and power direct-vent; all falling under the label of “Power Assist” storage tank water heaters. Each design is based on the ducting required for combustion air inlet, and exhaust gas outlet.

A recent style of water heater is an instantaneous, tank-less water heater that heats water “on demand”. These water heaters are becoming more popular for specific use needs, and may be more efficient because they have less heat loss during non-use periods.

Each system for water heating (other than solar) results in emissions of nitrogen oxides. Electric water heaters do not emit nitrogen oxides directly, but they result in increased power plant emissions. Solar water heating is the technology with the greatest potential to reduce emissions from the heating of hot water for residential and commercial use. A variety of solar water heating systems are available. However, for most applications an additional source of heat is needed when sunlight is not available.

Reducing NO_x emissions

All natural gas fired water heaters and boilers rely on a burner to combust fuel to heat the water. Manufacturers have tested a variety of burner types to achieve low NO_x emissions. For residential water heaters, manufacturers have focused on pre-mixed atmospheric burners. These burners mix fuel and air before the mixture is ignited at the surface of the burner. In premixed radiant burners, air and fuel are combusted slowly on the porous surface of the burner at the air-gas interface. Radiant burners are generally made of ceramic or metal fibers. Radiant burners evenly distribute the heat of combustion which stabilizes the flame and prevents "hot spots." When hot spots are prevented, NO_x emissions are minimized.

A number of burner and material manufacturers have developed atmospheric, pre-mixed, ceramic or metal fiber matrix burners. Manufacturers of ceramic and metal fiber radiant burners and other types of gas-fired appliances have developed burners with emission levels at or below the 10 ng/J limits the proposed amendments to Regulation 9, Rule 6 would ultimately require. These low NO_x burners are manufactured for a wide range of applications. Available information shows that the interim and final rule limits are achievable in both natural draft and fan-assisted applications. Radiant burners can meet the rule limits within a range of conditions (i.e., amount of excess air) and use a variety of ignition technologies.

Technology Assessment

The manufacturers of boilers, water heaters and process heaters use similar approaches to achieve low NO_x levels. The principle technique involves premixing of fuel and air before combustion takes place. This results in a lower and more uniform flame temperature. A lower flame temperature reduces formation of NO_x. 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 can result in less heat escaping the boiler through exhaust gases.

The technology to produce water heaters that emit less than 10 ng/joule is currently available. Manufacturers have integrated these low NO_x emissions into re-design of their water heaters, starting with the 50 gallon and smaller water heaters first. The re-design was required to meet U.S. Department of Energy Regulations¹, and California Energy Commission Appliance Efficiency Standards.² These standards require greater than 80% efficiency, and enhanced safety requirements including Flammable Vapor Ignition Resistance (FVIR). Each manufacturer is now certifying their parts suppliers and manufacturing process to ensure each water heater meets all requirements. Manufacturers expect to be able to supply water heaters that meet the efficiency, safety, and NO_x standards by September 2007. Manufacturers expect to supply water heaters over 50 gallons that meet all requirements by 2009, and water heaters that require power assisted ventilation by 2010.

Low NO_x burners for large heaters and small boilers can achieve NO_x emissions of less than 14 ng/joule. Manufacturer certification test results provided to SCAQMD show that manufacturers have made substantial progress in reducing the NO_x emissions from large water heaters and small boilers. Approximately 20 percent of the large water heaters providing test results in the 75,001 to 400,000 Btu/hr units size range meet the proposed Regulation 9, Rule 6 limit of 14 ng/joule. Approximately 45% of the small boilers and boiler type water heaters in the 400,001 to 2,000,000 Btu/hr size range units tested under the SCAQMD certification program meet the proposed limit. While no residential instantaneous water heaters currently meet the proposed emission limit, manufacturers have reported their progress quarterly to SCAQMD, and indicate they are on-track to achieve these standards by 2012.

IV. Rule Amendments Being Considered

Proposed Method of Control

Residential Water Heaters

This measure would reduce the NO_x emissions limit for residential water heaters to 10 nanograms/joule of heater output from its current limit of 40 nanograms/joule. This reduction is now technically feasible. Staff proposes amending Regulation 9, Rule 6 to require the following categories of residential water heaters to meet a NO_x emission limit of 10 ng/joule according to the following schedule:

- < 50 gallon storage tank effective January 1, 2009
- > 50 gallon storage tank effective January 1, 2010
- Power assist storage tank effective January 1, 2011
- Instantaneous effective January 1, 2013

Manufacturers claim in their quarterly progress reports to SCAQMD that they are certifying their manufacturing processes, and will be able to deliver less than 50 gallon tank water heaters that meet the efficiency, safety, and NO_x standards to southern California by September, 2007. Manufacturer progress reports also anticipate being able to achieve similar emissions for the

greater than 50 gallon tank water heaters by 2009, and for the direct-vent, power-vent, and power direct-vent water heaters by 2010.

Swimming Pool & Spa Heaters

Water heaters used exclusively for swimming pools and spas are similar in design to large commercial water heaters, and have been exempt from this regulation in the past. Residential pools are seldom heated year-round, so they will remain exempt from this rule. Commercial, public, and institutional swimming pools normally keep their pools heated all year, and therefore can be significant sources of NO_x emissions. Staff recommends requiring any new heaters used exclusively for commercial, public, and institutional swimming pools and spas to meet a NO_x emissions standard of 40 ng/joule, (~55 ppm), effective January 1, 2008. This water heater technology is now readily available, and swimming pool and spa heaters should no longer be exempt from this regulation. Further, staff recommends that the commercial, public and institutional pool and spa water heaters be required to meet a 14 ng/joule NO_x emission limit by January 1, 2013, consistent with other large commercial water heaters.

Mobile Home Water Heaters

Water heaters used exclusively for mobile homes are similar in design to those with power assist vent systems. Staff recommends requiring any new heaters not to exceed a NO_x emissions standard of 40 ng/joule, effective July 1, 2008. This water heater technology is now readily available, so mobile home water heaters should no longer be exempt from this regulation.

Commercial Water Heaters

Water heaters larger than 75K Btu/hr heat input are currently not regulated by the Air District. Regulation 9, Rule 7 imposes NO_x emission standards on industrial boilers larger than 10 MM Btu/hr. The proposed amendments to Rule 9-6 would impose a NO_x limit of 40 nanograms per joule of heat output (~55 ppm) for new water heaters from greater than 75K Btu/hr up to 400,000 Btu/hr heat input, effective January 1, 2008. Water heaters certified to meet these emissions are currently available in southern California. Staff proposes a 14 ng/joule standard become effective in the Bay Area by January 1, 2013.

New package boilers larger than 400,000 Btu/hr and less than or equal to 2 million Btu/hr will also be regulated by these amendments. Regulation 9, Rule 7 currently requires all large boilers to meet a NO_x emissions limit of 20 ng/joule (~30 ppm). The proposed amendments to Rule 9-6 would impose a similar NO_x limit of 20 nanograms per joule (~30 ppm) of heat output for new water heaters from greater than 400K Btu/hr up to 2,000,000 Btu/hr heat input, effective January 1, 2008. Staff further proposes to require water heaters with a heat input of 400K Btu/hr up to 2,000,000 Btu/hr to meet a 14 ng/joule standard effective January 1, 2013.

All of the NO_x emissions limits proposed for Regulation 9, Rule 6 will apply to new units only.

Emission Reductions Expected

Current emissions for residential water heaters are estimated at 3.29 tons per day (tpd). The proposed amendments will reduce NO_x by 75%, or 2.47 tpd. However, these emission reductions will occur as new water heaters replace the existing higher emissions water heaters. Typical life expectancy for a residential water heater is 12 years. Staff proposes this rule amendment go into effect on January 1, 2009, thus reducing NO_x emissions by a cumulative 0.21 tpd for each of the subsequent 12 years.

Current emissions inventory information for commercial, institutional, and industrial water heaters from 75K to 2 MM Btu/hr heat input is less certain. Current estimates for these NO_x emissions in the Air District inventory are a cumulative 0.5 tpd. The NO_x emission reductions staff expects will occur in two phases. The first phase is a reduction from uncontrolled NO_x emissions (~74 ng/joule) to 40 ng/joule beginning in 2008. The second phase is a reduction from 40 ng/joule to 14 ng/joule beginning in 2013. Large water heaters and small boilers also have a longer lifespan – estimated at 25 years, which equates to only 4% replacement each year. NO_x reductions will be 0.01 tpd each year beginning in 2008. NO_x reductions will increase to 0.016 tpd in 2013. Since this is a relatively small amount of potential NO_x reduction, staff proposes the strategy of replacement with new low emission water heaters and package boilers when they reach their end of useful life, rather than to require a retrofit or accelerated replacement.

Costs of Control

Cost of a typical residential 40 gallon, 40,000 Btu/hr heat input water heater is \$400 – \$500, plus an additional costs for installation. Incremental cost for a low-NO_x residential water heater is approximately \$50. These water heaters have also been redesigned to be more efficient, as required by Department of Energy standards. Incremental costs for increased efficiency of the new water heater is approximately \$60. The average residential water heater burns 200 Therms/year, producing 1.08 lbs. of NO_x. New residential water heaters are required to be at least 5% more efficient, and are estimated to be ~9% more energy efficient. Estimated energy savings are \$20 per year, generating a simple payback period of less than 6 years for both advantages of increased efficiency and low NO_x.

Water heaters from 75,000 to 400,000 Btu/hr heat input range in cost from \$2500 to \$10,000 plus installation. Incremental costs for low NO_x capability in large water heaters are estimated to be no more than \$100 per unit. A 100,000 Btu/hour commercial heater is expected to burn 876 Therms/year, generating 4.65 lbs of NO_x. These units are required to be at least 80% energy efficient. Efficiency improvements are less quantifiable in these cases because the large water heaters vary more in size and design, but are expected to be at least 5% more efficient. These water heaters will save 44 Therms, or approximately \$48/year.

Small boilers from 400,000 to 2,000,000 Btu/hr heat input range in cost from \$10,000 to \$50,000 plus installation. Incremental additional costs for low NO_x capability are estimated to be no more than \$500 per unit. A 1,000,000 Btu/hour commercial heater is expected to burn 8760 Therms/year, generating 46.5 lbs of NO_x. Estimates of improved efficiency for these larger

water heaters and small boilers is also at least 5%, generating savings of 438 Therms, or about \$480/year.

Other Impacts

Bay Area NO_x reductions may reduce ambient levels of fine particulate matter (PM) pollution, because some fraction of NO_x emissions is ultimately converted to nitrate particles in the atmosphere. Potential PM reductions resulting from the proposed amendments have not been quantified.

Burners used to comply with these amendments are included with the water heater redesign for improved efficiency, and will reduce energy usage. Energy savings from new water heaters are estimated to be from 5 – 10% better than existing conventional units. Increased energy efficiency will reduce greenhouse gas emissions by 0.27 MM tons/year from an estimated 11 MM tons/year.¹

BAAQMD air quality permits are not currently required for water heaters and boilers, and will not to be required under the proposed amendments. NO_x limits for these units would be enforced by requiring certification of any water heaters sold, or installed. Implementation of the measure is not expected to impose a significant administrative burden for the Air District.

V. Rule Development / Public Consultation Process

The Air District developed proposed amendments, and documented rationale for these proposals in this workshop report. These proposals are based on existing regulations in the Santa Barbara, Ventura, San Joaquin Valley, and South Coast air districts, and e-mail information exchange and discussions with water heater manufacturers, PG&E's Food Technology Center personnel, and individuals from the Valley Energy Efficiency Corporation's Super Efficient Gas Water Heating Appliance Initiative (SEGWHAI) Project. The public workshop is the next step in the rule development process. Based on the input staff receives at the workshop and during the comment period, staff will decide whether changes to this proposal are necessary prior to a public hearing before the Air District's Board of Directors.

VI. Preliminary Findings

NO_x reductions will reduce ozone precursors, and are the primary objective of these amendments. NO_x reductions may have the additional benefit of a slight reduction in particulate pollution. The proposed amendments will also improve energy efficiency. Preliminary work indicates these amendments are feasible, and will reduce NO_x emissions by more than 2 tons/day

¹ The 11 MM tons/year baseline is a 2020 projection for all domestic combustion. It includes other residential combustion such as space heating and cooking.

over a twelve year period. Air District staff is proceeding with a Public Workshop to gather input on proposed amendments to Regulation 9, Rule 6.

Manufacturers' progress on adapting low NO_x technology to the larger sizes and power assist configurations of water heaters appears to be proceeding well. Feedback from manufacturers is needed to ensure their low NO_x product development continues to meet expectations. Additional information on water heater sales volumes and incremental costs to produce low NO_x heaters will be helpful in assessing costs and economic feasibility of the proposed amendments.

References

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2. California Energy Commission, APPLIANCE EFFICIENCY REGULATIONS, CEC-400-2006-002-Rev1, Revised July 2006

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Base Year 2005 Emission Inventory, Category 284 for residential water heaters, Categories 299 and 307 for point sources and Category 1590 for other area sources, BAAQMD, February, 2007

South Coast Air Quality Management District Rule 1121 – Control of Nitrogen Oxides from Residential Type, Natural Gas-Fired Water Heaters, Amended September 2004

- SCAQMD Staff Report, Proposed Amended Rule 1121 – Control of Nitrogen Oxides from Residential Type, Natural Gas-Fired Water Heaters, August 2004

South Coast Air Quality Management District Rule 1146.2 – Emission of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters, Amended May 5, 2006

- SCAQMD Staff Report, Proposed Amended Rule 1146.2 – Emission of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters, April 2006
- SCAQMD Staff Report, Proposed Amended Rule 1146.2 – Emission of Oxides of Nitrogen from Large Water Heaters and Small Boilers and Process Heaters, December 2004

San Joaquin Valley Air Pollution Control District Rule 4308 – Boilers, Steam Generators, and process Heaters – 0.075 MM Btu.hr to 2.0 MM Btu/hr, Adopted 10/20/2005

Santa Barbara County APCD Rule 352 - Natural Gas-Fired Fan Type Central Furnaces and Residential Water Heaters, Adopted 9/16/1999

Santa Barbara County APCD Rule 360 - Emissions of Oxides of Nitrogen From Large Water Heaters and Small Boilers, Adopted 10/17/2002

Ventura County APCD Rule 74.11 – Natural Gas-Fired Residential Water Heaters – Control of NO_x, Adopted 4/9/85

Ventura County APCD Rule 74.11.1 – Large Water Heaters and Small Boilers, Adopted 9/14/1999