

**SACRAMENTO METROPOLITAN
AIR QUALITY MANAGEMENT DISTRICT**

STAFF REPORT

RULE 411, NOx from Boilers, Process Heaters and Steam Generators

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BACKGROUND

The District is currently designated as a “serious” nonattainment area for the state ozone standard. Ozone is a strong irritant that attacks the respiratory system, leading to the damage of lung tissues. Ozone is a secondary pollutant formed from the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NOx). Since NOx is a precursor to ozone, one of the strategies to control ozone is to reduce NOx emissions from existing stationary sources. The District is currently designated as a nonattainment area for the state and federal¹ PM10 standard and has been designated nonattainment for the state PM2.5 standard. Since NOx is a precursor to PM10 and PM2.5, one of the strategies to control particulate emissions is to reduce NOx emissions.

Rule 411 was first adopted on February 2, 1995 and approved by EPA into the SIP on February 9, 1996. The Rule was created in response to the requirement of the Federal Clean Air Act Amendments of 1990 that the District submit NOx Reasonably Available Control Technology (RACT) rules for stationary sources. Rule 411 also fulfilled the requirement of Health and Safety Code section 40919(a)(3) that required the District to implement Best Available Retrofit Control Technology (BARCT) for all existing permitted stationary sources. The RACT/BARCT document produced by the California Air Resources Board (CARB) and the “California Clean Air Act Guidance for Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology” both provided technical guidance and direction for the development of Rule 411. Rule 411 applies to new and existing units (e.g., boilers, steam generators, process heater).

The proposed amendments to Rule 411 will:

1. Lower rule applicability from 5 million Btu per hour (mmBtu/hr) input to one million Btu per hour input,
2. Set NOx emission levels for new and existing units rated at 1 mmBtu/hr to less than 5 mmBtu/hr,
3. Lower the NOx emissions limit for new and existing units rated at or above 5 mmBtu/hr input,
4. Require all new units to meet the proposed NOx limits regardless of their fuel usage level, and
5. For existing units, establish exemptions from the NOx limits at specified annual fuel usages.

Low NOx emission requirements for boilers, in some cases including small boilers, have been adopted by the following districts:

¹ Based on 1998-2000 monitoring data, EPA made a finding (February 15, 2002 Federal Register, Volume 67, Number 32 Page 7082 et.seq) that Sacramento County attained the federal ambient PM10 standard by the applicable December 31, 2000 attainment deadline. Note that this EPA finding did not redesignate the Sacramento district to attainment.

District	Rule(s) Number	Applicability mmBtu/hr Input
South Coast Air Quality Management District (SCAQMD)	Rules 1146, 1146.1, and 1146.2	>=75,000 Btu/hr input (See Applicability section in Appendix B for specific applicability limit for each rule)
Ventura County Air Pollution Control District (VCAPCD)	Rules 74.15.1, 74.11.1, and 74.15	>=75,000 Btu/hr input (See Applicability section in Appendix B for specific applicability limit for each rule)
San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD)	Rule 3046	>= 5
Santa Barbara Air Pollution Control District (SBPCD)	Rule 360, 342	>=75,000 Btu/hr input (See Applicability section in Appendix B for specific applicability limit for each rule)
Butte County Air Pollution Controlled District		>=5

LEGAL MANDATES

Federal Mandate: The District is designated severe nonattainment for the federal one-hour ozone standards and serious for the 8-hour ozone standard by the United States Environmental Protection Agency (EPA). Section 182 (c) of the federal Clean Air Act Amendments of 1990 requires all ozone nonattainment areas classified as “serious” and above to submit a State Implementation Plan revision by November 15, 1994 which describes, in part, how the area will achieve the National Ambient Air Quality Standard for ozone and achieve actual VOC emission reductions of at least three percent per year (with NOx emission reductions being substituted for some of the required VOC emissions reductions) averaged over each consecutive 3-year period beginning November 1996. Section 182(d) requires the District to submit for adoption the proposed control measures in the District’s State Implementation Plan (SIP). Section 172 (c)(1) requires the District to adopt Reasonable Available Control Technology for major stationary sources.

The 1994 Sacramento Area Regional Ozone Attainment Plan lists boiler NOx as one of the stationary source control measures for reducing NOx (1994 Attainment Plan, Appendix D-23). The original boiler rule satisfied the 1994 SIP commitment. These amendments may be needed to achieve the new 8-hour ozone standard by the 2013 deadline.

State Mandates: The District is designated serious nonattainment for the state ozone standard. The California Clean Air Act requires areas designated as serious nonattainment

for ozone to adopt control measures required in Sections 40913, 40914, and 40919 of the California Health and Safety Code. California Health and Safety Code Section 40913 requires districts to develop a plan to achieve California's ambient air quality standard by the earliest practicable date.

All Feasible Measures Requirements: Health and Safety Code Section 40914 requires each district plan to demonstrate that the plan includes "every feasible measure." Districts must adopt the most effective control measures to reduce NOx emissions from boilers, steam generators, and process heaters. Staff evaluated the standards in the rule against similar requirements contained in the ARB feasible measure document titled "Identification of Achievable Performance Standards and Emerging Technologies for Stationary Sources", March 1998 and requirements recently adopted by SJVUAPCD, VCAPCD, SCAQMD, and VCAPCD, and SBAPCD. The results are summarized in Attachment B. Based on the findings in Attachment B, the proposed amendments to the rule are intended to satisfy the all feasible measures requirements.

Transport Mitigation Emission Control Requirements: Districts within the areas of origin of transported air pollutants, as identified in section 70500(c), shall include sufficient emission control measures in their attainment plans for ozone adopted pursuant to Part 3, Chapter 10 (commencing with Section 40910) of Division 26 of the Health and Safety Code, to mitigate the impact of pollution sources within their jurisdictions on ozone concentrations in downwind areas commensurate with the level of contribution. An upwind district shall comply with the transport mitigation planning and implementation requirements set forth in this section regardless of its attainment status, unless the upwind district complies with the requirements of section 70601. At a minimum, the attainment/transport mitigation plans for districts within the air basins or areas specified below shall conform to the following requirements:

- (1) Broader Sacramento Area (as defined in section 70500(b)(3)) shall:
 - (A) require the adoption and implementation of all feasible measures as expeditiously as practicable.
 - (B) require the adoption and implementation of best available retrofit control technology, as defined in Health and Safety Code section 40406, on all existing stationary sources of ozone precursor emissions as expeditiously as practicable.
 - (C) require the implementation, by December 31, 2004, of a stationary source permitting program designed to achieve no net increase in the emissions of ozone precursors from new or modified stationary sources that emit or have the potential to emit 10 tons or greater per year of an ozone precursor.
 - (D) include measures sufficient to attain the state ambient air quality standard for ozone by the earliest practicable date within the Upper Sacramento Valley and that portion of the Mountain Counties Air Basin north of the Calaveras- Tuolumne County border and south of the Sierra-Plumas County border, except as provided in Health and Safety Code section 41503(d), during air pollution episodes which the state board has determined meet the following conditions:

- (i) are likely to produce a violation of the state ozone standard in the Upper Sacramento Valley or that portion of the Mountain Counties Air Basin north of the Calaveras-Tuolumne County border and south of the Sierra-Plumas County border; and
- (ii) are dominated by overwhelming pollutant transport from the Broader Sacramento Area; and
- (iii) are not measurably affected by emissions of ozone precursors from sources located within the Upper Sacramento Valley or that portion of the Mountain Counties Air Basin north of the Calaveras-Tuolumne County border and south of the Sierra-Plumas County border.

Best Available Retrofit Requirements: Section 40919 requires districts with serious nonattainment for ozone to adopt Best Available Retrofit Control Technology (BARCT) for all existing sources. BARCT means an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of sources (CHSC Section 40406). Staff has found that the proposed NO_x requirements meet the BARCT requirement and therefore the proposed rule meets the requirements of CHSC Section 40919.

Senate Bill (SB) 656: Senate Bill (SB656, Sher, 2003) requires ARB to adopt a list of feasible and most effective control measures to make progress towards state and federal PM₁₀ and PM_{2.5} standards. Districts are then required to adopt an implementation schedule for measures by July 31, 2005. Because NO_x contributes to particulate matter problems in certain areas, the measures included on ARB's draft list include SJVUAPCD Rule 4306 and SCAQMD Rules 1146.1 and 1146.2. Sacramento County has been designated nonattainment for both the state PM₁₀ and PM_{2.5} standards. An ARB report² "Characterization of Ambient PM₁₀ and PM_{2.5} In California", estimates that 37 percent of wintertime PM_{2.5} concentrations in the Sacramento area are due to nitrates from motor vehicles and other combustion sources.

SUMMARY OF REQUIREMENTS

This rule currently applies to institutional, commercial, and industrial boilers, steam generators and process heaters (units) rated at five million Btu per hour heat input or greater which are fired on gaseous, non-gaseous, or biomass fuels. The proposed amendments will lower the applicability level to one mmBtu/hr input and will require more stringent NO_x emission limits for existing and new units. Units rated between 1 and 5 mmBtu/hr input are used to supply steam or hot water for use in space heating, food processing and manufacturing of chemical products. Process heaters are used in food processing (e.g., drying of fruits and vegetables), and manufacturing processes.

NO_x Control Methods: Various control technologies presently exist for controlling the boiler emissions. These include Low-NO_x burners, Flue Gas Recirculation systems, Selective

² <http://www.arb.ca.gov/pm/pmcharacteristics2001.pdf>

Catalytic Reduction and Selective Non-Catalytic Reduction.

1. Low NOx Burners: Low NOx burners utilize one or a combination of control technologies (e.g., low excess air, fuel and/or air staging) in the design of the burner to reduce NOx emissions. Low excess air reduces the amount of oxygen available for combustion and thus reducing the number of oxygen atoms available to react with nitrogen to form NOx. Fuel staging, which is applicable to gas only, is done by burning part of the fuel at high excess air (low temperature) in a primary combustion zone. The remaining fuel is injected through another set of orifices or a gas gun into a secondary zone where combustion is complete at relatively low excess air. Since the inert products of combustion from the primary zone pass through the secondary zone, temperatures and NOx are reduced. In air staging, fuel is mixed with part of the air in a fuel rich primary combustion zone at low temperatures and without excess oxygen. Any remaining fuel burns completely with the remaining combustion air in the secondary combustion zone through which the inert products of combustion pass. Temperatures and NOx are reduced. NOx control efficiency for a Low NOx burner can range from 10 to 50%.

2. Flue Gas Recirculation Systems: Flue gas recirculation for NOx control consists of extracting a portion of the flue gas from the economizer outlet and returning it to the furnace, admitting the flue gas through the furnace windbox. Flue gas recirculation lowers the bulk furnace gas temperature and reduces oxygen concentration in the combustion zone.

3. Selective Catalytic Reduction: Selective catalytic reduction refers to a process that chemically reduces NOx with ammonia (NH3) from anhydrous ammonia or urea over a heterogeneous catalyst in the presence of oxygen. The process is termed selective because the reducing agent NH3 preferentially attacks NOx rather than O2.

4. Selective Noncatalytic Reduction: NH3 is injected into the hot flue gas by means of either air or steam carrier gas at a point in the flue specifically selected to provide optimum reaction temperature and residence time. In the temperature range of 1600 degrees Fahrenheit to 2200 degrees Fahrenheit, the reaction occurs through the injection of NH3 alone. NOx reductions of up to 90 percent have been demonstrated on oil field steam generators where favorable process conditions exist.

Proposed Emission Limits: The following tables summarize the current and proposed NOx emission limits for gaseous fuels in the rule.

Unit Size/Description mmBtu/hr Input	NOx Limits ppmvd @ 3% O2	
	Existing	Proposed
>= 1 - <5	-	30
>= 5 - <=20	30	15

>20	30	9
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Exemptions from Rule Requirements: The rule currently provides for an exemption from the existing NOx emission limits if the fuel usage for the unit is limited below 90,000 therms per year. The proposed amendments will provide three exemption levels depending on the unit size rating. Those exemption levels are listed in the table below:

Unit Size mmBtu/hr Input	Exemption Level (therms/yr)
1 - <2.5	40,000
2.5 - <5	70,000
>=5	200,000

Sources can elect to take a fuel usage limit in lieu of complying with the proposed NOx limits. Sources electing to take the low fuel usage exemption are required to install a non-resetting hour or fuel meter and tune the equipment at least annually.

SUMMARY OF CHANGES

The following are the main rule changes. Detailed listings of all of the changes are included in Attachment C to the staff report.

1. Lower rule applicability from 5 million Btu per hour (mmBtu/hr) input to one million Btu per hour input,
2. Set NOx emission levels for new and existing units rated at 1 mmBtu/hr to less than 5 mmBtu/hr,
3. Lower the NOx emissions limit for new and existing units rated at or above 5 mmBtu/hr input,
4. Require all new units to meet the proposed NOx limits regardless of their fuel usage level, and
5. For existing units, establish exemptions from the NOx limits at specified annual fuel usages.

EMISSIONS IMPACT

Staff identified 512 units (this includes 471 permitted units and 41 unpermitted units identified through the most recent boiler survey) with heat input of one mmBtu/hr or greater in the District's records. The proposed rule amendments will affect all units rated at or above 1 mmBtu per hour input and will also exempt from the NOx emission limits units below specific annual fuel usages.

There are 127 (of the 512) permitted boilers that are rated at or above 5 mmBtu/hr. The total estimated NOx emissions from these boilers are 48.9 tons per year. There are six boilers in this size range that already comply with the proposed emission standards (based on

information in the Permit to Operate and manufacturer's data). It is anticipated that an additional 34 of the permitted boilers will have to comply with the proposed emission standards. The remaining 87 boilers have fuel usages below the exemption level in the rule. Based on fuel usage data collected by the District, Staff estimates that the proposed amendments will result in approximately 43% overall reduction in NO_x emissions from these units, or 20.8 tons per year of NO_x reductions³ from the 5 mmBtu/hr or greater units.

There are 310 units (of the 512) that have a size rated from 1 – <5 mmBtu/hr. The total estimated NO_x emissions from these boilers are 37.3 tons per year. Seventy five boilers in this size range already comply with the proposed emissions limit (based on information in the Permit to Operate and manufacturer's data). It is anticipated that an additional 35 boilers will have to comply with the proposed emission standards. The remaining 200 boilers are expected to be exempt from the proposed emission standards because they have fuel usages below those proposed in the rule. Staff estimates that the proposed amendments will result in approximately 29% overall reduction in NO_x emissions from these units, or 10.7 tons per year reductions in NO_x emissions from the 1-<5 mmBtu/hr units (based on surveyed fuel usage data).

The remaining 75 units have not provided sufficient fuel usage data. All but two of these units are rated below 5 mmBtu/hr input. There are 28 of these boilers that are under construction. Of these 28 boilers, 27 of them comply with the proposed limits.

There may be additional boilers in the District that have not been permitted because either they never applied for a Permit to Operate from the District, or were exempt from permitting requirements when they were originally installed and did not apply for a permit to operate when the exemption level was lowered by the District in 1991. Regardless of the circumstances, operating a boiler greater than or equal to one mmBtu/hr input, is a violation of District rules. The potential NO_x emission reductions from these units have not been calculated since no information is available to Staff at this time that identifies the annual fuel usage for these units.

The total estimated NO_x emission reductions anticipated from this rule is 31.43 tons per year. The NO_x emission reductions will increase as additional boilers are identified.

COST IMPACT

Section 40703 of the California Health and Safety code requires that the District consider and make public its finding relating to the cost effectiveness of implementing an emission control measure.

Cost to Businesses: The rule amendments proposed here will require retrofitting or replacing existing units to meet the proposed NO_x emission limits. The amendments will

³ Staff assumed that owners or operators of all units that currently have annual fuel usages less than the exemption levels will choose to limit their annual fuel usage in order to be exempt from the proposed requirements. NO_x reductions may be higher if the owners or operators of these units elect to retrofit their units so that they are not limited to a lower annual fuel usage limit.

also require units installed after the amendments of the rule to meet the NOx limits in the rule. Staff analyzed the cost impact for:

1. Cost of retrofitting or replacing the existing unit,
2. Cost differential of installing new compliant units;
3. Cost for initial source testing and source test monitoring,
4. Cost for fuel meter and equipment tuning if it is exempt based on annual fuel usage, and
5. Authority to Construct and Permit to Operate modification fee.

Boilers 1 – <5 mmBtu/hr

Exempt Units: There are one time capital costs for boilers that choose to limit their fuel usage rather than retrofit to comply with the proposed emission limits. These costs are associated with installing a fuel meter and modifying their permit to add the fuel limitation. The estimated cost for installing a fuel meter is \$1,500 and the permit modification cost is \$278. Sources would also have the option of using a non-resetting hour meter rather than a fuel meter which is estimated to cost \$400 (Staff used the cost of the fuel meter rather than the cost of the hour meter when calculating the cost impacts). There is, in addition, a \$600 per year cost for performing the annual tune-up if electing not to comply with the 3% O₂ limit. Staff assumed that source will elect the tune up option over the 3% O₂ option.

Non-exempt Units: There are three categories of cost impacts for these boilers. The first category is the boilers that potentially already comply with the proposed limit of 30 ppm. These boilers would have a one time cost for demonstrating that they meet the 30 ppm limit and possibly a permit modification fee of \$278. This cost is estimated to be \$1,500 for an independent contractor to perform the source test and \$1,115 for the source test observation and report evaluation fee.

The second category is the boilers that will need to retrofit to meet the 30 ppm limit. Some of these units may not be retrofitted because of equipment age and design and will have to be replaced with new units. In estimating the total cost effectiveness it was assumed that all of the boilers in this size range that need to be retrofit would need to be replaced as a worst case scenario since the number of boilers that can be retrofitted is unknown. The estimated cost for new equipment and installation ranges from \$36,279 - \$80,282. There is also a permit modification cost of \$558, an independent source test cost of \$1500, and a cost of \$1,115 for the source test observation and report evaluation fee.

The third category is the new boilers that will be installed after adoption of the rule. Any new units that are added after adoption of the rule will be required to meet the 30 ppm limit regardless of their fuel usage. The cost impacts from these units will be the incremental cost between installing a compliant unit and a non-compliant unit. There are no additional installation or permit costs due to complying with the proposed rule. The estimated incremental costs range from \$18,140-\$40,141. There is also an independent source test cost of \$1,500 and a cost of \$1,115 for the source test observation and report evaluation fee.

Summary of costs for 1-<5 mmBtu/hr boilers

	Costs		Annualized Cost
Exempt Units	Fuel meter	\$400 - \$1,500	\$802
	Permit Modification	\$558	
	Annual Tune-up	\$600	
Already Complies with proposed limit	Independent Source Test	\$1,500	\$174
	Source Test Monitoring/Evaluation	\$1,115	
Retrofit/Replace to comply with proposed limit	Equipment/Installation Costs	Retrofit: \$28,279 - \$56,282 Replace: \$36,279 - \$80,282	Retrofit \$3,279 - \$6,354
	Permit Modification	\$278/\$558	Replace: \$4,188 - \$9,020
	Independent Source Test	\$1,500	
	Source Test Monitoring/Evaluation	\$1,115	
New Boilers	Incremental Costs for Equipment	\$18,140 - \$40,141	\$2,078 - \$4,494
	Independent Source Test	\$1,500	
	Source Test Monitoring/Evaluation	\$1,115	

Costs for Boilers that Potentially have been Identified for Retrofitting/Replacing: The following table summarizes the estimated cost effectiveness⁴ for the 35 boilers that have potentially been identified for needing to retrofit/replace to meet the proposed 30 ppm emission limit. These boilers are located at facilities such as hospitals, hotels, bakeries, office buildings, and manufacturing operations.

Boiler Size (mmBtu/hr)	Cost Effectiveness Range (\$/lb)	
	Estimated Cost for Retrofitting Existing Equipment	Estimated Cost for Replacement with New Equipment
1-<2.5	\$3.29 - \$12.57	\$4.20 - \$17.97
2.5 - <5	\$3.44 - \$14.25	\$4.74 - \$20.23

⁴ All cost effectiveness analyses for this rule are based on 7% annual interest rate and a 15-year unit life. Unit replacement/retrofit cost data were supplied by boiler manufacturers and from actual boiler retrofit cost at other air districts (i.e., SJUAPCD, SCAQMD and VCAPCD). Manufacturers cost information are only estimates for boiler size ranges since the cost will vary depending on each boiler installation.

Boilers 5 mmBtu/hr and greater

Exempt Units: There are three categories of exempt equipment. The first category is the boilers that have in place a 90,000-therm limitation from the current version of the rule. These boilers would already have a fuel/hour meter and are already required to meet the annual tune-up or the 3% O₂ requirements. There are no additional costs for these boilers from the proposed amendments to the rule.

The second category is the boilers that are not currently exempt but already have a fuel/hour meter. For these boilers there is the one time permit modification cost of \$278 - \$558 depending on the size of the equipment. There is, in addition, a \$600 per year cost for performing the annual tune-up if electing not to comply with the 3% O₂ limit. Staff assumed that all exempt units will be tuned annually.

The third category is the boilers that are not currently exempt and do not have a fuel/hour meter. There are one time costs for installing a fuel meter and modifying their permit to add the fuel limitation. The estimated average cost for a fuel meter is 1,500 and the permit modification cost ranges from \$278 – \$558 depending on the size of the boiler. Sources would also have the option of using a non-resetting hour meter rather than a fuel meter which is estimated to be \$400 (Staff used the cost of the fuel meter rather than the cost of the hour meeting when calculating the cost impacts). There is, in addition, a \$600 per year cost for performing the annual tune-up if electing not to comply with the 3% O₂ limit. (Staff assumed these units will be tuned annually)

Non-exempt Units: There are three categories of cost impacts for these boilers. The first category is the boilers that already comply with the proposed limits. These boilers would already be subject to existing source testing requirements. The lowering of the annual source testing requirement from units rated at 25 mmBtu/hr to 20 mmBtu/hr will only affect 2 units. These 2 units would have an independent source test cost of \$1,500 and a source test observation and report evaluation fee of \$1,115 yearly rather than every other year.

The second category is the boilers that will need to retrofit to meet the proposed limits. The estimated cost for equipment and installation ranges from \$65,000 - \$275,000. There is also a permit modification cost of \$278 - \$2,229, an independent source test cost of \$1500, and a cost of \$1,115 for the source test observation and report evaluation fee.

The third category is the new boilers that will be installed after adoption of the rule. Any new boilers that are added after adoption of the rule will be required to meet the proposed limit regardless of their fuel usage. The cost impacts from these boilers will be the incremental cost between installing a compliant unit and a non-compliant unit. There are no additional installation permit costs or source testing cost due to complying with the proposed rule because they are already required. The incremental equipment cost ranges from \$10,000 to \$125,000.

The incremental cost effectiveness for these boilers is listed in the following table:

Summary of costs for 5 mmBtu/hr boilers and greater

	Costs		Annualized Cost
Currently Exempt Units	Requirements already in place	\$0	\$0
Exempt Units (with hour/fuel meter in place)	Fuel meter (in place)	\$0	\$618 - \$636
	Permit Modification	\$278 - \$558	
	Annual Tune-up	\$600	
Exempt Units (with no hour/fuel meter in place)	Fuel meter (in place)	\$400 - \$1,500	\$783 - \$801
	Permit Modification	\$278 - \$558	
	Annual Tune-up	\$600	
Already Complies with proposed limit	Independent Source Test currently required	\$0	\$174
	Source Test Monitoring/Evaluation currently required for units rated at or above 25 mmBtu/hr. Annual testing is now required for units rated at or above 20 mmBtu/hr input.	\$1,500/\$1,115	
Retrofit/Replace to comply with proposed limit	Equipment/Installation Costs	Retrofit \$65,283 - \$277,329	Retrofit \$7,342 - \$30,449
		Replace \$135,283 - \$752,329	Replace \$14,853 - \$82,601
	Permit Modification	\$278 - \$2,229	
	Independent Source Test	\$1,500	
	Source Test Monitoring/Evaluation	\$1,115	
New Boilers	Incremental Costs for Equipment	\$10,000 - \$125,000	\$1,098 - \$13,724
	Independent Source Test	0	
	Source Test Monitoring/Evaluation	0	

Costs for Boilers that Potentially have been Identified for Retrofitting/Replacing:

The following table summarizes the estimated cost effectiveness⁵ for the 34 boilers that have

⁵ All cost effectiveness analyses for this rule are based on 7% annual interest rate and a 15-year unit life. Unit replacement/retrofit cost data were supplied by boiler manufacturers and from actual boiler retrofit cost at other air

potentially been identified for needing to retrofit to meet the proposed emission limit. Based on information from boiler manufacturer's these boilers should be able to be retrofitted rather than replaced. These boilers are located at colleges, hospitals, manufacturing plants, prisons, service companies, and food productions facilities.

Boiler Size (mmBtu/hr)	Cost Effectiveness Range (\$/lb)
	Estimated Cost for Retrofitting of Existing Equipment
5 – 25	\$3.86 - \$22.43
25 – 50	\$2.33 - \$23.96
50 – 100	\$14.64 – \$59.44

Overall Rule Cost Effectiveness: The prior sections summarized the costs and reported the cost effectiveness for retrofitting and replacing existing boilers. The overall rule cost effectiveness includes the costs imposed on both exempt and non-exempt units and includes both small and large boilers. This analysis is based on the data for permitted and unpermitted boilers described in the emissions impact section. The analysis does not include potential cost for other unpermitted boilers/process heaters that may exist nor those boilers/process heaters for which the District does not have fuel usage data.

The total lifetime cost for existing boilers/process heaters is \$13.4 million (\$6.1 million for small units 1-<5 mmBtu/hr + 7.2 million for units >= 5mmBtu/hr). Financing for the capital costs is expected to result in total annualized costs of \$899,548 (\$412,756 for small units 1-<5 mmBtu/hr + 487,873 for units >= 5mmBtu/hr). The total emission benefits are 31.5 tons per year or 63,000 pounds per year (10.5 tons/year for small units 1-<5 mmBtu/hr + 20.8 for units >= 5 mmBtu/hr). This results in an overall cost effectiveness of \$14.2/lb-NOx. To put these costs into perspective with costs imposed by other regulations, it is useful to compare the cost effectiveness for other rules. At the high end of the range, the cost effectiveness of the gasoline dispensing regulations (Rule 449, Transfer of Gasoline into Vehicle Fuel Tanks) was \$17/lb-VOC in today's dollars. At the low end of the range was Rule 452, Can Coating, at a cost of \$1/lb-VOC in today's dollars. Therefore, the cost effectiveness of this rule is at the upper end of the range of costs imposed on other businesses.

Cost to the District: The cost to the District consists of the additional staff time needed to evaluate the applications for Authority to Construct and Permit to Operate for retrofitting the existing units and the time needed to observe and later evaluate the initial source tests. Staff estimates the proposed amendments will result in additional need for one FTE (one full time equivalent) in the Permitting section and **(To be completed later)** in the Compliance Assistance section. The permitting impact should be limited in time until all permits are processed (12 months after date of amending this rule).

districts (i.e., SJUAPCD, SCAQMD and VCAPCD). Manufacturers cost information are only estimates for boiler size ranges since the cost will vary depending on each boiler installation.

SOCIOECONOMIC IMPACT

CHSC Section 40728.5 requires a district to perform an assessment of the socioeconomic impacts before adopting, amending, or repealing a rule that will significantly affect air quality or emission limitations. The District Board is required to actively consider the socioeconomic impacts of the proposal and make a good faith effort to minimize adverse socioeconomic impacts.

CHSC Section 40728.5 defines "socioeconomic impact" to mean the following:

1. The type of industry or business, including small business, affected by the proposed rule or rule amendments.
2. The impact of the proposed rule or rule amendments on employment and the economy of the region.
3. The range of probable costs, including costs to industry or business, including small business.
4. The availability and cost-effectiveness of alternatives to the proposed rule or rule amendments.
5. The emission reduction potential of the rule or regulation.
6. The necessity of adopting, amending, or repealing the rule or regulation to attain state and federal ambient air standards.

Type of industry or business, including small business, affected by the rule amendments:

Rule 411 applies to boilers, steam generators and process heaters. These units are used by large and small businesses. Examples of large businesses are major sources such as chemical production plants, food processors, hospitals, hotels, colleges, and office buildings. Examples of small businesses are drycleaners, motels, and small bakeries. Some of the public schools also have units between 1 and 5 mmBtu/hr input although most schools appear to be exempt. In addition, most of the public schools have replaced their existing units with furnaces and water heaters that are rated below one mmBtu/hr input.

Impact of Rule 411 amendments on employment and the economy in the District:

Approximately 512 units will be subject to the rule. Based on current information, Staff estimated that 69 permitted units will require retrofit or replacement. Another 287 units are expected to qualify for an exemption due to low annual fuel usage. Some sources in the District (e.g., schools, hospitals, hotels) have multiple units.

Most of the work for retrofitting/replacing the units will be performed by manufacturers that are located outside the District. The capital costs for retrofit/replacement are expected to be \$6.5 million. Some of the supporting work, however, may be performed by local businesses.

Source testing will most likely be performed by companies that are located outside the District. The cost of source testing is around \$1,500 per unit. There will be an initial source test to verify compliance with the proposed NO_x limits. There is also an additional cost of \$1,115 for source test monitoring and evaluation. The proposed amendments also will lower the annual testing requirements for units rated at or above 25 mmBtu/hr input to units rated at or above 20 mmBtu/hr

input. Only two units within this size range will be affected by the revised annual testing requirement. The total source testing cost for the affected 69 affected units is estimated to be around \$180,435.

Range of probable costs of Rule 411 amendments: The cost effectiveness per pound of NOx reduced ranges from \$2.33 to \$59.44 (See "Cost Impact" section above). The District however, has a few boilers that have cost effectiveness above \$16.0/lb. Staff expect these sources to take an annual fuel usage limit below those specified in the rule and therefore be exempt from the proposed rule requirements.

Availability and cost-effectiveness of alternatives to the Rule 411 amendments: One alternative to the proposed rule changes is not to adopt the proposed amendments. The NOx emission reductions will assist the District in meeting federal and state ozone and state PM10 and PM2.5 air quality attainment goals.

Another alternative to this rule is to require SCR in addition to the proposed requirements. Staff performed incremental cost effectiveness analysis for this control option and does not recommend this option at this time due to the high costs.

Another alternative is to set lower annual fuel usage for exemption levels. Setting of lower exemption levels will result in higher cost effectiveness levels than \$16.00 per pound and consequently will adversely impact sources in the District.

Another alternative is to set higher exemption level. Setting higher exemption levels will result in more sources qualifying for exemptions from the rule and this will lower the emission reduction benefits from the rule.

The emission reduction potential of Rule 411 amendments: The proposed amendments will achieve a minimum emission reduction of 31.5 tons per year of NOx (See discussion under Emissions Impact).

The necessity of adopting, amending, or repealing the rule or regulation to attain state and federal ambient air standards: The proposed amendments to Rule 411 are necessary to comply with all feasible measures requirements and provide additional NOx emission reductions that contribute to attainment of the both state and federal ozone and state particulate matter standards.

INCREMENTAL COST EFFECTIVENESS ANALYSIS

Pursuant to Health and Safety Code Section 40920.6(a)(3), the District is required to perform incremental cost effectiveness analysis for requirements for Best Available Retrofit Control Technology (BARCT). The District is required to identify one or more potential control options that achieve the emission reduction objectives for the regulation, determine the cost-effectiveness for each option, and calculate the incremental cost-effectiveness for each option.

The incremental cost effectiveness analysis performed for this rule is based on the Discounted Cash Flow cost analysis method to compute the present value of the proposed rule's costs over a 15-year period (the assumed equipment lifetime), using a 7% interest rate (based on a U.S. Treasury Security maturing in 10 years plus two percent.) The incremental cost effectiveness analysis was performed for the following:

1. Proposed NOx emission limits;
2. Air pollution control equipment (i.e., SCR); and
3. Proposed NOx emission limits and air pollution control equipment.

Since there are many different size units affected by the proposed regulations and the cost variation, Staff performed an incremental cost effectiveness analysis for a 31.5 mmBtu/hr input boiler since actual air pollution control data was available from the South Coast Air Quality Management District BACT determination clearinghouse. The costs for retrofitting the boiler and the air pollution control equipment are based on actual cost data from boilers that have been retrofitted with SCR systems in the South Coast Air Quality Management District. Staff also evaluated the alternative control options for different sizes and found that alternatives to the proposed control option are not cost effective. An example of the incremental cost effectiveness analyses is summarized in the table below.

Control Option	Present Value of Control Cost (\$)	Total NOx Emission Reductions (Tons)
Meeting proposed NOx emission limits	\$157,500.00	3.52
Adding APC Control Equipment (SCR)	\$282,173.64	4.53
Meeting proposed NOx limits and adding control equipment	\$439,673.64	4.88

The incremental cost effectiveness was performed for the following control options:

1. Proposed NOx limits vs. air pollution control equipment
2. Use of control equipment vs. air pollution control equipment and proposed NOx limits.

The following equation was used to calculate the incremental cost:

$$IC / E(\$ / ton) = \left(\frac{PV_{option2} - PV_{option1}}{TER_{option2} - TER_{option1}} \right)$$

Where: IC = Incremental Cost (\$)
 E = Emissions reductions (tons)
 PV_{option 2} = Present value of control costs for option 2 (\$/yr)

$PV_{\text{option 1}}$ = Present value of control costs for option 1 (\$/yr)
 TER_{option2} = Total emission reductions for option2 over a 10-year period (tons)
 TER_{option1} = Total emissions reductions for option 1 over a 10-year period (tons)

The following table lists the incremental costs of these control options:

Option	IC/E (\$/ton)	IC/E (\$/lb.)
Incremental cost between meeting the limit and just adding control equipment	\$123,852.60	61.93
Incremental control between just adding control equipment and both meeting these limits and adding control equipment	\$415,282.06	\$207.64

OTHER FACTORS:

Technological Feasibility: Staff evaluated the technological feasibility of the proposed NOx limits by consulting with boiler and burner manufacturers. Based on the information received, Staff has determined that the technology exists for achieving the proposed NOx levels. In some cases depending on the boiler and burner manufacturers and the boiler type (forced draft or atmospheric), it may be difficult to retrofit an existing unit and may require replacing the entire boiler.

Enforceability: Source testing (initial testing for small units, biennial for units rated at 5- <20 mmBtu/hr input, and annual for units rated at 20 mmBtu/hr input or greater), and tune-up requirements and fuel usage meters and permit modifications for low usage units have been included in the rule for enforceability.

Public Acceptability: The rule has a future compliance timeline to allow time for affected businesses to purchase new equipment or retrofit their existing equipment. The costs and cost effectiveness of this proposed rule are in the range of costs from prior rule requirements. Therefore, staff expects the rule amendments and other associated costs to be acceptable to the public. Staff will solicit comments on this at the public workshop.

SECTION 40727.2(a) ANALYSIS OF RULE 411

Section 40727.2(a) of the Health and Safety Code mandates that the District prepare a written analysis of the Rule proposed for amendment. Section 40727.2(a) also allows the District to put this analysis in a matrix form. The matrix analysis of Rule 411 is presented as

Attachment A at the end of this document.

ENVIRONMENTAL REVIEW AND COMPLIANCE

The proposed amendments to Rule 411 will strengthen the existing rule and reduce emissions from boilers, process heaters, and steam generators. The amendments do not create new requirements that may have an adverse effect on the environment. Pursuant to state CEQA Guidelines, the District's Environmental Coordinator finds the adoption of the proposed amendments to the rule is exempt from CEQA (Class 8 Categorical Exemption, Action by Regulatory Agencies for Protection of the Environment, Section 15308 State CEQA Guidelines).

FINDINGS

The California Health and Safety Code, Division 26, Air Resources, require local Districts to comply with a rule adoption protocol as set forth in Section 40727 of the Code. This section has been revised through legislative mandate to contain six findings that the District must make when developing, amending, or repealing a rule. These findings, effective January 1, 1992, and their definitions are listed in the table below.

Finding	Definition	Reference
Authority	The District is permitted or required to adopt, amend, or repeal the rule by a provision of law or a state or federal regulation.	California Health and Safety Code, Sections 40000, 40001, 40702, 40716, 40961, and 41010. (Health and Safety Code Section 40727(b)(2)).
Necessity	The District has demonstrated that a need exists for the rule, or for its amendment or repeal.	It is necessary for the District to adopt this amended rule in order to achieve additional NOx emission reductions from the boilers. The additional NOx reductions will assist the District in its effort to attaining air quality standards and to comply with state all feasible measures requirements (Health and Safety Code 40914 and California Code of Regulations, Section 40601). (Health and Safety Code Section 40727(b)(1))
Clarity	The rule is written or displayed so that its meaning can be easily understood by the persons directly affected by it.	There is no indication at this time that this rule is not written in such a manner that the person affected by the amendments can easily understand them. (Health and Safety Code Section (40727(b)(3))

Finding	Definition	Reference
Consistency	The rule is in harmony with, and not in conflict with or contradictory to, existing statutes, court decisions, or state or federal regulations.	The District has found the requirements of this rule are consistent with the state and federal guidelines. (Health and Safety Code Section 40727(b)(1))
Non-duplication	The rule does not impose the same requirements as an existing state or federal regulation, unless the District finds that the requirements are necessary or proper to execute the powers and duties granted to, and imposed upon the District.	The rule imposes similar requirements as which duplicate existing state BARCT/RACT and federal regulations (40 CFR Part 60 Subpart Db). The rule, however, imposes more stringent requirements than those adopted by existing state and federal regulations.
Reference	Any statute, court decision, or other provision of law that the District implements, interprets, or make specific by adopting, amending, or repealing the rule. An example of this would be the 1988 EPA State Implementation Plan call to revise District rules.	California Clean Air Act of 1988 (California Health and Safety Code Section 40914); California Health and Safety Code Sections 40910, 40913, 40914, 40919(a)(3); Section 70500(c); Sections 70500, 70600, and 70601 of Title 17 of the California Code of Regulations; Sections 182(c), 182(d), and 182(f) of the Federal Clean Air Act Amendments of 1990.
Additional Informational Requirements (Health and Safety Code Section 40727)	In complying with HSC Section 40727, the District must identify all federal requirements and District rules that apply to the same equipment or source type as the proposed rule or amendments.	The matrix attached (Attachment A) contains a comparison of other requirements that apply to boilers.

Attachment A
40727.2 Matrix for Proposed Amendments to Rule 411, Boiler NOx

			Comparative Requirements	
Elements of Comparison	Specific Provisions	Proposed Rule 411	Best Available Control Technology (BACT)	40CFR60 Subpart Db
Exemptions		Annual heat input less than the levels specified in Section 113 of the rule.		Heat input capacity \leq 29 megawatts
Averaging Provisions				
Units		ppmv	ppmv	Lbs/mmBtu
Emissions Limits		<p>Gaseous Fuel Firing (BARCT): 1-<5 mmBtu/hr input: <30 ppmv NOx 400 ppm CO over 15 min., @ 3% O2.</p> <p>=5 – 20 mmBtu/hr input: <15 ppm NOx and <400 ppm CO over 15 min., @ 3% O2.</p> <p>>20 mmBtu/hr input: <9 ppm NOx and <400 ppm CO over 15 min., @ 3% O2.</p> <p>Nongaseous Fuel Firing (BARCT):</p> <p>1-5 mmBtu/hr input: <40 ppmv NOx, <400 ppmv CO over 15 min., @ 3% O2.</p> <p>=5 – 20 mmBtu/hr input: <40 ppmv NOx, <400ppmv CO over 15 min., @ 3% O2.</p> <p>>20 mmBtu/hr input: <20 ppmvd NOx, 400 ppmv Co over 15 min.,</p> <p>Biomass Fuel Firing (BARCT): <70ppmv NOx and <400ppmv CO, rolling 3 hr. avg., @ 12% CO2.</p>	<p><16.7 MMBTU/Hr: \leq20 ppmv NOx and \leq50 ppmv (firetube type) or \leq100 ppmv (watertube type) CO, @ 3% O2</p> <p>\geq16.7 MMBTU/Hr: \leq5 ppmv NOx and \leq50 ppmv CO, @ 3% O2.</p> <p>Biomass Fuel Firing: \leq70 ppmv NOx, rolling 3 hr. Avg., @ 12% CO2. \leq173 ppmv CO, rolling 3 hr. avg., @ 12% CO2.</p>	<p>Natural Gas & Distillate Oil: \leq0.10 lb-NOx/mmBtu/hr (low heat) \leq0.10 lb-NOx/mmBtu/hr (high heat)</p> <p>Residual Oil: \leq0.30 lb-NOx/mmBtu/hr NOx(low heat) \leq0.40 lb-NOx/mmBtu/hr NOx(high heat)</p> <p>Coal: \leq0.50 lb-NOx/mmBtu/hr NOx(Mass-feed stoker) \leq0.60 lb-NOx/mmBtu/hr NOx (Spreader stoker) \leq0.70 lb-NOx/mmBtu/hr NOx(Pulverized Coal) \leq0.60 lb-NOx/mmBtu/hr NOx(Lignite) \leq0.80 lb-NOx/mmBtu/hr NOx(Lignite mined in ND, SD, or MO and combusted in a slag tap furnace)</p>

Staff Report
 Rule 411
 Attachment A
 40727.2 Matrix for Proposed Amendments to Rule 411, Boiler NOx
 October 21, 2004, Page 2

			Comparative Requirements	
Elements of Comparison	Specific Provisions	Proposed Rule 411	Best Available Control Technology (BACT)	40CFR60 Subpart Db
	Compliance alternatives	Limit fuel usage below the levels specified in the rule and either tune the boiler at least once per year or maintain O2 stack level of less than 3%; Install air pollution control equipment to reduce NOx and Co emissions; apply for SEED Credits		
Operating Parameters				30 day averaging (daily emission rates averaged over 30 days)
Work Practice Requirements		none		none
Monitoring/Records	Recordkeeping	Emergency Nongaseous Fuel Firing: record cumulative annual hours of operation on each non-gaseous fuel. Keep records of most recent 2 years and have available on request. Low Fuel Usage\Removal From Service: record HHV and cumulative gaseous and non-gaseous fuel usage. Keep record of most recent 2 years and have available on request. CEMS System: one cycle of operation (sampling, analyzing, and data recording) every 15 minutes.		Owner/operator submit notification of date of initial startup, submit performance test data from initial performance test and performance evaluation of CEMS. Affected facilities shall keep records for each steam-generating unit operating day. Submit excess emission reports for any calendar quarter where there are excess emissions or submit a report stating the absence of excess emissions. All records kept for two years. Submit quarterly report.
	Frequency	Initial testing to verify compliance with proposed NOx and CO emission limits; After this, unit rated at ≥ 20 million BTU an hour: source test annually. units rated at >5 million Btu an hour but <20 million BTU an hour: source test biennially.		Heat input capacity >250 million Btu's: Initial performance test; subsequent performance test each calendar year or every 400 hours. Heat input capacity < 250 million Btu's: Initial performance test; as requested thereafter.

Staff Report
 Rule 411
 Attachment A
 40727.2 Matrix for Proposed Amendments to Rule 411, Boiler NOx
 October 21, 2004, Page 3

			Comparative Requirements	
Elements of Comparison	Specific Provisions	Proposed Rule 411	Best Available Control Technology (BACT)	40CFR60 Subpart Db
Monitoring/ Testing	Test Methods	All emission determination made in as-found operating condition, except no determination during startup, shutdown, or malfunction. Test methods: -Oxide of Nitrogen: ARB Method 100 or EPA Method 7E -Carbon Monoxide: ARB Method 100 or EPA Method 10 -Stack Gas Oxygen: ARB Method 100 or EPA method 3A -Carbon Dioxide: ARB Method 100 or EPA Method 3A.		Emission standards apply at all times except during startup, shutdown, or malfunction. Test methods: -NOx: Continuous system -NOx with duct burners used in combined cycle systems: Method 20 -NOx for facilities with heat input capacity > 250 million Btu/hour: Method 7, 7A or 7E.

Attachment B

All Feasible Measures Requirements Rule 411, Boiler NOx

The following is a comparison with the proposed requirements in Rule 411 and those adopted by other districts. The table below lists these requirements:

	Proposed SMAQMD Rule 411	VCAPCD (Rule 74.11.1, 9/14/1999) (Rule 74.15.1, 6/13/2000) Rule 74.15, 11/8/1994)	SCAQMD (Rule 1146.2; 1/9/1998); (Rule 1146.1; 5/13/1994); (Rule 1146; 6/16/2000)	SJVUAPCD (Rule 4306, 9/18/2003)	SBAPCD (Rule 360, 10/17/2002) (Rule 342, 4/17/1997)
Applicability	New and existing units rated at or above one mmBtu/hr input.	<p>Rule 74.11.1 New units rated at or above 75,000 Btu/hr input and <= 2 mmBtu/hr input</p> <p>Rule 74.15 New and existing units rated at or above 5 mmBtu/hr input</p> <p>Rule 74.15.1 New and existing units rated at or above 1 mmBtu/hr input and less than 5 mmBtu/hr input.</p>	<p>Rule 1146.2 January 2000 – Type 2 units (units rated >400,000 Btu/hr input and <=2 mmBtu/hr input) manufactured after January 2000</p> <p>January 2001 - Type 1 units (units rated >=75,000 Btu/hr input and <=400,000 Btu/hr input) manufactured after January 2001</p> <p>July 2002 – Units rated > 1 mmBtu/hr input and <=2 mmBtu/hr input manufactured prior to January 1992</p> <p>January 2005 – Units rated >1 mmBtu/hr input and <= 2 mmBtu/hr input manufactured between 1992 and 1999</p> <p>January 2006 – Units rated >400,000 Btu/hr input and <= 1 mmBtu/hr input manufactured prior to January 2000</p>	New and existing units > 5 mmBtu/hr input	<p>Rule 360 New units >=75,000 therms – 2 mmBtu/hr input installed after 10/17/2003</p> <p>Rule 342 Units rated at or above 5 mmBtu/hr input</p>

Staff Report
 Rule 411
 Attachment B
 All Feasible Measures requirements
 October 21, 2004, Page 2

	Proposed SMAQMD Rule 411	VCAPCD (Rule 74.11.1, 9/14/1999) (Rule 74.15.1, 6/13/2000) Rule 74.15, 11/8/1994)	SCAQMD (Rule 1146.2; 1/9/1998); (Rule 1146.1; 5/13/1994); (Rule 1146; 6/16/2000)	SJVUAPCD (Rule 4306, 9/18/2003)	SBAPCD (Rule 360, 10/17/2002) (Rule 342, 4/17/1997)
			<p>Rule 1146.1</p> <p>New and existing units rated > 2 mmBtu/hr input and <5 mmBtu/hr input</p> <p>Rule 1146</p> <p>New and existing units rate at or above 5 mmBtu/hr input</p>		
Conclusion – Rule Applicability	Staff did not propose setting the rule applicability to units rated below one mmBtu/hr input at this time since these units will be addressed under a separate rule applying to small boilers and large water heaters.				
Exemptions	<p>Units with < 1 mmBtu/hr heat input</p> <p>1- <2.5 mmBtu/ hr – 40,000 therms/yr</p> <p>2.5 <5 mmBtu/ hr – 70,000 therms/yr</p> <p>>=5 mmBtu/hr – 200,000 therms/yr</p>	<p>Rule 74.11.1</p> <p>Units installed prior to December 31, 1999.</p> <p>Rule 74.15.1</p> <p>Fuel usage <18,000 therms Alternate fuel use if used less than 50 hours per year Alternate fuel use due to the curtailment of natural gas service by the natural gas supplier (Rule 74.15.1)</p>	<p>Rule 1146.2</p> <p>Units rated >1 mmBtu/hr input and less than 2 mmBtu/hr with fuel usage <9,000 therms per year – Effective January 2001</p> <p>Units rated below 400,000 Btu/hr input and <= 1 mmBtu/hr input with fuel usage <9,000 therms – Effective January 2005</p> <p>No low fuel usage exemption is provided for units with heat input <= 400,000 Btu/hr</p>	<p>Burning of fuels other than natural gas during natural gas curtailment. This is limited to 168 hours per year plus 48 hours for equipment testing.</p> <p>Units with annual heat input of >=90,000 and <=300,000 therms</p>	<p>Rule 360</p> <p>No fuel usage exemption is provided</p> <p>Rule 342</p> <p>Burning of fuels other than natural gas during natural gas curtailment. This is limited to 168 hours per year plus 24 hours for equipment testing.</p> <p>Units with annual heat input of >=90,000 and</p>

Staff Report
 Rule 411
 Attachment B
 All Feasible Measures requirements
 October 21, 2004, Page 3

	Proposed SMAQMD Rule 411	VCAPCD (Rule 74.11.1, 9/14/1999) (Rule 74.15.1, 6/13/2000) Rule 74.15, 11/8/1994)	SCAQMD (Rule 1146.2; 1/9/1998); (Rule 1146.1; 5/13/1994); (Rule 1146; 6/16/2000)	SJVUAPCD (Rule 4306, 9/18/2003)	SBAPCD (Rule 360, 10/17/2002) (Rule 342, 4/17/1997)
		Rule 74.15 Fuel usage <90,000 therms/year Alternate fuel use if used less than 50 hours per year Alternate fuel use due to the curtailment of natural gas service by the natural gas supplier	Units used in recreational vehicles Units used in mobile homes Units located at RECLAIM facilities Rule 1146.1 Units with annual fuel usage of <= 18,000 therms Rule 1146 <=90,000 therms per year for units with rated heat input of >= 5 mmBtu/hr and < 40 mmBtu/hr <=200,000 therms per year for units rated heat input at or above 40 mmBtu/hr		<=300,000 therms
Conclusion – Exemptions	SCAQMD and VCAPCD have the most stringent fuel usage for exemption from the rule requirements. SCAMD required existing small units to be retrofit/replaced (The final compliance date is 1/2005). The BACT level in SCAQMD is zero pounds per day for ozone precursors where it is 10 pounds/day for our district. In addition, these small units were required to meet 30 ppm NOx limit at the time of installation as BACT. Therefore, the total retrofit costs were lower in a relative sense in the SCAQMD. Staff established exemption levels based on costs for permitted and unpermitted units using specific data from sources in Sacramento.				
Source Testing Requirement	Annual for units at or above 20 mmBtu/hr Biennial for units at or above 5 mmBtu/hr and less than 20	Rule 74.11.1 Initial certification by the equipment manufacturer	Rule 1146.2 A certification source test required of the equipment manufacturer	CEMS or an approved alternate motoring system which required periodic monitoring	Rule 360 Initial source test for equipment certification

Staff Report
 Rule 411
 Attachment B
 All Feasible Measures requirements
 October 21, 2004, Page 4

	Proposed SMAQMD Rule 411	VCAPCD (Rule 74.11.1, 9/14/1999) (Rule 74.15.1, 6/13/2000) Rule 74.15, 11/8/1994)	SCAQMD (Rule 1146.2; 1/9/1998); (Rule 1146.1; 5/13/1994); (Rule 1146; 6/16/2000)	SJVUAPCD (Rule 4306, 9/18/2003)	SBAPCD (Rule 360, 10/17/2002) (Rule 342, 4/17/1997)
	mmBtu/hr Initial testing only to verify compliance with the proposed NOx limits for 1-5 mmBtu/hr. Annual tune-up or 3% O2 for exempt equipment	Rule 74.15.1 Annual testing 3% O2 or biannual tune-up for exempt equipment	Rule 1146.1 An initial source test is required Biannual tune-up or 3% O2 for exempt equipment Rule 1146 Initial source testing is required Units below 10 mmBtu/hr – source testing is required every 3 years Units above 10 mmBtu/hr – source testing is required every year Biannual tune-up or 3% O2 for exempt equipment	Annual testing may be used as an alternative to CEMS Units with low fuel usage exemption – monthly monitoring of the operational characteristics of the unit as recommended by the unit manufacturer Biannual tune-up or 3% O2 for exempt equipment Triennial testing if units demonstrate compliance on a consecutive 2 year period. Testing of similar units may be achieved by testing on unit.	Rule 342 Biennial source testing
Conclusion - Testing	Some districts require biannual tune-up or 3% O2 for exempt equipment if they are operated year-round. Some districts require annual testing for units rated above 10 mmBtu/hr input. Rule 411 requires annual tune-up for exempt equipment unless meeting 3% O2 , initial testing for units rated >-1 mmBtu/hr and below 5 mmBtu/hr, biennial testing for units rated at or above 5 mmBtu/hr and less than 20 mmBtu/r, annual testing for units rated at or above 20 mmBtu/hr. Staff did not require biannual tune-up for exempt equipment since most of these units are operated less than 6 months per year. While staff increased the testing frequency to annual for 20-25 mmBtu/hr Staff also did not set the annual testing requirements at units rated above 10				

Staff Report
 Rule 411
 Attachment B
 All Feasible Measures requirements
 October 21, 2004, Page 5

	Proposed SMAQMD Rule 411	VCAPCD (Rule 74.11.1, 9/14/1999) (Rule 74.15.1, 6/13/2000) Rule 74.15, 11/8/1994)	SCAQMD (Rule 1146.2; 1/9/1998); (Rule 1146.1; 5/13/1994); (Rule 1146; 6/16/2000)	SJVUAPCD (Rule 4306, 9/18/2003)	SBAPCD (Rule 360, 10/17/2002) (Rule 342, 4/17/1997)
	mmBtu/hr input to minimize the cost impact of affected sources.				
Equipment Requirements	Hour meter or fuel meter for exempt equipment	Rule 74.11.1 No equipment is specified Rule 74.15.1 Non-totalizing fuel meter 74.15 Same as Rule 74.15.1	Rule 1146.2 No fuel or hour meter is required Rule 1146.1 For exempt units - Non-resetting totalizing fuel meter for exempt equipment Rule 1146 Same as Rule 1146.1	Totalizing mass or flow meter for exempt equipment.	Rule 360 No fuel or hour meter is required Rule 342 Totalizing mass or flow meter for exempt equipment
Conclusion – Equipment Requirements	Equipment is being required to support enforcement of exemption levels. Without a fuel meter or hour meter, staff will not be able to verify the annual fuel usage for the exempt equipment.				
Permit Modification Requirements	Permit modification required for exempt equipment because of low fuel usage applied for within one year of adoption. For non-exempt units, no explicit permit modification is specified.	Rule 74.11.1 No explicit permit modification is specified Rule 74.15.1 No explicit permit modification is specified. Rule 74.15 Permit modification is specified	Rule 1146.2 No explicit permit modification is required Rule 1146.1 Permit modification is required AC application by January 1993 Rule 1146	Permit modification is required. A compliance plan is required, but no explicit date for AC application submittal is specified.	Rule 360 No explicit permit modification is required. Rule 342 Permit modification is required with a compliance plan. AC application by March 1994.

Staff Report
 Rule 411
 Attachment B
 All Feasible Measures requirements
 October 21, 2004, Page 6

	Proposed SMAQMD Rule 411	VCAPCD (Rule 74.11.1, 9/14/1999) (Rule 74.15.1, 6/13/2000) Rule 74.15, 11/8/1994)	SCAQMD (Rule 1146.2; 1/9/1998); (Rule 1146.1; 5/13/1994); (Rule 1146; 6/16/2000)	SJVUAPCD (Rule 4306, 9/18/2003)	SBAPCD (Rule 360, 10/17/2002) (Rule 342, 4/17/1997)
		AC application by March 1990 for units rated above 10 mmBtu/hr input AC application by March 1991 for units rated from 5 – 10 mmBtu/hr input	No explicit permit modification is specified.		
Conclusion – Modification	A permit application is required for exempt equipment to add the fuel limitation and any fuel meter/tune-up requirements that are necessary. However, no explicit application for modification is required by Rule 411 for non-exempt units because Rule 201, General Permit Requirements, Section 301 requires modification of the permit to include the requirements of Rule 411 in the Permit to Operate. Not all of the other districts require actual modification of the Permit to Operate, but instead they require recordkeeping to be kept to verify compliance. In other Districts, equipment modifications would trigger requirements through their permitting regulations also.				

Staff Report
 Rule 411
 Attachment B
 All Feasible Measures requirements
 October 21, 2004, Page 7

	Proposed SMAQMD Rule 411	VCAPCD (Rule 74.11.1, 9/14/1999) (Rule 74.15.1, 6/13/2000) Rule 74.15, 11/8/1994)	SCAQMD (Rule 1146.2; 1/9/1998); (Rule 1146.1; 5/13/1994); (Rule 1146; 6/16/2000)	SJVUAPCD (Rule 4306, 9/18/2003)	SBAPCD (Rule 360, 10/17/2002) (Rule 342, 4/17/1997)
Emission Limits	<p>Gaseous Fuels:</p> <p>NOx Limit</p> <p>30 ppmv (1-<5 mmBtu/hr) 15 ppmv >=5 - <= 20 mmBtu/hr 9 ppmv >20 mmBtu/hr</p> <p>Nongaseous Fuels:</p> <p>40 ppmv</p>	<p>Rule 74.11</p> <p>Gaseous Fuels:</p> <p>Units with rated capacity >=75,000 therms and <= 400,000 therms</p> <p>NOx limit – 55 ppm</p> <p>Units with rated capacity >400,000 therms and <= 2 mmBtu/hr</p> <p>NOx limit – 30 ppm</p> <p>Nongaseous Fuels:</p> <p>Same as gaseous fuels</p> <p>Rule 74.15.1</p> <p>NOx Limit – 30 ppm</p> <p>Rule 74.15</p> <p>Gaseous & Nongaseous Fuels</p> <p>NOx Limit – 30 ppm</p>	<p>Rule 1146.2</p> <p>Gaseous Fuels:</p> <p>NOx Limit - 30 ppm</p> <p>Nongaseous Fuels:</p> <p>Same as gaseous fuels</p> <p>Rule 1146.1</p> <p>Gaseous Fuels:</p> <p>NOx Limit - 30 ppm</p> <p>Nongaseous Fuels:</p> <p>Same as gaseous fuels</p> <p>Rule 1146</p> <p>Gaseous Fuels</p> <p>NOx Limit – 30 ppm</p> <p>Nongaseous Fuels:</p> <p>Same as gaseous fuels</p>	<p>Gaseous Fuels:</p> <p>NOx Limit –</p> <p>15 ppmv >=5 - <= 20 mmBtu/hr 9 ppmv >20 mmBtu/hr</p> <p>Weighted limit for units that burns a combination of gaseous and nongaseous fuels</p> <p>Nongaseous Fuels:</p> <p>NOx Limit – 40 ppm</p>	<p>Rule 360</p> <p>Gaseous Fuels</p> <p>NOx Limit</p> <p>75,000 therms – 400,000 therms – 55 ppm</p> <p>>400,000 therms – 2 mmBtu/hr – 30 ppm</p> <p>Nongaseous Fuels – No specific limit provided – assumed same as gaseous fuels.</p> <p>Rule 342</p> <p>Gaseous Fuels</p> <p>NOx Limit – 30 ppm</p> <p>Nongaseous Fuels</p> <p>NOx Limit – 40 ppm</p>

Staff Report
 Rule 411
 Attachment B
 All Feasible Measures requirements
 October 21, 2004, Page 8

	Proposed SMAQMD Rule 411	VCAPCD (Rule 74.11.1, 9/14/1999) (Rule 74.15.1, 6/13/2000) Rule 74.15, 11/8/1994)	SCAQMD (Rule 1146.2; 1/9/1998); (Rule 1146.1; 5/13/1994); (Rule 1146; 6/16/2000)	SJVUAPCD (Rule 4306, 9/18/2003)	SBAPCD (Rule 360, 10/17/2002) (Rule 342, 4/17/1997)
Conclusion – Emission Limits	Emission limits for gaseous fuels are consistent with those adopted in other districts. Other districts such as VCAPCD and SCAQMD have lower limits for small units fired on non-gaseous fuels. VAPCD, SBAPCD, and SJVUAPCD exempt units from the NOx requirements if non-gaseous fuel is used on standby basis. Therefore, staff did not propose a lower NOx limit for non-gaseous fuel firing. The only non-gaseous fuel use in the District is for standby purposes.				
Compliance Dates	One year after rule adoption	Rule 74.11.1 (December 2000 for units less than 400,000 Btu/hr input; December 1999 for unit more than 400,000 Btu/hr input) Rule 74.15.1 (Final compliance date is June 2000) Rule 74.15 Final compliance date is March 1992)	Rule 1146.2 (Compliance Dates are: January 2000, January 2001, July 2002, January 2005, and January 2006 depending on the unit size and manufacturing date) Rule 1146.1 (Compliance Timelines are: January 2003 for AC application submittal; December 1993 for full compliance) Rule 1146 (Compliance Date is July 2002)	There are phase in compliance timelines for sources with multiple units. 25% of units to comply by June 2005; 62.5% by June 2006; 100% by June 2007. Final compliance timeline is year 2007.	Rule 360 Compliance date is October 2003) Rule 342 Final compliance date is March 1996)
Compliance Date Conclusion	Some districts have different compliance dates depending on the equipment size. Other districts have phase in compliance timelines for sources with multiple units. Proposed Rule 411 gives one year of compliance timeline. This is more stringent than that adopted by other districts. The District has a few facilities with multiple units. A delayed compliance timeline may be proposed if request by these facilities.				
Overall Rule Feasibility Conclusion	Based on the analysis of boiler rules adopted by other districts, Staff has concluded that the proposed amendments will satisfy the "all feasible" measures requirements.				

Attachment C

Rule 411, Boiler NOx

Summary of Changes

Existing Section Number	New Section Number	Changes
101	NA	Revised this section to clarify that this rule applies to new and existing boilers, steam generators, and process heaters used for any type of application or process.
102	NA	Revised this section to lower the applicability to one mmBtu/hr and to clarify the rule language as noted in Section 101.
110	NA	Removed the section since the requirements for this section are covered under Section 102.
111-113	110-112	Section renumbering.
114	113	<p>Clarified this section to ensure that the current 90,000 therms exemption only applies to units rated at or above 5 mmBtu/hr input which are currently under permit from the District.</p> <p>Clarified that units exempt pursuant to this section are subject to the recordkeeping requirements in Section 502.</p> <p>Added an exemption from the proposed NOx limit based on the annual fuel usage. The proposed exemption levels are: 40,000 therms per year for units rated 1 – <2.5 mmBtu/hr input 70,000 therms per year for units rated 2.5 – <5 mmBtu/hr input 200,000 therms per year for units rated >=5 mmBtu/hr input</p>
202		Revised this section to clarify that Section 304 is a BARCT requirement.
204		Revised the definition of "Biomass Boiler or Steam Generator" to clarify that the rule applies to boilers, steam generators, and process heaters used for any type of application or process.
205	Same	Revised the definition of "Boiler or Steam Generator" to clarify that the rule applies to boilers, steam generators, and process heaters used for any type of application or process, including electric utility boilers. As a practical matter there are no permitted boilers used exclusively to produce power at this time. If future usage is changed or new units are sited, they would be subject to this rule.
209		Revised this section to correct the section number reference.
221		Revised the definition of "Unit" to clarify that it includes steam

Existing Section Number	New Section Number	Changes
		generators and process heaters.
301	Same	Revised this section to add proposed lower NOx standards for new and existing boilers and other equipment fired on gaseous fuels. Added new NOx requirements for new and existing units rated at one mmBtu/hr input and less than 5 mmBtu/hr input fired on gaseous fuels.
302	Same	Revised this section to clarify it and to add new NOx requirements for new and existing units rated at one mmBtu/hr input and less than 5 mmBtu/hr input fired on nongaseous fuels.
303		Revised this section to correct the section numbers referenced under this section.
305		Revised this section to remove the dates that no longer apply.
306		Revised this section to clarify that equipment exempt from the NOx and CO requirements are required to install a non-resetting totalizing fuel meter, hour meter, or a computerized tracking system.
401		Added a new subsection for units exempt pursuant to Section 113.2 to be equipped with a fuel monitoring equipment that comply with the requirements in Section 306.
403	NA	Added requirements for initial source testing to verify compliance with the proposed emissions units. Lowered the annual testing requirements from units rated at or above 25 mmBtu/hr input to units rated at or above 20 mmBtu/hr input to make it consistent with the proposed NOx limits which apply to units rated at or above 20 mmBtu/hr input. Revised the biennial testing requirements to apply to units rated at or above 5 mmBtu/hr - < 20 mmBtu/hr. Added initial testing requirements for units rated at or above 5 mmBtu/hr to < 5 mmBtu/hr.
Na	405	Added a new section for administrative requirements for unit that exceeds the allowable fuel usage and becomes subject to the lower NOx emission limits.
501	NA	Revised this section to reflect the change in numbering for Sections 217 and 219. Corrected test method number to reflect the updated test

Staff Report
 Rule 411
 Attachment C
 Summary of Changes
 October 21, 2004, Page 11

Existing Section Number	New Section Number	Changes
		<p>numbers.</p> <p>Added new rule language to clarify that a scheduled source test may not be discontinued solely due to the failure of one or more runs to meet applicable standards.</p> <p>Added clarifying language to allow compliance to be determined based on two test runs instead of three runs if the results of one of the runs are invalidated due to unforeseen reasons.</p> <p>Clarified Section 501.2 to ensure that CEMS are used when the unit is operated.</p>
502		<p>Revised this section to correct subsection number. Added references to applicable sections.</p> <p>Clarified recordkeeping requirements for exempt units.</p>
Attachment A		<p>Revised to include tune-up procedure for natural draft-fired units.</p>

Attachment D

Rule 411, Boiler NOx

Cost Effectiveness Analysis

Attachment D-1

Boiler Replacement Cost Effectiveness

Boiler Size mmBtu/hr	Equipment Cost \$	Installation Cost \$	Permit Modification \$	Total Capital Cost \$	Annualized Capital Cost \$/yr	Source Testing Cost \$/yr	Annual Tune-up Cost \$/yr	Total Annual Cost \$/yr
1	18,000	18,000	558	36,279	3,983	174	0	4,188
2	26,000	26,000	558	52,280	5,740	174	0	5,945
3	36,000	36,000	558	72,281	7,936	174	0	8,141
4	40,000	40,000	558	80,282	8,815	174	0	9,019
5	90,000	45,000	278	135,283	14,853	0		14,853
6	96,000	48,000	278	144,284	15,842	0		15,842
7	102,000	51,000	278	153,285	16,830	0		16,830
8	108,000	54,000	278	162,286	17,818	0		17,818
9	114,000	57,000	278	171,287	18,806	0		18,806
10	120,000	60,000	558	180,568	19,825	0		19,825
15	185,000	92,500	558	278,073	30,531	0		30,531
20	250,000	125,000	558	375,578	41,236	0		41,236
30	283,333	141,667	558	425,588	46,727	0		46,727
40	316,666	158,333	558	475,597	52,218	0		52,218
50	350,000	175,000	1,115	526,165	57,770	0		57,770
60	380,000	190,000	1,115	571,175	62,712	0		62,712
70	410,000	205,000	1,115	616,185	67,654	0		67,654
80	440,000	220,000	1,115	661,195	72,596	0		72,596
90	470,000	235,000	1,115	706,205	77,538	0		77,538
100	500,000	250,000	2,229	752,329	82,602	0		82,602

Attachment D-2

Boiler Retrofit Cost Effectiveness

Boiler Size mmBtu/hr	Equipment Cost \$	Installation Cost \$	Permit Modification \$	Total Capital Cost \$	Annualized Capital Cost \$/yr	Source Testing Cost \$/yr	Total Annual Total Cost \$/yr
1	14000	14000	278	28279	3105	174	3279
2	18000	18000	278	36280	3983	174	4158
3	26000	26000	278	52281	5740	174	5915
4	28000	28000	278	56282	6179	174	6354
5	65000	0	278	65283	7168	174	7342
6	68000	0	278	68284	7497	0	7497
7	71000	0	278	71285	7827	0	7827
8	74000	0	278	74286	8156	0	8156
9	77000	0	278	77287	8486	0	8486
10	80000	0	558	80568	8846	0	8846
15	92500	0	558	93073	10219	0	10219
20	105000	0	558	105578	11592	0	11592
30	115000	0	558	115588	12691	0	12691
40	125000	0	558	125598	13790	0	13790
50	135000	0	1115	136165	14950	0	14950
60	163000	0	1115	164175	18026	0	18026
70	191000	0	1115	192185	21101	0	21101
80	219000	0	1115	220195	24176	0	24176
90	247000	0	1115	248205	27252	0	27252
100	275000	0	2229	277329	30449	0	30449