Monterey Bay Air Resources District
Serving Monterey, San Benito, and Santa Cruz Counties

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Notice of Availability of Proposed Rule 441 Boilers, Steam Generators, and Process Heaters

November 25, 2019

The Monterey Bay Air Resources District (MBARD) is considering adoption of proposed Rule 441 Boilers, Steam Generators, and Process Heaters. Interested parties are invited to submit written comments and to attend and participate at the hearing. The following public meetings provide an opportunity to learn about the proposed rule and provide comments.

Activity	**Date/Time**	**Where**
Advisory Committee Meeting	December 05, 2019, 1:30 PM	MBARD Board Room 24580 Silver Cloud Ct., Monterey
Public Workshop	January 15, 2020, 10 AM	MBARD Board Room 24580 Silver Cloud Ct., Monterey
Board Adoption	February 19, 2020, 1:30 PM	MBARD Board Room 24580 Silver Cloud Ct., Monterey

Copies of the proposed regulatory action, including the staff report addressing possible fiscal impacts upon regulated sources, are available for inspection at the District office or on our website at www.mbard.org. This proposed rule is exempt from the requirements of Public Resources Code Section 21000 et seq. California Environmental Quality Act (CEQA) Guidelines which allows certain actions to be excluded from the requirements of CEQA.

Written comments must be received no later than 4:45 PM on February 7, 2020 to ensure inclusion in the District Board adoption package. Public comment will also be heard at the hearing. Written comments on the items listed above should be directed as follows:

Email comments to Seong Kim: skim@mbard.org

To mail in comments:
Monterey Bay Air Resources District
c/o Seong Kim
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MONTEREY BAY

AIR RESOURCES DISTRICT

PROPOSED STAFF REPORT

Proposed Rule:

Rule 441 (Boilers, Steam Generators, And Process Heaters)

Published Date: November 25, 2019

Adoption Hearing: February 19, 2020

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Monterey Bay

Air Resources District

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1. Summary

1.1 Introduction

The Monterey Bay Air Resources District (MBARD) is nonattainment for the state 8-hour ozone standard and per California Health and Safety Code Section (CH&SC) 40920.6(c) must adopt an expedited BARCT schedule for creating or updating rules. Thus, MBARD is proposing to create Rule 441, Boilers, Steam Generators, and Process Heaters. Rule 441 will address controlling oxides of nitrogen (NO_x) and carbon monoxide (CO) emissions from boilers, steam generators, and process heaters at subject sources per CH&SC Section 40920.6(c)(2).

The proposed Rule 441 will not have a significant or detrimental effect on the environment. The rule will require existing equipment to meet lower emission limits at four specific industrial sources. Therefore, staff will prepare and submit a Notice of Exemption to satisfy the requirements of the California Environmental Quality Act (CEQA). The notice will state that the adoption of Rule 441 is exempt from the requirements of CEQA pursuant to Title 14, California Code of Regulations, Section 15308, Actions by Regulatory Agencies for Protection of the Environment.

1.2 Background

Assembly Bill 617 (AB 617) was approved on July 26, 2017 and amends CH&SC Division 26, Part 3, Chapter 10, Section 40920.6. AB 617 requires each air district that is a nonattainment area for one or more air pollutants to adopt, by January 1, 2019, an expedited schedule for implementation of best available retrofit control technology (BARCT) by the earlies feasible date, but no later than December 31, 2023. This requirement applies to each industrial sources subject to California Greenhouse Gas (GHG) Cap-and-Trade requirements. Within the jurisdiction of MBARD, there are four industrial sources subject to the BARCT schedule: Aera Energy, LLC, Chevron U.S.A. Inc., Eagle Petroleum, LLC, and Lhoist North America of Arizona, Inc. MBARD reviewed the permitted emission sources at these facilities and developed a list of potential rule development activities to implement BARCT by the deadline of December 31, 2023.

On October 15, 2018, MBARD's Board of Directors approved the proposed BARCT schedule as shown in Table 1 below.

Table 1. Expedited BARCT Implementation Schedule

Rule Development Sources	2019				2020				2021				2022				2023			
Steam Generators/ Boilers/Process Heaters		■	■	■	■															
Internal Combustion Engines						■	■	■	■											
Steam Driven Oil Production Wells (revise Rule 427)										■	■	■	■							
Lime Kiln														■	■	■	■			

To fulfill Table 1 of the BARCT schedule, staff is proposing to adopt Rule 441.

1.3 Public Review

As part of MBARD's rule development procedures, MBARD will send the rule adoption announcement to interested parties, post the announcement on our website, hold a public workshop, and review the rule with MBARD's Advisory Committee prior to taking the proposed rule to the Board of Directors for adoption. The proposed rule was publically noticed on our website on November 25, 2019 and public meetings will be held as shown below.

Activity	Date/Time	Where
Advisory Committee Meeting	December 05, 2019, 1:30 PM	MBARD Board Room 24580 Silver Cloud Ct., Monterey
Public Workshop	January 15, 2020, 10 AM	MBARD Board Room 24580 Silver Cloud Ct., Monterey
Board Adoption	February 19, 2020, 1:30 PM	MBARD Board Room 24580 Silver Cloud Ct., Monterey

1.4 California Environmental Quality Act (CEQA) Analysis

California Public Resource Code Section 21159 requires MBARD to perform an environmental analysis of the reasonably foreseeable methods of compliance at the time of adopting a rule requiring the installation of pollution control equipment or a performance standard. The analysis must include the following information.

1. An analysis of the reasonably foreseeable environmental impacts of the methods of compliance.

2. An analysis of the reasonably foreseeable mitigation measures.

3. An analysis of the reasonably foreseeable alternative means of compliance with the rule or regulation.

The proposed Rule 441 will reduce NO_x emissions from existing boilers, process heaters, and steam generators. The proposed rule does not create new requirements that may have an adverse effect on the environment. MBARD is proposing the rule to comply with the requirements of CH&SC 40920.6(c)(2) to implement a BARCT schedule, there are no alternatives in the Health and Safety Code for MBARD to meet this requirement. Finally, the emission standards that are proposed have been in place in other air districts for the last 15 years, and there are a number of manufacturers that can supply equipment that complies with the proposed rule. Thus, pursuant to state CEQA guidelines, MBARD finds the adoption of the proposed rule to be exempt from CEQA under Class 8 Categorical Exemption, Action by Regulatory Agencies for Protection of the Environment, Section 15308 State CEQA Guidelines.

2. Discussion of Proposed Rule 441 Requirements

This chapter describes the proposed elements of Rule 441.

2.1 Part 1. General

This part of the rule discusses the purpose, applicability, exemptions, and effective date of Rule 441. The purpose of this Rule is to control NO_x emissions from boilers, steam generators, and process heaters at subject sources per CH&SC Section 40920.6(c)(2). Exemptions to the rule have been added for certain units, and an exemption from the emission standards of Section 3.1 of the Rule have been added for units operating less than 90,0000 therms in any calendar year, units operating during curtailment conditions, non-operational units, and for units that provide emission reduction credits per Rule 215 in lieu of meeting the emission standards. Staff anticipates the effective date of this rule to be February 19, 2020.

2.2 Part 2 Definitions

Definitions were added to this rule to help clarify in understanding the rule requirements.

2.3 Part 3 Standards

This part of the rule presents the NO_x and CO emission requirements for subject AB 617 industrial units and performance testing required to demonstrate compliance with the emission limits. Tables 2 and 3 below summarize these requirements:

Table 2. Proposed BARCT Emission Limits

Source Category	Total Unit Rated Heat Input/Description (MMBTU/hr)	Fuel	NO_x Limit (ppmv @ 3% O_2)	CO Limit (ppmv @ 3% O_2)
Boilers & Process Heaters	≥ 2 to < 5	Gaseous	30	400
	≥ 5 to < 20		15	400
	≥ 20		9	400
Oilfield Steam Generators	≥ 2	Gaseous	15	400

Table 3. Performance Testing Requirements

Section	Source Category	Total Unit Rated Heat Input/Description (MMBTU/hr)	Testing Method & Frequency
3.4.1	Boiler & Process Heaters	≥ 2 to < 5	Portable analyzer test at least once every one year
3.4.2		≥ 5 to < 20	
3.4.3		≥ 20	Source test at least once every calendar year
3.4.4	Oilfield Steam Generator	≥ 2	Source test at least once every calendar year

This part of the rule also discusses the requirements of the owners or operators of units claiming the low-use exemption.

2.4 Administrative Requirements

This part of the rule discusses the reporting requirements for the tune-up and source test reports, and as well the compliance requirements when a unit loses it low-fuel usage exemption. Lastly, it also presents the compliance schedule to meet the emission requirements of this rule.

2.5 Recordkeeping and Test Methods

This part of the rule discusses the recordkeeping requirements for each of the units subject to the rule and the approved test methods to demonstrate compliance with the emission requirements.

3. Rule Comparison

CH&SC Section 40727.2 requires districts to prepare a written analysis that identifies all existing federal air pollution control requirements, including, but not limited to, emission control standards constituting best available control technology (BACT) that apply to the same equipment or source type as the rule or regulation proposed by for adoption or modification by MBARD. In addition, the analysis shall identify any other District rule or regulation that applies to the same equipment or source type.

Rule 441 applies to boilers, steam generators, and process heaters except for certain units that are entirely exempt from the rule. Units subject to Rule 441 may be subject to the requirements of New Source Performance Standards (NSPS) contained in Title 40, Code of Federal Regulations, Part 60 (40 CFR Part 60) Subpart D, Db, and Dc depending on their rated heat inputs and the date upon which the unit was constructed, modified, or reconstructed. Units subject to Rule 441 may also be subject to the requirements of National Emission Standards for Hazardous Air Pollutants (NESHAP)

contained in 40 CFR Part 63 Subparts DDDDD and JJJJJJ depending upon whether a unit is located at a major or area source of Hazardous Air Pollutants (HAP). A comparison of the MBARD's proposed Rule 441 to the existing federal regulations is shown below in Table 4. Staff also compared Rule 441 to the rules adopted by other nearby air districts. A comparison of MBARD's proposed Rule 441 to other nearby air district rule is shown below in Tables 5 and 6.

As shown in Table 4 below, the Rule 441 requirements are more stringent than federal regulations. However, as shown in Tables 5 and 6, the proposed rule is not requiring any provisions that are more stringent than what has already been adopted by other air districts. Furthermore, Rule 441 was written to be consistent with other air districts while still adequately acknowledging the specific industrial sources in the region covered by MBARD.

Table 4. Comparison of Rule 441 Requirement with Federal Regulations

Rule Number	MBARD Rule 441	40 CFR Part 60 Subpart D	40 CFR Part 60 Subpart Db	40 CFR Part 60 Subpart Dc	40 CFR Part 63 Subpart DDDDD	40 CFR Part 63 Subpart JJJJJJ
NO_x Emission Limits	Highest Limit equates to 30 ppm or 0.0365 lb/MMBTU	Lowest limit is 0.20 lb/MMBTU	Lowest limit is 0.10 lb/MMBTU	No NO_x limit in the regulation	No NO_x limit in the regulation	No NO_x limit in the regulation
CO Emission Limits	400 ppm or 0.2960 lb/MMBTU	0.15 lb/MMBTU limit for certain sources	0.15 lb/MMBTU limit for certain sources	0.15 lb/MMBTU limit for certain sources	Lowest CO limits are 130 ppm and 150 ppm[b]	420 ppm as 3-run average or 10-day rolling average
Testing	Portable analyzer test[c] and source test[d] at least once every calendar year.	Initial test plus CEMS & COMS at most	Initial test plus CEMS & COMS at most	Initial test plus CEMS & COMS at most	Initial test plus CEMS & COMS at most	Initial test plus CEMS & COMS at most
Usage Monitoring	Monthly records of fuel usage and operating hours	Fuel usage records not required	Daily or monthly records of fuel usage	Daily or monthly records of fuel usage	Daily or monthly records of fuel usage	Daily or monthly records of fuel usage
Recordkeeping	5 years	No record retention period specified	2 years	2 years	5 years	5 years

a. In this regulations, compliance with CO limit is one requirement for sources that elect not to install and operate a Continuous Opacity Monitoring (COMS).
b. The 130 ppm limit is the lowest limit for any category of emissions unit for which compliance is determined by the average of three test runs and the 150 ppm limit is the lowest limit for a unit in any category that is equipped with a Continuous Emissions Monitoring System (CEMS) determined as a 30-day rolling average.
c. Portable analyzer test only required for boilers and process heaters that have a total heat input rate between 2 - 20 MMBTU/hr.
d. Sources test only required for boilers and process heaters that have a total heat input rate greater than or equal to 20 MMBTU/hr and for oilfield steam generators.

Table 5. Comparison of Rule 441 to Nearby Air District (≥2 to 5 MMBTU/Hr)

Air District and Rule Number		MBARD Rule 441 (Proposed)	Santa Barbara APCD Rule 361 (2019)	San Luis Obispo APCD Rule 430 (2014)	San Joaquin Valley APCD Rule 4307 (2008)	Bay Area AQMD Regulation 9 Rule 7 (2011)
Section	**Rule Component**					
Applicability	MMBtu/hr	≥2	2 - 5	NA	2 - 5	2 - 5
Exemptions	Curtailment	Yes - 200 hours	Yes - 168 hours	NA	Yes - 168 hours	---
	Low-Fuel Usage	Yes - 90,000 therms/yr	Yes - 1.8 billion BTUs/yr or 18,000 therms/yr	NA	---	Yes - 90,000 therms/yr
	Startups & Shutdown	Yes	Yes	NA	Yes	Yes
NO_x Emission Limits	NG - non atmospheric	30 ppm limit for subject sources	9 ppm	NA	9 ppm or 0.011 lb/MMBTU	30 ppm
	NG - atmospheric	30 ppm limit for subject sources	12 ppm	NA	12 ppm or 0.014 lb/MMBTU	---
	FG - non atmospheric	---	9 ppm	NA	9 ppm or 0.011 lb/MMBTU	---
	FG - atmospheric	---	12 ppm	NA	12 ppm or 0.014 lb/MMBTU	---
	Oilfield Steam Generator	15 ppm	---	NA	---	---
	Landfill Gas	---	25 ppm	NA	---	30 ppm
	Digester Gas	---	15 ppm	NA	---	30 ppm
	LPG/Propane	---	20 ppm	NA	---	30 ppm
Testing	Source Test	None	Natural Gas: none All others: none	NA	When installed or modified, if not certified	Annual
	Tune-up	Low-Use: Annual	Natural Gas: Semiannual All others: none	NA	Semiannual	Low-use: Annual
	NO_x Analyzer	Annual	During Tune-ups	NA	May be performed in lieu of tune-up	May be performed in lieu of source test
Recordkeeping	Record Duration	5 years	5 years	NA	5 years	2 years

Table 6. Comparison of Rule 441 to Nearby Air District (≥ 5 MMBTU/Hr)

Air District and Rule Number		MBARD Rule 441 (Proposed)	Santa Barbara APCD Rule 342 (2019)	San Luis Obispo APCD Rule 430 (2014)	San Joaquin Valley APCD Rule 4320 (2008)	Bay Area AQMD Regulation 9 Rule 7 (2011)
Section	**Rule Component**					
Applicability	MMBtu/hr	5+	5+	5+	5+	5+
Exemptions	Curtailment	Yes - 200 hours	Yes - 168 hours	Yes	Yes - 168 hours	---
	Low-Fuel Usage	Yes - 90,000 therms/yr	Yes - 90,000 therms/yr	Yes - 90,000 therms/yr	---	Yes - 90,000 therms/yr
	Startups & Shutdown	Yes	Yes	Yes	Yes	Yes
NO_x Emission Limits	Gaseous (NG/FG/LPG): 5-20 MMBtu/hr	15 ppm limit for subject sources	9 ppm	30 ppm	9 ppm	15 ppm
	Gaseous (NG/FG/LPG): 20+ MMBtu/hr	9 ppm limit for subject sources	7 ppm	30 ppm	7 ppm	20 +, load-following unit: 15 ppm 20-75 MMBtu/hr: 9 ppm 75+ MMBtu/hr: 5 ppm
	Oilfield Steam Generator	15 ppm	---	---	15 ppm	---
	Landfill Gas	---	25 ppm	30 ppm	---	30 ppm
	Digester Gas	---	15 ppm	30 ppm	9 ppm	30 ppm
	Nongaseous	---	40 ppm	40 ppm	40 ppm	40 ppm
Testing	Source Test	≥20 MMBTU/hr: Annual Oilfield Steam Generator: Annual	Every 2 years	When installed or modified	Every 1-3 years	Gaseous/Landfill/Digester: Every calendar year Non-gaseous: Within 60-days
	Tune-up	Low-use: Annual	Low-use: Annual	Low-use: Annual	Semiannual	Low-use: Annual
	NO_x Analyzer	---	---	---	Monthly operating parameter check	---
Recordkeeping	Record Duration	5 years	5 years	3 years	5 years	2 years

4. Cost Implications

Pursuant to CH&SC Section §40920.6, prior to adopting rules or regulations to meet the requirement for best available retrofit control technology, MBARD shall review the information developed to assess the cost-effectiveness of the potential control options. "Cost-effectiveness" means the cost, in dollars, of the potential control option divided by emission reduction potential, in tons, of the potential control option. In addition, MBARD shall calculate the incremental cost-effectiveness for the potential control options. To determine the incremental cost-effectiveness under this paragraph, MBARD shall calculate the difference in the dollar costs divided by the difference in the emission reduction potentials between each progressively more stringent potential control option as compared to the next less expensive control option.

Emission Impacts

To identify the emission impacts of the rule, MBARD first needed to identify the applicable units that may get emission reductions under the proposed rule. The emission reductions come from natural gas fired boilers, process heaters, and oilfield steam generators. Accordingly, staff queried MBARD's permit database to evaluate how many existing units already comply with the proposed NO_x limits and how many units may need to meet the NO_x limits of Rule 441. The results of MBARD's permit database query are shown in Table 7 below.

Table 7. Number of Units Subject to Rule 441

MMBTU/hr Range	# Low NOx Units	#Higher Emitting Units	Total Units
2 - 5	0	1	1
5 - 20	0	15	15
20+	24	24	48
		Total Units	64

The emissions reductions will be based upon the permitted emissions levels, however, staff understands that in practice, the units do not operate at full capacity. Thus, to quantify the emission reductions from the higher-emitting units an operating capacity factor of 75%, 50%, and 25% were chosen as a conservative estimate to quantify the emission reductions from the higher-emitting units. Using these assumptions, the estimated emissions reductions for each size range are shown in Table 8 below.

Table 8. Estimated Emission Reductions from Rule 441

MMBTU/hr Range	#Higher Emitting Units	Emission Reduction (ton/yr)	Emission Reduction of 75% Operation (ton/yr)	Emission Reduction of 50% Operation (ton/yr)	Emission Reduction of 25% Operation (ton/yr)
2 - 5	1	0.73	0.55	0.37	0.18
5 - 20	15	32.7	24.55	16.4	8.19
20+	24	1,356.41	1,017.33	6,78.24	339.15
Total Reductions:		1,390	1,043	695	348

The anticipated emission reductions from the proposed rule, excluding units qualifying for the low-use exemption, is calculated to be approximately 348 to 1,390 tons of NO_x per year depending on the operating capacity factor of these units. The NO_x emission reductions from the proposed rule will occur gradually as units are retrofitted or replaced with newer, low NO_x units. Overall, it is reasonable to assume that over the course of implementation of Rule 441, all units subject to the rule will be replaced in a linear fashion.

Cost Effectiveness

The proposed rule will require units subject to Rule 441 to meet the NO_x and CO limits of Section 3.1 of Rule 441. The cost impact was analyzed for:

1. Cost of retrofitting or replacing the existing unit;

2. Cost of differential of installing new compliant units;

3. Cost for fuel meter and equipment tuning, and

4. Authority to Construct and Permit to Operate modification fee.

The following assumptions and formulas were used for calculating the absolute cost effectiveness of lowering the NO_x emission limits.

1. Annualized Compliance Cost (ACC)

$$ACC = Cost \times Capital\ recovery\ Factor\ (CRF)$$

2. $CRF = \frac{i(1+i)^n}{(1+i)^n-1} = \frac{0.04(1+0.04)^{10}}{(1+0.04)^{10}-1} = 0.123$

Where: i = interest rate (4%)
n = equipment life (assume 10 years for low-NO_x/ultra low-NO_x burners, assume 20 years for SNCR, and assume 25 years for SCR)

Tables 9 & 10 below present the details for the cost of installing Ultra Low NOx Burners (ULNB) on current oilfield steam generators units to achieve the 15 ppmv NO_x emission level. The detailed analyses include the estimated costs for installed capital equipment, electricity, fuel, and operations and maintenance based upon data from other air district's staff reports.[1,2] MBARD evaluated the emissions reduced from these units at different operating capacity factors. Oilfield steam generators typically operate at around 75% capacity.[3] For conservative measures, MBARD also evaluated these units at 50% capacity. Both analyses found that installing ULNB for units rated between 25 and 62.5 to be cost effective.

The cost values presented in Tables 9 & 10 were evaluated based upon the cost data provided by the vendor at the time of this staff report, which includes only the cost of the new retrofit. MBARD expects to receive a detailed analysis that includes the costs for installation, electricity, fuel, and operations and maintenance. Once MBARD receives the information, Tables 9 & 10 will be updated accordingly. However, this additional data is not expected to change the overall conclusion that ULNB is cost effective.

Table 9. ULNB Cost Effectiveness Calculation for Units At 75% Capacity Factor (Retrofit to 15 ppmv NO_x at 3% O_2)

MMBTU/hr Range	Capital Cost	Installation Cost	Annualized Capital Cost	Incremental Operation	Annualized Cost	NO_x Reduced	Cost Effectiveness
25[a]	$145,000	$60,175	$25,296	$5,000	$30,296	9.41	$3,220
30[a]	$145,000	$60,175	$25,296	$6,000	$31,296	1.79	$17,484
60[a]	$155,000	$64,325	$27,041	$12,000	$39,041	70.32	$555
62.5[a]	$155,000	$64,325	$27,041	$14,500	$41,541	40.72	$1,020
62.5[b]	$2,160,000	$896,400	$376,826	$14,500	$391,326	30.46	$12,847

a. Units fired on PUC quality gas.

b. Units fired on non-PUC quality gas.

Table 10. ULNB Cost Effectiveness Calculation for Units At 50% Capacity Factor (Retrofit to 15 ppmv NO_x at 3% O_2)

MMBTU/hr Range	Capital Cost	Installation Cost	Annualized Capital Cost	Incremental Operation	Annualized Cost	NO_x Reduced	Cost Effectiveness
25[a]	$145,000	$60,175	$25,296	$5,000	$30,296	6.28	$4,824
30[a]	$145,000	$60,175	$25,296	$6,000	$31,296	1.2	$26,080
60[a]	$155,000	$64,325	$27,041	$12,000	$39,041	46.8	$834
62.5[a]	$155,000	$64,325	$27,041	$14,500	$41,541	27.14	$1,531
62.5[b]	$2,160,000	$896,400	$376,826	$14,500	$391,326	24.87	$15,735

a. Units fired on PUC quality gas.

b. Units fired on non-PUC quality gas.

[1] San Joaquin Valley Unified Air Pollution Control District, Appendix C, Cost Effectiveness Analysis For Proposed Amendments To Rule 4306 and Rule 4307 and Proposed New Rule 4320 (August 21, 2008).

[2] Santa Barbara Air County Air Pollution Control District Staff Report for Rule 361 and 342 (May 13, 2019).

[3] San Joaquin Valley Unified Air Pollution Control District, Appendix C, Cost Effectiveness Analysis For Proposed Amendments To Rule 4306 and Rule 4307 and Proposed New Rule 4320 (August 21, 2008).

Tables 11, 12, & 13 below present the details for the cost of installing ULNB on current boilers, heater treaters, and process heaters to reach the 15 ppmv NO_x emission level. The detailed analyses include the estimated costs for installed capital equipment, electricity, fuel, and operations and maintenance based upon data from other Air District's staff report. MBARD evaluated the emissions reduced from these units at three different operating capacity factor 75%, 50%, and 25%. All analyses determine that installing ULNB for units rated between 2.7 and 8.4 to be cost effective.

The cost values presented in Tables 11, 12, & 13 were evaluated based upon the cost data provided by the vendor at the time of this staff report, which includes only the cost of the new retrofit. MBARD expects to receive a detailed analysis that includes the costs for installation, electricity, fuel, and operations and maintenance. Once MBARD receives the information, Tables 11, 12 & 13 will be updated accordingly. However, this additional data is not expected to change the overall conclusion that ULNB is cost effective.

Table 11. ULNB Cost Effectiveness Calculation for Units At 75% Capacity Factor (Retrofit to 15 ppmv NO_x at 3% O_2)

MMBTU/hr Range	Capital Cost	Installation Cost	Annualized Capital Cost	Incremental Operation	Annualized Cost	NO_x Reduced	Cost Effectiveness
2.7	$30,000	$12,450	$5,234	$540	$5,773	0.55	$10,497
4.8	$60,000	$24,900	$10,467	$960	$11,427	1.26	$9,069
6	$60,000	$24,900	$10,467	$1,200	$11,667	1.58	$7,384
7	$60,000	$24,900	$10,467	$1,400	$11,867	1.84	$6,449
8.4	$60,000	$24,900	$10,467	$1,680	$12,147	2.21	$5,496

Table 12. ULNB Cost Effectiveness Calculation for Units At 50% Capacity Factor (Retrofit to 15 ppmv NO_x at 3% O_2)

MMBTU/hr Range	Capital Cost	Installation Cost	Annualized Capital Cost	Incremental Operation	Annualized Cost	NO_x Reduced	Cost Effectiveness
2.7	$30,000	$6,000	$4,438	$540	$4,978	0.37	$13,455
4.8	$60,000	$12,000	$8,876	$960	$9,836	0.84	$11,710
6	$60,000	$12,000	$8,876	$1,200	$10,076	1.05	$9,597
7	$60,000	$12,000	$8,876	$1,400	$10,276	1.23	$8,355
8.4	$60,000	$12,000	$8,876	$1,680	$10,556	1.47	$7,181

Table 13. ULNB Cost Effectiveness Calculation for Units At 25% Capacity Factor (Retrofit to 15 ppmv NO_x at 3% O_2)

MMBTU/hr Range	Capital Cost	Installation Cost	Annualized Capital Cost	Incremental Operation	Annualized Cost	NO_x Reduced	Cost Effectiveness
2.7	$30,000	$6,000	$4,438	$540	$4,978	0.18	27,658
4.8	$60,000	$12,000	$8,876	$960	$9,836	0.42	$23,421
6	$60,000	$12,000	$8,876	$1,200	$10,076	0.53	$19,013
7	$60,000	$12,000	$8,876	$1,400	$10,276	0.61	$16,847
8.4	$60,000	$12,000	$8,876	$1,680	$10,556	0.74	$14,266

Incremental Cost Effectiveness

CH&SC 40920.6 require an assessment of the incremental cost-effectiveness for proposed regulations relative to ozone, carbon monoxide (CO), oxides of sulfur (SO_x), oxides of nitrogen (NO_x), and their precursors. Incremental cost-effectiveness is defined as the difference in control costs divided by the difference in emission reductions between two potential control options that can achieve the same emission reduction goal of a regulation. The incremental cost-effectiveness is the difference in cost between two successively more effective controls, divided by the additional emission reductions achieved. The equation is shown below:

$$\frac{IC}{E}\left(\frac{\$}{ton}\right) = (\frac{CC_{option2} - CC_{option1}}{ER_{option2} - ER_{option1}}$$

Where: IC = Incremental Cost ($)
E -= Emission reduction (tons)
$CC_{option2}$ = Control costs for option 2 ($/yr)
$CC_{option1}$ = Control costs for option 1 ($/yr)
$ER_{option2}$ = Emission reductions for option 2 (tons)
$ER_{option1}$ = Emission reductions for option 1 (tons)

MBARD reviewed the incremental cost-effectiveness between adding low NO_x burners to comply with the proposed 15 ppmvd @ 3% O_2 NO_x standard and adding selective catalytic reduction (SCR) to achieve 5 ppmvd @ 3% O_2 NO_x standard. The use of SCR involves injecting aqueous ammonia into the exhaust stream, in which the ammonia reacts with the flue gas over a catalyst to reduce the NO_x in nitrogen gas, water vapor, and carbon dioxide. Installation and maintenance cost of SCR systems are quite expensive, with preliminary cost estimates exceeding $50,000/ton of NO_x reduced.[4] Thus, when comparing alternative technologies available for achieving NO_x reductions for boilers, process heaters, and steam generators, the most cost-effective means to meet the emission limit is installing low NO_x burners.

Fiscal Impact Upon Industrial Sources

The proposed rule would require the four applicable industrial sources to incur costs to retrofit or replace equipment to meet the NOx emission limits.

[4] Santa Barbara Air County Air Pollution Control District Staff Report for Rule 361 and 342 (May 13, 2019).

Fiscal Impact Upon District

Adopting the new Rule 441 would be consistent with the proposed budget for fiscal year 2019-2020 which includes revenue from an AB 617 grant received from CARB to implement the BARCT schedule. Therefore, staff does not anticipate any fiscal impact upon MBARD.

Socioeconomic Effects

CH&SC 40728.5(a) requires MBARD, in the process of the adoption of any rule or regulation, consider the socioeconomic impact if air quality or emissions limits may be significantly affected. However, pursuant to Section 40728.5(e), upon approval by a majority vote of MBARD board, a county district is not required to include the analyses specified in paragraphs (2) and (4) of subdivision (b) in any assessment of socioeconomic impact for any rule or regulation that only adopts a requirement that is required by, a state or federal statute, regulation, or applicable formal guidance document. On October 15, 2018, MBARD's Board of Director approved the rule development for boilers, steam generators, and heaters to comply with the requirements set forth in CH&SC Division 26, Part 3, Chapter 10, Section 40920.6. Therefore, only the information specified in paragraphs (1), (5), and (6) of subdivision (b) of CH&SC Section 40728.5 will be included in the socioeconomic analysis for this rulemaking.

1. The type of industries or business, including small business, affected by the rule or regulation will be sources subject to the California GHG Cap-and-Trade requirements as of January 1, 2017. In the MBARD jurisdiction, these industries are oil and gas facilities and a lime kiln processing facility.

2. The emission reduction potential of the rule is estimated to be about 352 to 1,392 tons per year of NO_x.

3. MBARD is currently designated as nonattainment for the state 8-hour ozone standard and 24-hour particulate matter less than 10 microns (PM_{10}) standard. The adoption of Rule 441 is necessary to comply with the requirements set forth in AB 617 as described in CH&SC 40920.6(c). This section requires MBARD to implement a Best Available Retrofit Control Technology (BARCT) schedule which includes addressing NO_x emissions from boilers, steamer generators, and process heaters. BARCT is an emission limitation that is based on maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of sources. NO_x emissions are considered ozone precursors, and the purpose of Rule 441 is to reduce emissions of NO_x from boilers, steam generators, and process heaters. Therefore, the adoption of Rule 441 is necessary to help achieve the attainment for the state 8-hour ozone standard.

5. Regulatory Findings

CH&SC Section 40727(a) requires that prior to adopting or amending a rule or regulation, an air district's Board make findings of necessity, authority, clarity, consistency, non-duplication, and reference. The findings must be based on the following:

1. Information presented in the written analysis, prepared pursuant to CH&SC 40727.2;

2. Information contained in the rulemaking records pursuant to 40728; and

3. Relevant information presented at the Board's hearing for adoption of the rule.

The required findings are:

Necessity: It is necessary for MBARD to adopt this rule in order to comply with our obligations pursuant to CH&SC Section 40920.6(c). The additional NO_x emissions reduced through the rule requirements will help MBARD in our effort to attain the state 8-hour ozone standard.

Authority: MBARD is authorized to adopt rules and regulations by CH&SC Sections 40001, 40702, 40716.

Clarity: The proposed rule is written so that the meaning can be easily understood by the industrial sources directly affected by the rule. In addition, the record contains no evidence that the industrial sources directly affected by the rule cannot understand the rule.

Consistency: The proposed rule does not conflict with and is not contradictory to existing statutes, court decisions, or state or federal regulations. As stated above, MBARD wrote the rule to be consistent with similar rules in other air districts.

Non-Duplication: The proposed rule does not duplicate any state laws or regulations regarding attainment and maintenance of state and federal air quality standards.

Reference: The District must refer to any statute, court decision, or other provision of law that MBARD implements, interprets, or makes specific by adopting, amending, or repealing the rule.

6. References

1. Bay Area Air Quality Management District – Regulation 9 Rule 7 (Nitrogen Oxides and Carbon Monoxide From Industrial, Institutional, and Commercial Boilers, Steam Generators and Process Heaters, Amended on May 4, 2011.
2. Santa Barbara Air Pollution Control District – Rule 361 (Boiler, Steam Generators, and Process Heaters – 2 to 5 MMBTU/hr), Amended on June 20, 2019.
3. Santa Barbara Air Pollution Control District – Rule 342 (Boiler, Steam Generators, and Process Heaters – 5 MMBTU/hr and greater), Amended June 20, 2019.
4. Santa Barba Air Pollution Control District – Staff Report Rule 361 and Rule 342, Published on May 13, 2019.
5. San Joaquin Valley Unified Air Pollution Control District – Rule 4307 (Boilers, Steam Generators, and Process Heaters – 2.0 MMBTU.hr to 5.0 MMBTU/hr), Amended October 16, 2008.
6. San Joaquin Valley Unified Air Pollution Control District – Rule 4320 (Boilers, Steam Generators, and Process Heaters – 2.0 MMBTU.hr to 5.0 MMBTU/hr), Amended October 16, 2008.

7. San Joaquin Valley Unified Air Pollution Control District, Appendix C, Cost Effectiveness Analysis For Proposed Amendments To Rule 4306 and Rule 4307 and Proposed New Rule 4320, Published on August 21, 2008.
8. San Luis Obispo County Air Pollution Control District – Rule 430 (Control of Oxides of Nitrogen From Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters), Amended on November 12, 2014.
9. Yolo-Solano Air Quality Management District – Staff Report for Rule 2.27, Large Boilers, Published on May 7, 2019.
10. Yolo-Solano Air Quality Management District – Staff Report for Rule 2.45, Boilers, Published on May 7, 2019.

7. Attachments

7.1 Attachment A: Rule 441

ATTACHMENT A

MONTEREY BAY AIR RESOURCES DISTRICT
REGULATION IV
PROHIBITIONS

RULE 441. BOILERS, STEAM GENERATORS, AND PROCESS HEATERS

(Proposed X-XX-20.)

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PART 1 GENERAL

1.1 Purpose

To reduce emissions of oxides of nitrogen (NO_x) from boilers, steam generators, and process heaters at subject industrial sources per Health and Safety Code §40920.6 (c)(2).

1.2 Applicability

This rule applies to AB 617 industrial sources that have boilers, steam generators, and process heaters with rated heat input greater than or equal to 2 million British Thermal Units (BTU) per hour.

1.3 Exemptions

The requirements of this Rule shall not apply to the following:

1.3.1 Any unit that is exclusively used by an electric utility to generate electricity.

1.3.2 Waste heat recovery boilers.

1.3.3 Afterburners, vapor incinerators, or thermal or catalytic oxidizers used as an emission control device.

1.3.4 Kilns, ovens, open heated tanks, dehydrators, dryers, crematories, calciners, cookers, roasters, furnaces, or smelters.

1.3.5 Solid fuel fired units.

The requirements of Section 3.1 of this Rule shall not apply to the following:

1.3.6 Any unit when under curtailment conditions, provided that the curtailment fuels are not burned for more than 200 cumulative hours in a calendar year, including testing and maintenance.

1.3.7 Any unit that uses less than 90,000 therms per year of fuel provided that the owner or operator complies with one of the requirements listed in Section 3.2, the requirements of Section 3.3.2, and the Compliance Schedule of Section 4.4.2. If the fuel usage for any unit claiming this exemption exceeds or equals 90,000 therms in any calendar year, then unit must be operated in compliance with the applicable NOx emission limits in Section 3.1. within the timeline defined by Section 4.3.3

1.3.8 Any non-operational unit, as defined in Section 2.11, provided that the owner or operator complies with the Compliance Schedule of Section 4.4.3.

1.3.9 Any unit, that provides emission reduction credits per Rule 215 in lieu of meeting the emission standards in Section 3.1, provided that the owner or operator complies with the Compliance Schedule of Section 4.4.

1.4 Effective Date

This Rule, as most recently revised, is effective on Month XX, 2020.

PART 2 DEFINITIONS

For the purpose of this Rule, the definitions below shall apply.

2.1 AB 617 Industrial Source

Means any source located at a facility that, as of January 1, 2017, was subject to a market-based compliance mechanism adopted by the state board pursuant to Health and Safety Code §38562(c).

2.2 Annual Heat Input

Means the total heat input of fuels burned by a unit in a calendar year, as determined from the higher heating value and cumulative annual usage of each fuel.

2.3 Best Available Retrofit Control Technology (BARCT)

Best available retrofit control technology as defined in Health and Safety Code §40406 is "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." These limits are specified in Table 1 of this Rule.

2.4 Boiler or Steam Generator

Any external combustion equipment fired with any fuel used to produce hot water or steam, excluding waste heat recovery boilers.

2.5 British Thermal Unit (BTU)

The amount of heat required to raise the temperature of one pound of water from 59˚F to 60˚F at one atmosphere.

2.6 Curtailment Conditions

Periods in which a unit that normally burns Public Utilities Commission (PUC) quality natural gas instead burns a nongaseous fuel only during emergency interruption of natural gas delivery by the serving utility.

2.7 Dryer

Any unit where the material being dried comes into direct contact with the product of combustion.

2.8 Gaseous Fuel

Any fuel which is a gas at standard conditions.

2.9 Heat Input

The chemical heat released due to fuel combustion in a combustion unit, using the higher

heating value of the fuel. This does not include the sensible heat of incoming combustion air.

2.10 Higher Heating Value (HHV)

The total heat liberated per mass of fuel burned (BTU per pound), when fuel and dry air at standard conditions undergo complete combustion and all resultant products are brought to their standard states at standard conditions. HHV shall be determined by one of the following test methods:

208.1 ASTM D 2015 for solids fuel; or

208.2 ASTM D 240 or ASTM D 2382 for liquid hydrocarbon fuels; or

208.3 ASTM D 1826 or ASTM D 1945 in conjunction with ASTM D 3588 for gaseous fuels.

2.11 Non-Operational Unit

Any unit not in operation during calendar year 2019, provided that the unit is physically located at the affected AB 617 Industrial Source.

2.12 NO_x Emissions (NO_x)

The sum of nitric oxide and nitrogen dioxide in the flue gas

2.13 Nongaseous Fuel

Any fuel which is not a gas at standard conditions.

2.14 Oilfield Steam Generator

An external combustion equipment which converts water to dry steam or to a mixture of water vapor and steam, with an absolute pressure of more than 30 psia, and which is used exclusively in thermally enhanced crude oil production.

2.15 Parts Per Million By Volume (ppmv)

The ratio of the number of gas molecules of a given species, or group of species, to the number of millions of total gas molecules.

2.16 Process Heater

Any combustion equipment fired with any fuel, and which transfers heat from combustion gases to water or process streams. For the purpose of this rule applicability, process heater does not include any of the following combustion sources:

a. Kilns, ovens, open heated tanks, dehydrators, dryers, crematories, incinerators, calciners, cookers, roasters, furnaces, or smelters.

b. Afterburners, vapor incinerators, or thermal or catalytic oxidizers used as an emission control device.

2.17 Public Utilities Commission (PUC) Quality Natural Gas

Any gaseous fuel, gas-containing fuel where the sulfur content is no more than one-fourth (0.25) grain of hydrogen sulfide per one hundred (100) standard cubic feet and no more than five (5) grain of total sulfur per one hundred (100) standard cubic feet. PUC quality natural gas also means high methane gas (at least 80% methane by volume) as specified in the most current PUC General Order for Gas Service in California.

2.18 Rated Heat Input Capacity

The heat input capacity, in million BTU per hour, specified on the nameplate of the combustion unit. If the combustion unit has been altered or modified such that its combined maximum heat input is different than the heat input capacity specified on the nameplate, the combined maximum heat input shall be considered as the rated heat input.

2.19 Solid Fuel

Any fuel which is a solid at standard conditions.

2.20 Standard Conditions

For the purpose of this rule, standard conditions are 68˚F and one atmosphere.

2.21 Therm

One hundred thousand (100,000) BTUs.

2.22 Unit

Any boiler, steam generator, or process heater as defined in Section 2.3, 2.13 and 2.15.

2.23 Waste Heat Recovery Boiler

A device that recovers normally unused energy and converts it to usable heat. Waste heat recovery boilers incorporating duct or supplemental burners that are designed to supply 50 percent or more of the total rated heat input capacity of the waste heat recovery boiler are not considered waste heat recovery boilers, but are considered boilers. Waste heat recovery boilers are also referred to as heat recovery steam generators.

PART 3 STANDARDS

All ppmv emission limits specified in Part 3 shall be measured as ppmv on a dry basis, as determined pursuant to Section 4.5.2, and corrected to three percent oxygen. Any unit subject to this Rule shall be subject to the following NO_x and CO requirements:

3.1 BARCT Emission Limits

NO_x and CO emissions shall not exceed the following levels:

Table 1. Emission Limits for AB 617 Industrial Units

Source Category	Total Unit Rated Heat Input/Description (MMBTU/hr)	Fuel	NO_x Limit (ppmv @ 3% O_2)	CO Limit (ppmv @ 3% O_2)
Boilers & Process Heaters	≥ 2 to < 5	Gaseous	30	400
	≥ 5 to < 20		15	400
	≥ 20		9	400
Oilfield Steam Generators	≥ 2	Gaseous	15	400

3.2 Low Fuel Usage

Any unit exempted pursuant to Section 1.3.7 shall meet one of the following conditions:

3.2.1 The unit shall be operated in a manner that maintains stack-gas oxygen concentration at less than or equal to 3.00% by volume on a dry basis; or

3.2.2 The unit shall be tuned at least once per year by a qualified technician. If the unit did not operate for the entire calendar year, the tune-up must be conducted within 30 days of startup. The tune-up shall be performed in accordance with manufacturer's recommendations or EPA 40 CFR 63, Subpart JJJJJJ guidance.

3.3 Monitoring Equipment

3.3.1 Owners or operators of units exempt from the emission requirements pursuant to Section 1.3.6 because of curtailment conditions shall install and maintain a non-totalizing hour meter on each unit, or shall install a computerized tracking system that maintains a continuous daily record of hours of operation.

3.3.2 Owner or operators of units exempt from the emission requirements pursuant to Section 1.3.7 because of low fuel usage shall install and maintain a dedicated non-resetting totalizing fuel meter in each fuel line. If a volumetric flow rate meter is install, it must compensate for temperature and pressure using integral gauges.

3.4 Performance Testing

Any unit subject to Section 3.1 shall perform testing to demonstrate compliance with the emission limitation in accordance with the following frequency:

Table 2. Performance Testing

Section	Source Category	Total Unit Rated Heat Input/Description (MMBTU/hr)	Testing Method & Frequency
3.4.1	Boiler & Process Heaters	≥ 2 to < 5	Portable analyzer test at least once every calendar year
3.4.2		≥ 5 to < 20	

Section	Source Category	Total Unit Rated Heat Input/Description (MMBTU/hr)	Testing Method & Frequency
3.4.3	Boiler & Process Heaters	≥ 20	Source test at least once every calendar year
3.4.4	Oilfield Steam Generator	≥ 2	Source test at least once every calendar year

PART 4 ADMINISTRATIVE REQUIREMENTS

4.1 Reporting Tune-Up Verification

The owner or operator of units subject to the requirements in Section 3.2.2 of this Rule shall submit to the Air Pollution Control Officer a tune-up verification report or a verification of inactivity not less than once every calendar year for each unit.

4.2 Source Testing Protocol

4.2.1 **Source Tests:** The owner or operators of units subject to Section 3.4.3 and 3.4.4 in Table 2 of this Rule shall submit a written testing protocol to the District for approval no later than 30 days prior to the test event, and District notification at least 10 days prior to the actual date of testing shall be provided so that a District observer can be present. The owner or operator shall furnish the District written results of such performance tests within 60 days of the source test date.

4.2.2 **Portable Analyzer:** Emission readings using a portable analyzer pursuant to Section 3.4.1 through 3.4.2 in Table 2 of this Rule shall be averaged over a 15 consecutive-minute period by either taking a cumulative 15-consecutive-minute sample reading or by taking at least five (5) readings evenly spaced over the 15-consecutive-minute period. If the results of the portable analyzer show that the NO_x emissions from the unit exceed the allowable limits in Table 1 of this Rule, then the unit will be required to be source tested no later than 60 days from the date of discovering such exceedance.

4.3 Loss of Exemption

Any owner or operator of any existing unit that qualified for the Section 1.3.7 low fuel usage exemption where the fuel usage exceeds 90,000 therms at any time within a

calendar year shall comply with the following.

4.3.1 Within 30 days of the exceedance notify the District in writing of the unit's loss of exemption.

4.3.2 Within 90 days submit an Authority to Construct permit application to comply with Section 3.1 of this Rule.

4.3.3 Within 12 months after the end of calendar year during which the unit exceeded the low fuel usage exemption level, conduct an initial performance test and demonstrate compliance with Section 3.1 of this Rule. The unit will subsequently not qualify for exemption pursuant to Section 1.3.7

4.4 Compliance Schedule

4.4.1 An owner or operator of any unit subject to Table 1 of this Rule shall fulfill the following requirements:

4.4.1.1 By December 31, 2020, submit a written plan containing a description of the method the owner or operator will use to comply with the emission limits listed in Table 1 of this Rule.

4.4.1.2 By December 31, 2021, submit an application for Authority to Construct for any modification required to achieve compliance with the requirements of Table 1 of this Rule, or submit an application to surrender emission reduction credits.

4.4.1.3 By December 31, 2023, all owners or operators subject to this Rule shall demonstrate final compliance with all applicable standards and requirements of this Rule.

4.4.2 Any owner or operator of any unit claiming the low usage exemption of Section 1.3.5 shall fulfill the following requirements:

4.4.2.1 By July 1, 2020, submit an application for Authority to Construct for any existing unit for which the low usage exemption pursuant to Section 1.3.5 will be claimed.

4.4.2.2 If the unit loses its exemption, the owner or operator must follow the requirements of Section 4.3.

4.4.3 An owner or operator of any unit claiming non-operational equipment shall fulfill the following requirements:

4.4.3.1 By July 1, 2020, submit a Permit to Operate modification application for any existing unit for which the non-operational status will be claimed. The unit will be required to meet the requirements of Table 1 of this Rule prior to the unit becoming operational.

4.5 Compliance Determination

4.5.1 All emission determinations shall be made in the as-found operating conditions, at the maximum attainable firing rate allowed by the District permit. No determination of compliance with the requirement of Section 3.1 shall be established during startup, shutdown, or under breakdown conditions.

4.5.2 All ppmv emission limits specified in Section 1.3.4 and 3.1 are referenced at dry stack-gas conditions and 3.00 percent by volume stack-gas oxygen. Emission concentrations shall be corrected to 3.00 percent oxygen as follows:

$$[ppm \ \ NO_x]_{corrected} = \frac{20.9\% - 3.0\%}{20.9\% - [\%O_2]_{measured}} * [ppm \ \ NO_x]_{measured}$$

PART 5 RECORDKEEPING REQUIREMENTS

5.1 The records required by Sections 5.1.1 through 5.1.3 shall be maintained for five (5) calendar years and shall be made available to District staff upon request.

5.1.1 The operator of any unit operated under the exemption of Section 1.3.6 shall monitor and record for each unit the cumulative annual hours of operation on each fuel other than PUC quality natural gas during periods of natural gas curtailment and equipment testing and maintenance.

5.1.2 The operator of any unit operated under the exemption of Section 1.3.7 shall record the amount of fuel use at least on a monthly basis for each unit.

5.1.3 The operator of any unit subject to Section 3.2.1 or 3.2.2 shall maintain records to verify that the required tune-up and the required monitoring of the operational characteristics of the unit have been performed.

PART 6 TEST METHODS

6.1 Compliance with NOx emission and oxygen requirements of Section 3.1 shall be determined using the following test methods:

6.1.1 Oxides of Nitrogen – ARB Method 100 or EPA Method 7E:

6.1.2 Stack Gas Oxygen – ARB Method 100 or EPA Method 3A

6.1.3 Carbon Monoxide – ARB Method 100 or EPA Method 10

6.2 Test methods other than those specified in Section 6.1 for oxides of nitrogen and stack-gas oxygen, may be used to determine compliance so long as they are functionally equivalent and approved by the Air Pollution Control Officer and EPA.

6.3 For source testing performed pursuant to Section 3.4, compliance with an applicable standard or numerical limitation of this Rule shall be determined as defined by the test methods listed on Section 6.1 of this Rule.