



Boiler NOx Emissions and Energy Efficiency

Prepared For:

Boiler NOx Webinar November 5, 2010

Prepared By:



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Review of Regulations

- Bay Area Air Quality Management District (Julian Elliot, BAAQMD)
- San Joaquin Valley Air Pollution Control District (Joy Ulickey, Enovity)

Energy Efficiency Opportunities (Justin Nagy, Enovity)

- Combining Energy Efficiency with NOx Reduction
- Example Energy Efficiency Measures

Getting Rebates Through the Boiler Efficiency Program (Keelan McClymont, Enovity)

- Eligibility
- Services Offered

Questions

June 2010

**Bay Area AQMD
Requirements for Boilers**

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Senior Air Quality Engineer

www.baaqmd.gov

Contact Information

BAAQMD website: *www.baaqmd.gov*

Rules are available at:

www.baaqmd.gov/Divisions/Planning-and-Research/Rules-and-Regulations.aspx

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BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

BAAQMD Jurisdiction



BAAQMD Boiler Regulation

- BAAQMD regulates **air emissions, not safety.**
- Requires **permits** for certain boilers (see Reg 2-1-114.1):
 - natural gas & LPG-fired: input rating ≥ 10 MM BTU/hr
 - all other fuels: input rating ≥ 1 MM BTU/hr
- Has **rules** that apply to boiler emissions and operation:
 - Reg 9, Rule 6: natural gas-fired up to 2 MM BTU/hr
 - Reg 9, Rule 7:
 - >2 MM BTU/hr for natural gas & LPG-fired
 - ≥ 1 MM BTU/hr for all other fuels

Recent BAAQMD Actions

Permit Requirements

- No change

Reg 9, Rule 6 – Natural Gas Water Heaters & Boilers (2007)

- New NO_x standards go into effect 2009 through 2013, depending on heater size and application
- Emissions limits apply **only to new heaters** (up to 2 MM BTU/hr)

Reg 9, Rule 7 – Boilers, Steam Generators, Process Heaters (2008)

- New NO_x standards go into effect 2011 and later
- New efficiency requirements go into effect 2009 through 2011
- Registration in 2011 for boilers that do not need permits
- Standards apply to **new AND existing heaters** (“retrofit rule”)

Regulation 9, Rule 7 Permits & Registration

- No new permit requirements, BUT operators who **modify or replace** a boiler to comply with Reg 9-7 must submit permit application **if** modified or replacement boiler is subject to permit requirements.
- New registration requirements for heaters that do not require permits (Effective January 1, 2011):
 - Natural gas & LPG-fired heaters rated >2 to <10 MM BTU/hr
 - One-Time Registration fees: \$425 per facility with an affected heater plus \$50 for each heater after the first one
 - Will be available on BAAQMD website in 2010:
<http://www.baaqmd.gov/Divisions/Engineering/Equipment-Registration.aspx>

BAAQMD Regulation 9, Rule 7 Exemptions to New Requirements

Device using <10% of “annual maximum heat capacity” each year are not subject to new NO_x or efficiency requirements:

- 1 to <10 MM BTU/hr (non-gas-fired) and >2 to <10 (gas-fired):
 - perform annual tune-up, operate fuel meter, keep fuel records
- 10 MM BTU/hr and higher:
 - 30 ppmv NO_x limit (in effect since 1993)
 - operate fuel meter & keep fuel records to verify exempt status
- District may approve fuel-use monitoring other than a fuel meter (see Regulation 9-7-504.1)

BAAQMD Regulation 9, Rule 7 Annual Maximum Heat Capacity Exemption

Example: Boiler with 3 million BTU/hr input rating

Less than 10% of annual maximum heat capacity =

< (3,000,000 BTU/hr) (8,760 hr/yr) (therm/100,000 BTU) (0.10)

< 26,280 therm/yr

So if this boiler used less than 26,280 therms per year of fuel, it would qualify for an exemption.

BAAQMD Regulation 9, Rule 7 Natural Gas & LPG NOx Limits

Input (MM BTU/hr)	Old NOx Limit	New NOx Limit	Effective Date (Single-Heater Facilities)
>2 to 5	None	30 ppmv	1/1/2011 (10 yrs after manufacture date if before 1/1/2011)
>5 to <10	None	15 ppmv	1/1/2012 (10 yrs after manufacture date if before 1/1/2012)
10 to <20	30 ppmv	15 ppmv	
20 to <75	30 ppmv	9 ppmv	1/1/2012 (5 yrs after manufacture date if before 1/1/2012)
75 & up	30 ppmv	5 ppmv	

BAAQMD Regulation 9, Rule 7

De-Rating is Allowed

A boiler may be physically modified to have a lower input heat rating to avoid NO_x limits and other requirements applicable to a larger boiler.

Multiple-Heater Facilities

If there are other heaters at the facility subject to the same NO_x limit as the 1st heater, then:

- at least 33% of heaters must comply on 1st effective date
- at least 66% of heaters must comply 1 year after 1st effective date
- all heaters must comply 2 years after 1st effective date

BAAQMD Regulation 9, Rule 7 Other Fuels – NO_x Limits

Fuel	NO_x Limit	Effective Date (Single-Heater Facilities)
landfill or digester gas	30 ppmv	already in effect
liquid fuel	40 ppmv*	<10 MM BTU/hr: effective 1/1/2011 ≥10 MM BTU/hr: already in effect

* 150 ppmv NO_x limit applies to liquid fuel use during natural gas curtailment or testing of backup liquid fuel for limited periods – see Regulation 9-7-113.1.

BAAQMD Regulation 9, Rule 7 Load-Following Device NO_x Limits

Load-following device, 20 MM BTU/hr and higher:

- 15 ppmv NO_x limit.
- Operator must apply for a permit modification, as described in Regulation 9-7-408, to qualify for this relaxed NO_x limit.

BAAQMD Regulation 9, Rule 7 Energy Efficiency Measures

Note: Heaters using <10% of “annual max heat capacity” are exempt

Insulation Requirement (Effective 1/1/2010):

- Exposed surfaces limited to 120°F
- Applies only to boilers and steam generators (not process heaters)
- Other exemptions in Regulation 9-7-311.1 through 311.5

Stack Gas Temperature Limits (Effective 1/1/2011):

- Limits stack gas temperature limits to ensure reasonable heat transfer to heated material (see table in Regulation 9-7-312)
- Applies only to boilers and steam generators (not process heaters)

BAAQMD Regulation 9, Rule 7

Energy Efficiency Measures

Note: Heaters using <10% of “annual max heat capacity” are exempt

- **Annual Tune-Up**

- Effective 1/1/2009 (1st tune-up must occur in 2009)

- **Elements of Tune-Up:**

- Compliance verification for insulation

- Compliance verification for stack gas temperature

- Minimization of Excess Air

- Optimization of Liquid Blowdown

- See BAAQMD Manual of Procedures, Volume 1, Chapter 5

BAAQMD Regulation 9, Rule 7

Initial Demonstration of Compliance

Devices rated 10 to <20 MM BTU/hr:

- Must be tested within 1 year of new NO_x standard effectiveness
- May be tested with approved hand-held analyzer (see rule Attachment 1 for analyzer requirements)

Devices rated 20 MM BTU/hr and higher:

- Must be tested within 1 year of new NO_x standard effectiveness
- Test must be a standard District source test

BAAQMD Regulation 9, Rule 7

Periodic Monitoring

Note: Periodic testing may be performed with a hand-held analyzer

Device Size (MM BTU/hr)	Testing Interval
10 to <20 (gas-fired)	Every 2 years
20 and higher (gas-fired)	Every year
1 and higher (non-gas-fuel)	Every year that non-gas-fuel is used, except for testing purposes

Questions?



San Joaquin Valley Boiler Emissions Overview

Prepared For:

Boiler NOx Webinar
November 5, 2010

Prepared By:



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Introduction

- SJV APCD Territory
- NOx Emission Limit Overview

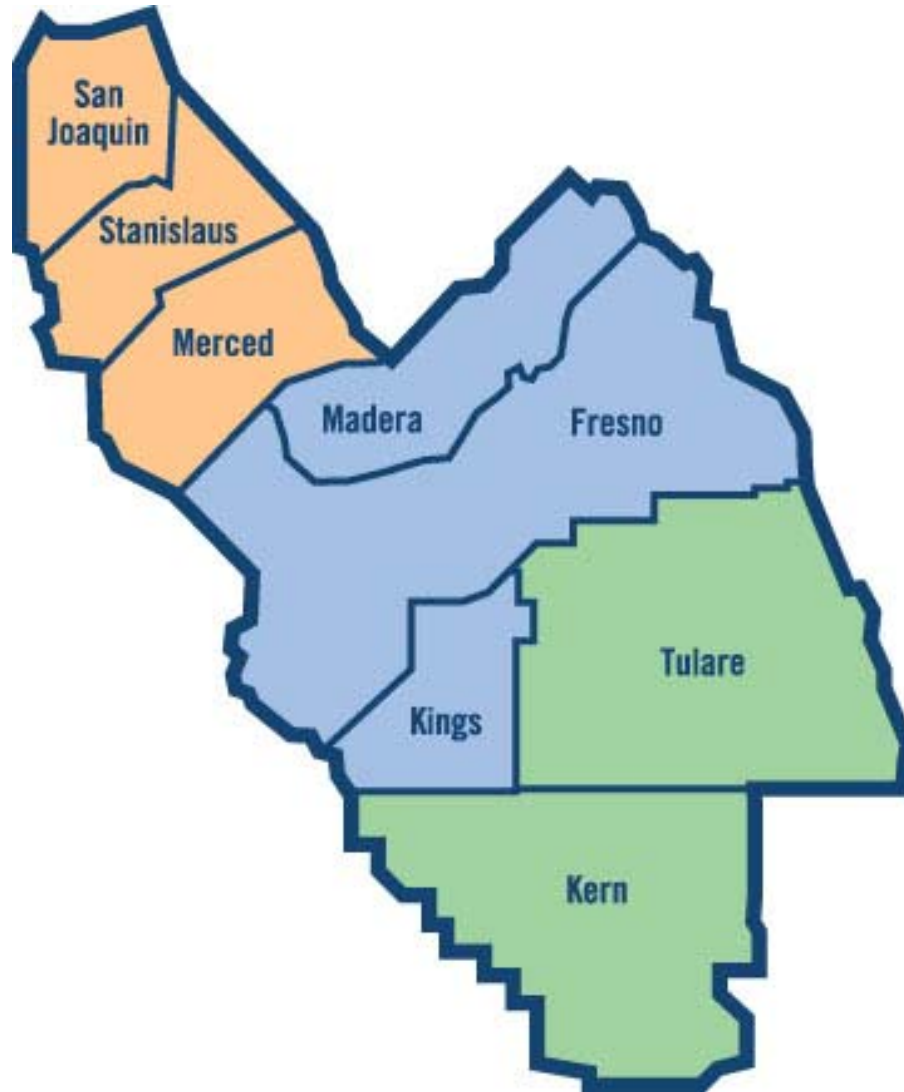
Rule 4307

- Affected Devices
- Limits and Deadlines

Rule 4320

- Affected Devices
- Limits and Deadlines
- Fee Option

SAN JOAQUIN VALLEY APCD



Rule 4307*

- Was amended October 16, 2008
- Affects boilers between 2.0 and 5.0 MMBtu/hr
- Requires existing units to meet 30 ppm NO_x
- Requires units installed after January 1, 2010 to meet:
 - *12 ppm if atmospheric*
 - *9 ppm if non-atmospheric*

*See actual regulation for more information and specific compliance requirements.

Rule 4320*

- Was adopted October 16, 2008
- Replaces Rule 4306
- Affects boilers larger than 5.0 MMBtu/hr
- Has compliance dates ranging from 2010 to 2014
- Offers three compliance options
 - *Standard schedule*
 - *Enhanced schedule*
 - *Annual emissions fee (starting January 2010)*
- Requires operators to submit Emissions Control Plan by January 1, 2010

*See actual regulation for more information and specific compliance requirements.

COMPLIANCE SUMMARY

Rated Input (MMBtu/hr)	Rated Output (HP)	NOx Limit (@ 3% O ₂)	Compliance Option / Schedule	Compliance Date
> 2 to 5	> 60 to 150	30 ppmv	Existing Units	July 1, 2009
		12 ppmv	New Atmospheric Units	January 1, 2010
		9 ppmv	New Non-Atmospheric Units	January 1, 2010
> 5 to 20	> 150 to 600	9 ppmv	A. Standard Schedule	July 1, 2012
		6 ppmv	B. Enhanced Schedule	July 1, 2014
		N/A	C. Pay Annual Fee	January 1, 2010
> 20	> 600	7 ppmv	A. Standard Schedule	July 1, 2010
		5 ppmv	B. Enhanced Schedule	July 1, 2014
		N/A	C. Pay Annual Fee	January 1, 2010

Notes:

Table does not include oilfield/refineries, schools, and low usage boilers.

Table only includes boilers firing at least 50% PUC-quality natural gas.

See actual regulations for further information and specific compliance requirements.

CONTACT SJV APCD

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QUESTIONS





Combining Energy Efficiency with NOx Upgrades

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Introduction

Combining Energy Efficiency with NOx Reduction

- Benefits
- Example Energy Efficiency Upgrades

Getting Rebates through the Boiler Efficiency Program

- Eligible Customers
- Services Offered
- Incentives and Rebates
- Getting Started

Questions

ABOUT ENOVITY

Enovity:

- Is an energy engineering and sustainability consulting firm
- Offers an array of services:
 - *Utility Programs*
 - *Energy Services*
 - *Building Commissioning*
 - *Building Automation*
 - *Advanced Operations and Maintenance*
 - *Sustainability Services*
- Has a team of 80+ mechanical and controls engineers, project managers, O&M, and admin staff
- Operates offices in San Francisco, Sacramento, Irvine, and Phoenix



WHY INCLUDE ENERGY EFFICIENCY?

Reasons to include energy efficiency with NOx upgrades include:

- Mitigating efficiency decrease and/or operating cost increase from NOx reduction
- Energy and utility cost savings
- Some advantages of implementing as a single project:
 - *Downtime is limited*
 - *Upgrades may be more cost-effective*
 - *Project can generate a ROI*
- Greenhouse gas emission reductions
- Taking advantage of rebates available for energy efficiency upgrades
- Increasing boiler capacity
- Improving operations and maintenance
- Replacing aged equipment

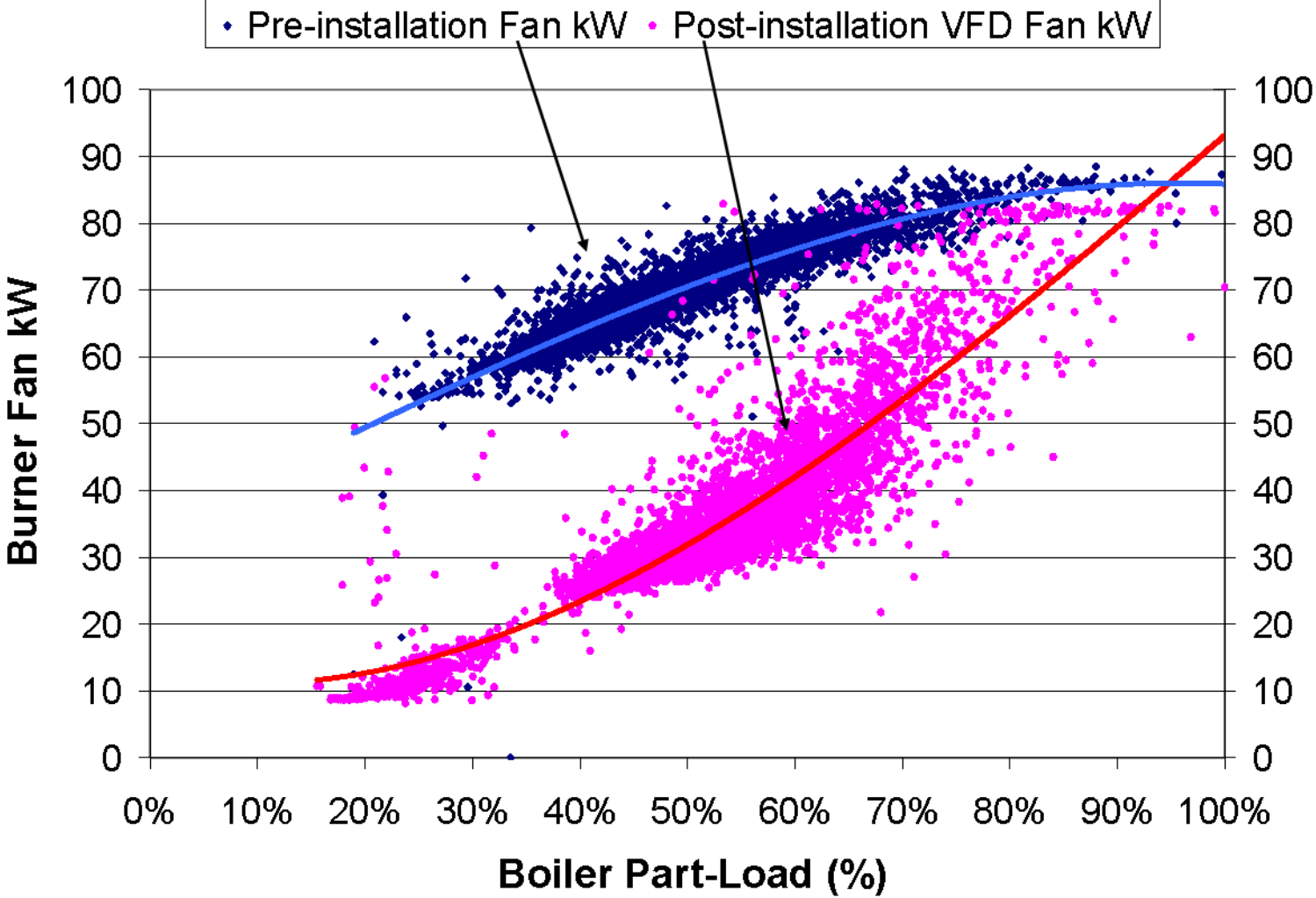
VARIABLE FREQUENCY DRIVES

Variable frequency drives for:

- Boiler burner combustion air fan
- Feedwater pumps
- Condensate return pumps
- Process water pumps



EXAMPLE BURNER FAN VFD RESULTS



NEW BOILERS

When replacing a boiler, consider:

- High-efficiency boilers
- Condensing boilers
- Direct-contact water heaters
- Steam generators
- Switching from steam to hot water



HEAT RECOVERY OPPORTUNITIES

- Pipe, tank, and other heated surface insulation
- Exhaust stack economizers (feedwater or condensing)
- Blowdown heat recovery
- Condensate recovery
- Mechanical vapor recompression or other custom efficiency upgrades for evaporators
- Flash steam recovery
- Thermosorber heat pump
- Process heat recovery



REPAIRS AND SETTING CHANGES



- Replace old or failed steam traps
- Repair/replace control linkage
- Repair/replace failed blowdown controls or reduce excessive blowdown
- Reduce or eliminate boiler cycling
- Repair/replace dirty heat exchanger or boiler economizer
- Replace boiler refractory
- Reduce boiler steam pressure or hot water supply temperature set points
- Repair/replace failed VFD

PROGRAM INTRODUCTION

The Program:

- Is a PG&E Third Party Program
- Offers incentives/rebates and no-cost technical services to commercial, industrial, and agricultural customers
- Evaluates opportunities for boiler system energy efficiency
- Focuses on achieving installed energy savings
- Is vendor-neutral



*Pacific Gas and
Electric Company*[®]

This program is funded by California utility customers and administered by PG&E under the auspices of the California Public Utilities Commission.



All projects:

- Advice and recommendations for energy efficiency projects
- Report on energy savings and greenhouse gas reductions
- Implementation coordination assistance
- Cash incentives and rebates to buy down the cost of projects

Larger, more complex projects:

- Customized analysis and measurements to determine system efficiency
- Detailed evaluation and analysis of energy savings
- Independent verification of savings achieved after installation

ELIGIBLE CUSTOMERS

Customers must:

- Pay the Public Good Charge or Public Purpose Program Surcharge as part of PG&E bill
- Operate hot water, steam boilers or thermal fluid heaters
- Have funds available to implement energy efficiency projects

Past participants include:

- Hotels
- Hospitals
- High-tech facilities and labs
- Office buildings
- Fruit and vegetable packers
- Wineries
- Creameries
- Tomato processors
- Industrial bakeries
- Paper product manufacturers



Other eligibility requirements may apply. Please contact Enovity to confirm eligibility.

FIXED REBATES

Offer a fixed dollar amount per unit of equipment:

- High-efficiency process, space heating, and domestic hot water boilers
- Condensing boilers
- Direct-contact water heaters
- Steam traps
- Pipe and tank insulation (low- to medium- temperature)
- VFD on new burner fan

See the Rebate Catalog for full details, including rebate rates and eligibility requirements.



CUSTOM INCENTIVES

Based on the one-year energy savings for a project:

- \$100 per peak kW reduced
- \$0.09 per kWh saved
- \$1.00 per therm saved

Incentives can cover up to 50% of the incremental project cost.



CONTACT ENOVITY

BOILER EFFICIENCY PROGRAM

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QUESTIONS





enovity
inc

energy innovation integrity

Providing commissioning, energy engineering,
sustainable design and building operations
and maintenance services to the construction
and property management industry.