

San Joaquin Valley Air Pollution Control District

Best Available Control Technology (BACT) Guideline 1.8.x

Emission Unit: Natural Gas-Fired Process Heater

Industry Type: All

Equipment Rating: >20 MMBtu/hr

Last Update: March 1, 2024

Pollutant	Achieved in Practice or contained in SIP	Technologically Feasible	Alternate Basic Equipment
NOx	5 ppmvd @ 3% O ₂	2.5 ppmvd @ 3% O ₂	
SOx	Use of PUC-Quality Natural Gas		
PM10	Use of PUC-Quality Natural Gas		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

***This is a Summary Page for this Class of Source – Permit Specific BACT Determinations on Next Page(s)**

Best Available Control Technology Analysis

Process Heaters >20 MMBtu/hr (natural gas-fired)

Prepared by:
James Harader, Supervising Air Quality Engineer

Reviewed by:
Nick Peirce, Permit Services Manager

I. Introduction

The purpose of this analysis is to determine Best Available Control Technology (BACT) requirements for process heaters with a rating > 20 MMBtu/hr. This analysis will be limited to natural gas-fired units. The BACT Guideline for this source category will be developed and published under a separate project.

II. Source of emissions

Aemetis Riverbank is proposing three process heaters in this size range:

1. 27.6 MMBtu/hr Natural Gas-Fired Process Heater
 - Triggers BACT for NO_x
2. 41.5 MMBtu/hr Natural Gas-Fired Process Heater
 - Triggers BACT for NO_x, SO_x, and PM₁₀

These emissions result from the combustion of gaseous fuels in the process heaters.

III. Top-Down BACT Analysis

BACT analysis for NO_x Emissions

Step 1 - Identify All Possible NO_x Control Technologies

The following BACT clearinghouse references were reviewed to determine the control technologies that have been required for NO_x from process heaters.

- EPA RACT/BACT/LAER (RBLC) clearinghouse
- CARB BACT clearinghouse
- South Coast AQMD (SCAQMD) BACT clearinghouse
- Bay Area AQMD (BAAQMD) BACT clearinghouse
- Sacramento Metro AQMD (SMAQMD) BACT clearinghouse
- San Joaquin Valley APCD (SJVAPCD) BACT clearinghouse
- Monterey Bay Air Resources District (MBARD) BACT clearinghouse
- Santa Barbara County APCD (SBAPCD) BACT clearinghouse

The following table shows the results of the search of the EPA RBLC:

Non-Refinery Units from EPA RBLC		
RBLC ID Facility Name	Fuel Equipment Rating	NOx Limit
LA-0345 Nucor Steel Louisiana	Natural Gas 923 MMBtu/hr	0.007 lb/MMBtu
TX-0865 Equistar Chemicals	Natural Gas and Process Gas 202 MMBtu/hr	5 ppmvd @ 3% O ₂
AR-0162 Energy Security Partners	Fuel Gas 391.5 MMBtu/hr	0.03 lb/MMBtu
TX-0933 Nacero Penwell	Natural Gas and Fuel Gas Not Provided	0.015 lb/MMBtu
LA-0346 IGP Methanol	Not Identified 522 MMBtu/hr	0.017 lb/MMBtu
SC-0182 Fiber Industries	Not Identified Not Provided	0.05 lb/MMBtu
LA-0291 Sasol Chemicals Unit #1	Process Gas 73.8 MMBtu/hr	0.038 lb/MMBtu
LA-0291 Sasol Chemicals Unit #2	Process Gas 424.8 MMBtu/hr	0.01 lb/MMBtu

The CARB BACT Clearinghouse was searched and applicable BACT Guidelines/Determinations were found from SCAQMD and BAAQMD. The requirements of these guidelines are discussed below.

South Coast BACT Requirements	
Category/Determination	BACT Requirement for NOx
Process Heater – Non Refinery BACT Guideline for Non-Major Pollution Facilities (page 104 of BACT Guidelines Part D)	Compliance with South Coast Rule 1146

Bay Area AQMD BACT Requirements*

Category/Determination	BACT Requirement for NOx
Heater – Refinery Process ≥ 50 MMBtu/hr	<ul style="list-style-type: none"> • 5 ppmvd NOx @ 3% O₂ (Achieved in Practice)
Heater – Refinery Process, Natural or Induced Draft 5 MMBtu/hr to < 50 MMBtu/hr	<ul style="list-style-type: none"> • 25 ppmvd NOx @ 3% O₂ (Achieved in Practice) • 10 ppmvd NOx @ 3% O₂ (Technologically Feasible)
Heater – Refinery Process, Forced Draft 5 MMBtu/hr to < 50 MMBtu/hr	<ul style="list-style-type: none"> • 20 ppmvd NOx @ 3% O₂ (Achieved in Practice) • 10 ppmvd NOx @ 3% O₂ (Technologically Feasible)

*Bay Area AQMD only has BACT Guidelines listed for process heaters at Refineries. Although this BACT Guideline is not applicable to refinery units, refinery process heaters operate similarly to non-refinery process heaters. Therefore, the requirements have been included as a reference point for the emission levels that have been achieved in similar units to those being evaluated in this project.

Monterey Bay ARD, Sacramento Metro AQMD, Santa Barbara County APCD, and San Joaquin Valley APCD Clearinghouses do not include Guidelines that would apply to process heaters > 20 MMBtu/hr.

A review of District, State and Federal rules revealed the following requirements:

Rule	Requirements for NOx
SCAQMD Rule 1146 Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters	<u>≥ 20 MMBtu/hr and ≤ 75 MMBtu/hr</u> 5 ppmvd @ 3% O ₂ <u>> 75 MMBtu/hr</u> 5 ppmvd @ 3% O ₂
BAAQMD Regulation 9 Rule 7 Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters	<u>≥ 20 MMBtu/hr and ≤ 75 MMBtu/hr</u> 9 ppmvd @ 3% O ₂ <u>> 75 MMBtu/hr</u> 5 ppmvd @ 3% O ₂
SMAQMD Rule 411 NOx from Boilers, Process Heaters, and Steam Generators	<u>≥ 20 MMBtu/hr</u> 30 ppmvd @ 3% O ₂
SBCAPCD Rule 342 Boilers, Steam Generators, and Process Heaters	<u>> 20 MMBtu/hr</u> 7 ppmvd @ 3% O ₂

MBARD Rule 441 Boilers, Steam Generators, and Process Heaters	<u>≥ 20 MMBtu/hr</u> 9 ppmvd @ 3% O ₂
SJVAPCD Rule 4306 Boilers, Steam Generators and Process Heaters – Phase 3	<u>> 20 MMBtu/hr and ≤ 75 MMBtu/hr</u> 7 ppmvd @ 3% O ₂ <u>> 75 MMBtu/hr</u> 5 ppmvd @ 3% O ₂
SJVAPCD Rule 4320 Advanced Emission Reduction Options for Boilers, Steam Generators, and Process Heaters	<u>> 20 MMBtu/hr and ≤ 75 MMBtu/hr</u> 2.5 ppmvd @ 3% O ₂ or pay Fees Pursuant to Section 5.3 of Rule 4320 <u>> 75 MMBtu/hr</u> 2.5 ppmvd @ 3% O ₂ or pay Fees Pursuant to Section 5.3 of Rule 4320

A review of District permits for process heaters (non-refinery) equal to or greater than 20 MMBtu/hr revealed the following operations:

Facility Permit	Permit Limit for NO _x
Valley Milk N-9149-9-2 24.3 MMBtu/hr natural gas-fired process heater	5 ppmvd @ 3% O ₂
California Dairies N-9141-5-0 29.48 MMBtu/hr natural gas-fired process heater	5 ppmvd @ 3% O ₂
Gill Ranch Storage, LLC C-7830-2-2 29.4 MMBtu/hr natural gas-fired process heater	9 ppmvd @ 3% O ₂
Pacific Pipeline System, LLC S-83-7-11 33.75 MMBtu/hr natural gas-fired process heater	7 ppmvd @ 3% O ₂
California Resources Elk Hills S-2234-247-4 68 MMBtu/hr natural gas-fired process heater	7 ppmvd @ 3% O ₂

The following control options were identified based on the above information:

Option 1: 5 ppmvd NOx @ 3% O₂ for units rated > 20 MMBtu/hr

This control option is based upon South Coast AQMD Rule 1146 Requirements. Additionally, multiple units were identified above, throughout the size range, that are currently limited to and have demonstrated compliance with 5 ppmvd NOx. Therefore, this option is Achieved in Practice.

Option 2: 7 ppmvd NOx @ 3% O₂ for units rated > 20 MMBtu/hr and ≤ 75 MMBtu/hr, and 5 ppmvd NOx @ 3% O₂ for units rated > 75 MMBtu/hr

This control option is based upon the requirements of San Joaquin Valley Air Pollution Control District Rule 4306. This is the minimum level of control required to comply with San Joaquin Valley Air Pollution Control District Rules. These control levels have been met by multiple units; therefore, this option is Achieved in Practice. This option is less stringent than Option1 and will be removed from consideration.

Option 3: 2.5 ppmvd NOx @ 3% O₂ for units rated > 20 MMBtu/hr

This control option is based upon San Joaquin Valley Air Pollution Control District Rule 4320 requirements. No units were identified that are currently limited to or complying with this emission level. Since no units are currently permitted at this limit, this control option is considered to be Technologically Feasible.

Step 2 - Eliminate Technologically Infeasible Options

All of the items listed in step 1 are technologically feasible. Therefore, none can be eliminated.

Step 3 - Rank Remaining Control Technologies by Control effectiveness

Rank	Capture and Control Efficiency	Status
1. 2.5 ppmvd NOx @ 3% O ₂ for all units	N/A	Technologically Feasible
2. 5 ppmvd NOx @ 3% O ₂ for all units	N/A	Achieved in Practice

Step 4 - Cost Effectiveness Analysis

The applicant is proposing the most stringent control requirement listed above, 2.5 ppmvd NOx @ 3% O₂. Therefore, a cost effective analysis is not required.

Step 5 - Select BACT

The applicant is proposing the most stringent control technology identified for NOx, 2.5 ppmvd @ 3% O₂, for each process heater rated > 20 MMBtu/hr. Therefore, BACT for NOx emissions is satisfied.

BACT analysis for SOx Emissions

Step 1 - Identify All Possible SOx Control Technologies

The following BACT clearinghouse references were reviewed to determine the control technologies that have been required for SOx from process heaters.

- EPA RACT/BACT/LAER (RBLC) clearinghouse
- CARB BACT clearinghouse
- South Coast AQMD (SCAQMD) BACT clearinghouse
- Bay Area AQMD (BAAQMD) BACT clearinghouse
- Sacramento Metro AQMD (SMAQMD) BACT clearinghouse
- San Joaquin Valley APCD (SJVAPCD) BACT clearinghouse
- Monterey Bay Air Resources District (MBARD) BACT clearinghouse
- Santa Barbara County APCD (SBAPCD) BACT clearinghouse

The following table shows the results of the search of the EPA RBLC:

Non-Refinery Units from EPA RBLC		
RBLC ID Facility Name	Fuel Equipment Rating	SOx Limit
LA-0345 Nucor Steel Louisiana	Natural Gas 923 MMBtu/hr	0.002 lb/MMBtu
TX-0865 Equistar Chemicals	Natural Gas and Process Gas 202 MMBtu/hr	None
AR-0162 Energy Security Partners	Fuel Gas 391.5 MMBtu/hr	0.0006 lb/MMBtu
TX-0933 Nacero Penwell	Natural Gas and Fuel Gas Not Provided	None

The CARB BACT Clearinghouse was searched and applicable BACT Guidelines/Determinations were found from SCAQMD and BAAQMD. The requirements of these guidelines are discussed below.

South Coast BACT Requirements	
Category/Determination	BACT Requirement for SOx
Process Heater – Non Refinery BACT Guideline for Non-Major Pollution Facilities (page 104 of BACT Guidelines Part D)	Natural Gas

Bay Area AQMD BACT Requirements*	
Category/Determination	BACT Requirement for SOx
Heater – Refinery Process ≥ 50 MMBtu/hr	<ul style="list-style-type: none"> • Natural Gas or Treated Refinery Gas Fuel with ≤ 100 ppmv Total Reduced Sulfur (Achieved in Practice) • Natural Gas or Treated Refinery Gas Fuel with ≤ 50 ppmv Hydrogen Sulfide and ≤ 100 ppmv Total Reduced Sulfur (Technologically Feasible)
Heater – Refinery Process, Natural or Induced Draft 5 MMBtu/hr to < 50 MMBtu/hr	<ul style="list-style-type: none"> • Natural Gas or Treated Refinery Gas Fuel with ≤ 100 ppmv Total Reduced Sulfur (Achieved in Practice) • Natural Gas or Treated Refinery Gas Fuel with ≤ 50 ppmv Hydrogen Sulfide and ≤ 100 ppmv Total Reduced Sulfur (Technologically Feasible)
Heater – Refinery Process, Forced Draft 5 MMBtu/hr to < 50 MMBtu/hr	<ul style="list-style-type: none"> • Natural Gas or Treated Refinery Gas Fuel with ≤ 100 ppmv Total Reduced Sulfur (Achieved in Practice) • Natural Gas or Treated Refinery Gas Fuel with ≤ 50 ppmv Hydrogen Sulfide and ≤ 100 ppmv Total Reduced Sulfur (Technologically Feasible)

*Bay Area AQMD only has BACT Guidelines listed for process heaters at Refineries. Although this BACT Guideline is not applicable to refinery units, refinery process heaters operate similarly to non-refinery process heaters. Therefore, the requirements have been included as a reference point for the emission levels that have been achieved in similar units to those being evaluated in this project.

Monterey Bay ARD, Sacramento Metro AQMD, Santa Barbara County APCD, and San Joaquin Valley APCD Clearinghouses do not include Guidelines that would apply to process heaters > 20 MMBtu/hr.

A review of District, State and Federal rules revealed the following requirements:

Rule	Requirements for SOx
South Coast Rule 1146 Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters	None
BAAQMD Regulation 9 Rule 7 Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters	None
SMAQMD Rule 411 NOx from Boilers, Process Heaters, and Steam Generators	None
SBCAPCD Rule 342 Boilers, Steam Generators, and Process Heaters	None
MBARD Rule 441 Boilers, Steam Generators, and Process Heaters	None
SJVAPCD Rule 4306 Boilers, Steam Generators and Process Heaters – Phase 3	None
SJVAPCD Rule 4320 Advanced Emission Reduction Options for Boilers, Steam Generators, and Process Heaters	<ul style="list-style-type: none"> • Fire exclusively on PUC-quality natural gas, commercial propane, butane, or liquefied petroleum gas, or a combination of such gases; or • Limit fuel sulfur content to no more than 5 grains of total sulfur per 100 scf; or • Install and properly operate an emission control system that reduces SO₂ emissions by at least 95% by weight or limits exhaust SO₂ to less than or equal to 9 ppmv @ 3% O₂

A review of District permits for process heaters (non-refinery) equal to or greater than 20 MMBtu/hr revealed the following operations:

Facility Permit	Permit Limit for SOx
Valley Milk N-9149-9-2 24.3 MMBtu/hr natural gas-fired process heater	Use of PUC Natural Gas Fuel
California Dairies N-9141-5-0 29.48 MMBtu/hr natural gas-fired process heater	Use of PUC Natural Gas Fuel
Gill Ranch Storage, LLC C-7830-2-2 29.4 MMBtu/hr natural gas-fired process heater	Use of PUC Natural Gas Fuel
Pacific Pipeline System, LLC S-83-7-11 33.75 MMBtu/hr natural gas-fired process heater	Use of PUC Natural Gas Fuel
California Resources Elk Hills S-2234-247-4 68 MMBtu/hr natural gas-fired process heater	Use of PUC Natural Gas Fuel

The following control options were identified based on the above information:

Option 1: Use of PUC-Quality Natural Gas

This control option is based upon the requirements of San Joaquin Valley Air Pollution Control District Rule 4320. These control levels have been met by multiple units; therefore, this option is Achieved in Practice.

Step 2 - Eliminate Technologically Infeasible Options

All of the items listed in step 1 are technologically feasible. Therefore, none can be eliminated.

Step 3 - Rank Remaining Control Technologies by Control effectiveness

Rank	Capture and	Status

	Control Efficiency	
1. Use of PUC-Quality Natural Gas	N/A	Achieved in Practice

Step 4 - Cost Effectiveness Analysis

The only control option listed is Achieved in Practice. Therefore, a cost effective analysis is not required.

Step 5 - Select BACT

The applicant is proposing the only control option listed for SO_x, which is the use of PUC-Quality natural gas. Therefore, BACT for SO_x emissions is satisfied.

BACT analysis for PM₁₀ Emissions

Step 1 - Identify All Possible PM₁₀ Control Technologies

The following BACT clearinghouse references were reviewed to determine the control technologies that have been required for PM₁₀ from process heaters.

- EPA RACT/BACT/LAER (RBLC) clearinghouse
- CARB BACT clearinghouse
- South Coast AQMD (SCAQMD) BACT clearinghouse
- Bay Area AQMD (BAAQMD) BACT clearinghouse
- Sacramento Metro AQMD (SMAQMD) BACT clearinghouse
- San Joaquin Valley APCD (SJVAPCD) BACT clearinghouse
- Monterey Bay Air Resources District (MBARD) BACT clearinghouse
- Santa Barbara County APCD (SBAPCD) BACT clearinghouse

The following table shows the results of the search of the EPA RBLC:

Non-Refinery Units from EPA RBLC		
RBLC ID Facility Name	Fuel Equipment Rating	PM₁₀ Limit
LA-0345 Nucor Steel Louisiana	Natural Gas 923 MMBtu/hr	0.006 lb/MMBtu
TX-0865 Equistar Chemicals	Natural Gas and Process Gas 202 MMBtu/hr	0.007 lb/MMBtu
AR-0162 Energy Security Partners	Fuel Gas 391.5 MMBtu/hr	0.0039 lb/MMBtu
TX-0933 Nacero Penwell	Natural Gas and Fuel Gas Not Provided	0.0075 lb/MMBtu
LA-0346 IGP Methanol	Not Identified 522 MMBtu/hr	0.0075 lb/MMBtu
SC-0182 Fiber Industries	Not Identified Not Provided	0.0076 lb/MMBtu

The CARB BACT Clearinghouse was searched and applicable BACT Guidelines/Determinations were found from SCAQMD and BAAQMD. The requirements of these guidelines are discussed below.

South Coast AQMD BACT Requirements

Category/Determination	BACT Requirement for PM ₁₀
Process Heater – Non Refinery BACT Guideline for Non-Major Pollution Facilities (page 104 of BACT Guidelines Part D)	Natural Gas

Bay Area AQMD BACT Requirements*	
Category/Determination	BACT Requirement for PM ₁₀
Heater – Refinery Process ≥ 50 MMBtu/hr	<ul style="list-style-type: none"> • Natural Gas or Treated Refinery Gas Fuel
Heater – Refinery Process, Natural or Induced Draft 5 MMBtu/hr to < 50 MMBtu/hr	<ul style="list-style-type: none"> • Natural Gas or Treated Refinery Gas Fuel
Heater – Refinery Process, Forced Draft 5 MMBtu/hr to < 50 MMBtu/hr	<ul style="list-style-type: none"> • Natural Gas or Treated Refinery Gas Fuel

*Bay Area AQMD only has BACT Guidelines listed for process heaters at Refineries. Although this BACT Guideline is not applicable to refinery units, refinery process heaters operate similarly to non-refinery process heaters. Therefore, the requirements have been included as a reference point for the emission levels that have been achieved in similar units to those being evaluated in this project.

Monterey Bay ARD, Sacramento Metro AQMD, Santa Barbara County APCD, and San Joaquin Valley APCD Clearinghouses do not include Guidelines that would apply to process heaters > 20 MMBtu/hr.

A review of District, State and Federal rules revealed the following requirements:

Rule	Requirements for PM ₁₀
South Coast Rule 1146	None

Emissions of Oxides of Nitrogen from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters	
BAAQMD Regulation 9 Rule 7	
Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters	None
SMAQMD Rule 411	
NOx from Boilers, Process Heaters, and Steam Generators	None
SBCAPCD Rule 342	
Boilers, Steam Generators, and Process Heaters	None
MBARD Rule 441	
Boilers, Steam Generators, and Process Heaters	None
SJVAPCD Rule 4306	
Boilers, Steam Generators and Process Heaters – Phase 3	None
SJVAPCD Rule 4320	
Advanced Emission Reduction Options for Boilers, Steam Generators, and Process Heaters	<ul style="list-style-type: none"> • Fire exclusively on PUC-quality natural gas, commercial propane, butane, or liquefied petroleum gas, or a combination of such gases; or • Limit fuel sulfur content to no more than 5 grains of total sulfur per 100 scf; or • Install and properly operate an emission control system that reduces SO₂ emissions by at least 95% by weight or limits exhaust SO₂ to less than or equal to 9 ppmv @ 3% O₂

A review of District permits for process heaters (non-refinery) equal to or greater than 20 MMBtu/hr revealed the following operations:

Facility Permit	Permit Limit for PM ₁₀
Valley Milk N-9149-9-2 24.3 MMBtu/hr natural gas-fired process heater	Use of PUC Natural Gas Fuel
California Dairies N-9141-5-0 29.48 MMBtu/hr natural gas-fired process heater	Use of PUC Natural Gas Fuel
Gill Ranch Storage, LLC C-7830-2-2 29.4 MMBtu/hr natural gas-fired process heater	Use of PUC Natural Gas Fuel
Pacific Pipeline System, LLC S-83-7-11 33.75 MMBtu/hr natural gas-fired process heater	Use of PUC Natural Gas Fuel
California Resources Elk Hills S-2234-247-4 68 MMBtu/hr natural gas-fired process heater	Use of PUC Natural Gas Fuel

The following control options were identified based on the above information:

Option 1: Use of PUC-Quality Natural Gas

This control option is based upon the requirements of San Joaquin Valley Air Pollution Control District Rule 4320. These control levels have been met by multiple units; therefore, this option is Achieved in Practice.

Step 2 - Eliminate Technologically Infeasible Options

All of the items listed in step 1 are technologically feasible. Therefore, none can be eliminated.

Step 3 - Rank Remaining Control Technologies by Control effectiveness

Rank	Capture and	Status

	Control Efficiency	
1. Use of PUC-Quality Natural Gas	N/A	Achieved in Practice

Step 4 - Cost Effectiveness Analysis

The only control option listed is Achieved in Practice. Therefore, a cost effective analysis is not required.

Step 5 - Select BACT

The applicant is proposing the only control option listed for PM₁₀, which is the use of PUC-Quality natural gas. Therefore, BACT for PM₁₀ emissions is satisfied.