

**San Joaquin Valley
Unified Air Pollution Control District**

Best Available Control Technology (BACT) Guideline 5.8.1

Emissions Unit: Dairy Milking Parlor

Industry Type: Dairy

Last Update: 9/30/2026

Pollutant	Achieved in Practice or in SIP	Technologically Feasible	Alternate Basic Equipment
VOC	Flush or hose milking parlor before, after, or during milking each group of cows.	1. Enclosure of milking parlor with captured exhaust air vented to thermal oxidizer with minimum 93% capture and control efficiency. 2. Enclosure of milking parlor with captured exhaust air vented to biofilter with minimum 80% capture and control efficiency.	
NH ₃	Flush or hose milking parlor before, after, or during milking each group of cows.	Enclosure of milking parlor with captured exhaust air vented to biofilter with minimum 80% capture and control efficiency.	

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.

Proactive Best Available Control Technology (BACT) Determination

District BACT Guideline 5.8.1

Dairy Milking Parlor

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I. Introduction

The objective of this document is to proactively reevaluate Best Available Control Technology (BACT) Guideline 5.8.1 for dairy milking parlor operations and, if warranted based on this evaluation, establish an updated BACT guideline. The previous BACT Guideline 5.8.1 was finalized on December 18, 2013, and subsequently rescinded on August 16, 2023.

This proactive update is necessary to incorporate the most stringent emission control standards that have been achieved in practice. Furthermore, this BACT guideline will bring consistency in implementing the BACT standard throughout the regional offices of the District for new and modified dairy milking parlor operations triggering BACT. The discussion in this document will be limited to the following items:

- Source of emissions
- Top-Down BACT Analysis for each pollutant
- Recommendation

II. Source of emissions

A dairy milking parlor is a specialized area where cows are milked. It is designed to efficiently manage the milking process for a large number of cows, often involving a holding area for pre-milking and a milking area where the cows are secured for the milking process.

Volatile Organic Compounds (VOC) emissions are generated from the biological decomposition of organic chemical compounds in the manure and from enteric emissions from the animals. Ammonia (NH₃) emissions are generated from the nitrogen contained in excreted urine and feces, and the rate of NH₃ volatilization is influenced by factors such as the amount of ammonia in the manure, surface area, temperature, pH, and airflow.

III. Top-Down BACT Analysis

BACT Analysis for VOC and NH₃ Emissions

Step 1 - Identify All Possible Control Technologies

The following BACT clearinghouse references were reviewed to identify any control technologies for VOC and NH₃ emissions from milking parlors:

- EPA RACT/BACT/LAER clearinghouse
- California Air Resources Board (CARB) BACT clearinghouse
- South Coast AQMD (SCAQMD) BACT clearinghouse
- Bay Area Air District (BAAD) BACT clearinghouse

- Sacramento Metro AQMD (SMAQMD) BACT clearinghouse
- San Diego APCD (SDAPCD) BACT clearinghouse
- San Joaquin Valley APCD (SJVAPCD) BACT clearinghouse

In addition, the following rules and regulations were reviewed to identify any potential VOC and NH₃ emission limits or control techniques:

- SCAQMD Rule 223 – Requirements for Confined Animal Facilities (last amended 9/5/2025)
- SCAQMD 1127 – Emission Reductions from Livestock Waste (adopted 8/6/2004)
- BAAD Regulation 2, Rule 10 – Large Confined Animal Facilities (adopted 7/19/2006)
- SMAQMD Rule 496 - Large Confined Animal Facilities (adopted 8/24/2006)
- SJVAPCD Rule 4570 – Confined Animal Facilities (last amended 10/21/2010)
- Imperial County APCD (ICAPCD) Rule 217 - Large Confined Animal Facilities (LCAF) Permits Required (last amended 2/9/2016)
- Butte County AQMD (BCAQMD) Rule 450 - Large Confined Animal Facilities (adopted 12/21/2006)

Survey of BACT Guidelines:

The EPA RACT/BACT/LAER clearinghouse does not include general guidelines, only determinations made by individual agencies. No determinations for milking parlors were identified in the EPA RACT/BACT/LAER clearinghouse.

No BACT guidelines for milking parlors were found in the SCAQMD, BAAD, SMAQMD, or SDAPCD BACT clearinghouses. The CARB clearinghouse references SJVAPCD's previous milking parlor Guideline 5.8.1 which has been rescinded.

Although Guideline 5.8.1 was rescinded in 2023, the technologies identified in the previous guideline will be retained for consideration as possible control technologies for BACT. The requirements from previous Guideline 5.8.1 are presented in Appendix B and summarized in the following table.

Agency	VOC
SJVAPCD	<u>Achieved in Practice</u>
	1. Flush/Spray before, after, or during milking each group of cows.
	<u>Technologically Feasible</u>
	1. Enclosure of milk parlor with biogas vented to incinerator with 95% control.
	2. Enclosure of milk parlor with biogas vented to biofilter with minimum 80% control.
	<u>Alternate Basic Equipment</u>
	None

Survey of Applicable Rules and Regulations:

California Health and Safety Code Section 40724.6 required California air districts designated as federal nonattainment areas for ozone as of January 1, 2004, to adopt rules or regulations requiring Large Confined Animal Facilities (CAF) to obtain permits and implement feasible measures to reduce emissions of air contaminants. As a result, several California air districts adopted regulations establishing emission mitigation requirements for CAF operations.

As part of this proactive BACT determination, applicable CAF rules and regulations adopted by other California air districts were reviewed to identify control technologies, practices, or emission mitigation measures applicable to dairy milking parlors that should be considered in determining current BACT.

SCAQMD Rule 223 – Requirements for Confined Animal Facilities

SCAQMD Rule 223 establishes the requirements for agricultural sources in the SCAQMD subject to permit, and requires Large CAF to select mitigation measure(s) from a list of specified options to reduce emissions from different areas and processes at the facility, including milking parlors, feed, cow housing, solid manure handling and land application, and liquid manure handling and land application. Rule 223 requirements for milk parlors are shown in the following table.

SCAQMD Rule 223 – Milk Parlor:	
Owners/operations shall incorporate at least one (1) of the following mitigation measures in each milk parlor:	
<i>Class One Mitigation Measures</i>	
1.	a. Flush or hose milk parlor immediately prior to, immediately after, or during each milking in accordance with the recommendations in NRCS Agricultural Waste Management Field Handbook Chapter 10 Section 651.1002 or more recent NRCS guidance.

SCAQMD Rule 223 – Milk Parlor: Owners/operations shall incorporate at least one (1) of the following mitigation measures in each milk parlor:	
2.	Implement alternative mitigation measure(s), not listed above, subject to approval of the Executive Officer.
<i>Class Two Mitigation Measures</i>	
3.	a. Enclose and vent the milk parlor to a control device certified by the District to achieve at least 80% capture and control efficiency when animals are in the parlor.

SCAQMD Rule 1127 – Emission Reductions from Livestock

The purpose of SCAQMD Rule 1127 is to reduce ammonia, VOC, and PM₁₀ emissions from livestock waste. SCAQMD Rule 1127 applies to dairy farms and related operations, such as heifer and calf farms, and the manure produced on them. Although the requirements of SCAQMD Rule 1127 apply to cattle operations, the rule does not contain specific mitigation measures for a dairy milking parlor. Therefore, Rule 1127 does not identify additional control technologies for consideration in this BACT analysis.

BAAD Regulation 2, Rule 10 – Large Confined Animal Facilities

The purpose of BAAD Regulation 2, Rule 10 is to reduce emissions of air contaminants from large confined animal facilities through control measures established during permit review. However, the rule does not contain specific emission mitigation measures for CAF. Therefore, Regulation 2, Rule 10 does not identify additional control technologies for consideration in this BACT analysis.

SMAQMD Rule 496 – Large Confined Animal Facilities

The purpose of SMAQMD Rule 496 is to limit VOC emissions from CAF, and requires Large CAF to select mitigation measure(s) from a list of specified options to reduce emissions from different areas and processes at the facility, including milking parlors, feed, cow housing, solid manure handling and land application, and liquid manure handling and land application. Rule 496 requirements for milk parlors are shown in the following table:

SMAQMD Rule 496 – Large Confined Animal Facilities - Dairies The owner/operator shall incorporate at least one of the following mitigation measures in each milking parlor. Measure 1 is classified as a class one mitigation measure and measure 2 is classified as a class two mitigation measure:	
1.	Flush or hose milking parlor immediately prior to, or immediately after, or during each milking
2.	Enclose and vent the milk parlor to a VOC control device with an overall VOC capture and VOC control efficiency of at least 80% when animals are in the parlor.

ICAPCD Rule 217 – Large Confined Animal Facilities (LCAF) Permits Required

The purpose of ICAPCD Rule 217 is to limit emissions of VOC and NH₃ from Large CAF. The rule requires Large CAF to obtain an air permit and requires Large CAF to select from a list of specified options to reduce emissions from different areas and processes at the facility, including milking parlors, feed, cow housing, solid manure handling and land application, and liquid manure handling and land application. Rule 217 requirements for milk parlors are shown in the following table.

ICAPCD Rule 217 – Milking Parlor: Owners/operations shall implement at least one (1) of the following mitigation measures in each milk parlor:	
1.	Flush or hose milking parlor immediately prior to, immediately after, or during each milking.
2.	Implement alternative mitigation measure(s), not listed above.

BCAQMD Rule 450 – Large Confined Animal Facilities

The purpose of BCAQMD Rule 450 is to establish the permitting requirements for agricultural sources subject to permit as a result of amendments to California Health and Safety Code Section 40724 that became effective January 1, 2004. However, the rule does not contain specific emission mitigation measures for milking parlor operations. Therefore, Rule 450 does not identify additional control technologies for consideration in this BACT analysis.

SJVAPCD Rule 4570 – Confined Animal Facilities

The purpose of SJVAPCD Rule 4570 is to limit emissions of VOC from CAF, and requires CAF to implement mitigation measure(s) from a list of specified options to reduce emissions from various areas and processes at the facility, including milking parlors, feed, cow housing, solid manure handling and land application, and liquid manure handling and land application.

Although Rule 4570 does not establish requirements specifically for the control of ammonia (NH₃) emissions, certain mitigation measures required by the rule for VOC control may also reduce NH₃ emissions from milking parlors. Therefore, applicable Rule 4570 mitigation measures were reviewed in this analysis for their potential effectiveness in controlling both VOC and NH₃ emissions from milking parlors.

The Rule 4570 requirements applicable specifically to milking parlors are shown in the following table.

SJVAPCD Rule 4570 – Milking Parlor: An owner/operation of a dairy CAF shall implement at least one (1) of the following mitigation measures in each milk parlor:	
1.	Flush or hose milk parlor immediately prior to, immediately after, or during each milking.
2.	Implement alternative mitigation measure(s), not listed above.

Flushing or hosing the milking parlor may reduce both VOC and NH₃ emissions. This measure is also identified in the previous District BACT Guideline 5.8.1 as Achieved in Practice BACT for both VOC and NH₃ emissions from milking parlors.

Rule 4570 also requires applicable dairy CAF to feed animals in accordance with National Research Council (NRC) guidelines. NRC-based feeding practices may reduce emissions associated with dairy operations by limiting excess nutrients in animal diets. However, feeding in accordance with NRC guidelines is a non-optional requirement applicable to all dairy CAF subject to the mitigation measure requirements in Rule 4570. This mitigation measure is listed separately from milking parlors, and is identified and implemented as a mitigation measure specifically for the handling of feed. Because dairies are already required to implement this mitigation measure, feeding animals in accordance with NRC guidelines will not be separately evaluated or established as a milking parlor-specific BACT requirement as part of this determination.

Summary of VOC and NH₃ Control Technologies

The following options are identified as possible controls for VOC and NH₃ emissions from dairy milking parlors:

VOC:

- 1) Enclosed Milking Parlor Vented to a Thermal Oxidizer (Incinerator)¹
- 2) Enclosed Milking Parlor Vented to a Biofilter
- 3) Flush or Hose Milking Parlor Before, After, or During Milking Each Group of Cows²

¹ Previous District BACT Guideline 5.8.1 referred to a thermal oxidizer as an incinerator. However, to more accurately describe the VOC control technology, the term “thermal oxidizer” will be used in this analysis.

² Previous District BACT Guideline 5.8.1 identified flushing/spraying as a control technique. To be consistent with the wording of the mitigation measures required by the rules reviewed in Step 1 of this analysis, “flush/spray” will be replaced with “flush or hose.”

NH₃:

- 1) Enclosed Milking Parlor Vented to a Biofilter³
- 2) Flush or Hose Milking Parlor Before, After, or During Milking Each Group of Cows²

Description of Control Technologies

1) Enclosed Milking Parlor Vented to a Thermal Oxidizer

Milking parlors can be either naturally or mechanically ventilated. According to some dairy designers, mechanical ventilation is more reliable than natural ventilation. Mechanical ventilation can be easily applied to all areas of the milking parlors, except the holding area. The mechanical system for the milking parlors can be utilized to capture the gases emitted from the milking parlors. However in order to capture all of the gases, and to keep an appropriate negative pressure throughout the system, the holding area would also need to be entirely enclosed. No facility currently encloses the holding area since cows are continuously going in and out of the barn throughout the day. The capital required to enclose this large area would be significant in cost. Although the feasibility of such a technology is in question, it will be considered in this analysis.

The captured VOC emissions could then be sent to a thermal oxidizer. A thermal oxidizer is a well-established VOC control technique. During combustion, gaseous hydrocarbons are oxidized to form CO₂ and water. Previous SJVAPCD BACT analyses have assumed that 95% of the gases emitted from the milking parlor can be captured by a mechanical ventilation system and that 98% of the captured VOCs will be eliminated by thermal oxidation⁴; therefore, the total control for VOCs from the milking parlor is 93.1% (calculated as 0.95 capture efficiency x 0.98 control efficiency = 93.1%).

2) Enclosed Milking Parlor Vented to a Biofilter

A biofilter is a device that removes contaminants from a gas in which the gas is passed through a media that supports microbial activity by which pollutants are degraded by biological oxidation. During biofiltration, exhaust air containing pollutants passes through a media that contains an established, diverse population of aerobic microorganisms. These microorganisms oxidize the gaseous organic contaminants, ammonia, and sulfur compounds in the exhaust air resulting in carbon dioxide, nitrogen, water, salt, and biomass. The bacterial cultures (microorganisms that typically consist of several species coexisting in a colony)

³ Previous District BACT Guideline 5.8.1 identified enclosing the milk parlor and venting to a biofilter as a technologically feasible BACT option for VOC emissions. However, as discussed on page 8 of this analysis, a biofilter is expected to control both VOC and NH₃ emissions. Therefore, this option will also be listed as a potential NH₃ control technique.

⁴ OAQPS Control Cost Manual, 4th Edition, EPA 450/3-90-006, January 1990, page 3-8.

that use oxygen to biodegrade organics are called aerobic cultures. These aerobic cultures are usually supported by organic material contained in the biofilter, such as compost, wood chips, soil, peat, etc.

Biofilters must maintain sufficient porosity to allow the contaminated air stream to pass through for treatment and to prevent anaerobic conditions. The moisture content of biofilter beds must also be regulated to ensure that there is sufficient moisture to maintain the microorganisms needed for treatment while avoiding excess moisture that can cause anaerobic conditions. A filtration system may be required upstream of the biofilter to remove particulate matter which will clog the biofilter over time. Biofilters must be maintained free of rodents and weeds to avoid channeling of gases through the filter media and a loss of performance. The filter media of natural biofilters needs to be replaced periodically because of deterioration and loss of porosity.

Since biofilters rely on living organisms to function, a biofilter's performance will be affected by several factors, including: ambient temperature; temperature of the air stream being treated; the pollutant concentrations in the air stream; moisture content of the filter and air stream, and pH of the filter media. These parameters should be monitored to ensure optimum operating conditions for the biofilter.

Consistent with the District's previous BACT Guideline 5.8.1, as well as the Class Two mitigation measures identified by SCAQMD and SMAQMD, it is assumed that the overall capture and control efficiency of gases captured from an enclosed milking parlor and vented to a properly functioning biofilter is 80% of VOC emissions.⁵ A properly functioning biofilter is also expected to achieve the same control efficiency for NH₃ emissions. Therefore, assuming the same capture efficiency of gases from an enclosed milking parlor, an overall capture and control efficiency of 80% of NH₃ emissions is expected.

3) Flush/Hose Milking Parlor Before, After, or During Milking Each Group of Cows

Dairy operations commonly utilize some type of flush or hose system to wash out the manure that dairy cows deposit in the milking parlors. The primary purpose of the flush or hose system is to maintain the minimum level of sanitation required in the milking parlors. However, this system also serves as an emission control for reducing VOC and ammonia emissions.

The manure deposited in the milking parlor, which is a source of VOC emissions, is removed from the milking parlors many times a day by flushing after each milking. Many of the VOCs emitted from fresh cow manure, such as alcohols (ethanol and methanol) and many Volatile Fatty Acids (VFAs), are highly soluble

⁵ The SCAQMD Rule 1133.2 staff report (page 18) indicates control efficiencies of 80% to 90% for VOC and 70% to over 90% for ammonia for existing biofilter composting applications, and that a well-designed, well-operated, and well-maintained biofilter is capable of achieving 80 percent control efficiency for VOC and ammonia, <https://www.aqmd.gov/docs/default-source/rule-book/support-documents/rule-1133/staff-report.pdf>

in water. Therefore, a large percentage of these compounds will dissolve in the flush water and will not be emitted from the milking parlors. The flush water can then carry the manure and the dissolved volatile compounds to an anaerobic treatment lagoon or other manure stabilization process for treatment.

Ammonia emissions are influenced by the amount and characteristics of urine and feces deposited on the parlor floor, the interaction of urine and feces, surface temperature, pH, and the length of time manure and urine remain exposed to the atmosphere. Applying water can remove manure and urine from the parlor surface and can temporarily reduce surface temperature. Water can also absorb a portion of the gaseous ammonia.

Flushing or hosing out the milking parlors before, after, or during each group of cows is milked will control the VOCs and NH₃ emitted from the urine and manure. However, the SJVAPCD's Rule 4570 Staff Report indicates that the emission factors for milking parlors were calculated assuming all dairies implement the flushing or hosing mitigation measure. Therefore, the emission factors already incorporate the emissions reduction attributable to this practice. Assigning an additional control efficiency to flushing or hosing would result in double-counting the emissions reduction. Accordingly, no control efficiency will be assigned for the purposes of this BACT analysis because no emissions reductions from the baseline will be quantified.

Step 2 - Eliminate Technologically Infeasible Options

No options identified in Step 1 will be eliminated.

Enclosing an operating milking parlor and holding area, together with collection and treatment of the resulting exhaust stream, presents significant design and operational challenges. However, the thermal oxidizer and biofilter options are retained as technologically feasible alternatives for purposes of this proactive guideline.

Step 3 - Rank Remaining Control Technologies by Control Effectiveness

The following control technologies were identified to reduce emissions of VOC and NH₃ from milking parlors

VOC:

- 1) Milking Parlor Vented to a Thermal Oxidizer (93% overall capture and control efficiency)
- 2) Milking Parlor Vented to a Biofilter (80% overall capture and control efficiency)
- 3) Flush or Hose Milking Parlor Before, After, or During Milking Each Group of Cows

NH₃:

- 1) Milking Parlor Vented to a Biofilter (80% overall capture and control efficiency)
- 2) Flush or Hose Milking Parlor Before, After, or During Milking Each Group of Cows

Step 4 - Cost Effectiveness Analysis

Because this is a proactive BACT determination that is not part of a specific permitting action, a cost effectiveness analysis is not necessary and will not be included as a part of this analysis. Therefore, control technologies identified as technologically feasible but not achieved in practice or contained in an approved SIP will be subject to a project-specific cost effectiveness analysis when BACT is triggered.

Step 5 - Select BACT

Because this is a proactive BACT determination that is not part of a specific permitting action, selecting BACT is not applicable. Recommendations for updates, corrections, or changes to previous BACT Guideline 5.8.1 requirements are discussed in the following section and summarized in the draft updated BACT guideline attached in Appendix A.

IV. Recommendation

Based on the analysis above, the following recommendations are adopted in the draft BACT guideline:

Achieved-in-Practice:

- Retain “flush/spray before, after, or during milking each group of cows” as Achieved in Practice BACT for VOC and NH₃ emissions, with the following clarification:
 - Replace “flush/spray” with “flush or hose milking parlor” to be consistent with the mitigation measures required by the rules reviewed in Step 1 of this document.

Technologically Feasible:

- For VOC emissions, retain enclosure of milk parlor with biogas vented to incinerator, with the following clarifications and corrections:
 - Remove reference to “biogas” being vented to a control device, and replace with “exhaust air,” as raw biogas is not expected to be produced in an enclosed milking parlor.
 - Remove reference to control device as an “incinerator” and replace with “thermal oxidizer,” to more accurately reflect the VOC control technology.

- Previous Guideline 5.8.1 listed a 95% control efficiency. However, 95% was based only on the efficiency of the thermal oxidizer and did not consider the capture efficiency of gases in an enclosed milking parlor. The minimum overall expected control efficiency is 93% based on the amount of exhaust air assumed to be captured and controlled, as shown in the calculations on page 7 of this analysis. The updated guideline will be clarified to indicate the overall capture and control efficiency.
- For VOC emissions, retain enclosure of milk parlor with biogas vented to biofilter, with the following clarification.
 - Remove reference to “biogas” being vented to a control device, and replace with “exhaust air,” as raw biogas is not expected to be produced in an enclosed milking parlor.
- For NH₃ emissions, add enclosure of milk parlor with captured exhaust air vented to biofilter with minimum 80% capture and control efficiency.

Appendices:

Appendix A: Draft BACT Guideline 5.8.1

Appendix B: Previous BACT Guideline 5.8.1 (rescinded August 16, 2023)

Appendix A
Draft BACT Guideline 5.8.1

**San Joaquin Valley
Unified Air Pollution Control District**

Best Available Control Technology (BACT) Guideline 5.8.1

Emissions Unit: Dairy Milking Parlor

Industry Type: Dairy

Last Update: 9/30/2026

Pollutant	Achieved in Practice or in SIP	Technologically Feasible	Alternate Basic Equipment
VOC	Flush or hose milking parlor before, after, or during milking each group of cows.	1. Enclosure of milking parlor with captured exhaust air vented to thermal oxidizer with minimum 93% capture and control efficiency. 2. Enclosure of milking parlor with captured exhaust air vented to biofilter with minimum 80% capture and control efficiency.	
NH ₃	Flush or hose milking parlor before, after, or during milking each group of cows.	Enclosure of milking parlor with captured exhaust air vented to biofilter with minimum 80% capture and control efficiency.	

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.

Appendix B
Previous BACT Guideline 5.8.1

**San Joaquin Valley
Unified Air Pollution Control District**

Best Available Control Technology (BACT) Guideline 5.8.1

Emissions Unit: Milking Parlor

Industry Type: Dairy

Last Update: 12/18/2013

Pollutant	Achieved in Practice or in SIP	Technologically Feasible	Alternate Basic Equipment
VOC	Flush/Spray before, after, or during milking each group of cows	1) Enclosure of milk parlor with biogas vented to incinerator with 95% control 2) Enclosure of milk parlor with biogas vented to biofilter with minimum 80% control	
NH ₃	Flush/Spray before, after, or during milking each group of cows		

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