San Joaquin Valley
Unified Air Pollution Control District

Best Available Control Technology (BACT) Guideline 1.4.3*

Emissions Unit: Landfill Gas Vapor Collection System **Industry Type:** Municipal Solid Waste Landfill

Equipment Rating: All **Last Update:** 9/21/2026

Pollutant	Achieved in Practice or contained in SIP	Technologically Feasible	Alternate Basic Equipment
VOC	Use of an enclosed ultra-low NOx flare with a control efficiency of ≥ 98% or a controlled VOC emissions concentration of ≤ 20 ppmvd @ 3% O2 (as hexane, equivalent to 0.038 lb-VOC/MMBtu) and a NOx emissions rate of ≤ 0.025 lb-NOx/MMBtu.		

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**

Proactive Best Available Control Technology Analysis
Landfill Gas Vapor Collection System

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Reviewed by:

I. Introduction

The objective of this project is to proactively update the Best Available Control Technology (BACT) guideline 1.4.3, which covers landfill gas vapor collection systems. This guideline was last updated on January 12, 2021.

This proactive update is being performed to review the most stringent emission control standards that have been achieved in practice, and to ensure that the District's BACT policy remains up-to-date with modern best practices for controlling landfill VOC emissions. The discussion in this document will be consist of the following items:

- Source of Emissions discussion
- Top-Down BACT Analysis for each pollutant
- Recommendation for a revised BACT guideline

II. Source of Emissions

Landfill gas production results from chemical reactions and microbes acting upon landfill waste as materials in a landfill begin to breakdown and emit VOC air contaminants as landfill gas (LFG). Extraction wells throughout the landfill will collect the LFG and vent it to a control device, such as a flare, for VOC emissions control. NO_X, SO_X, PM_{10}, CO, and VOC will be emitted from the combustion of LFG in a flare. A pilot burner is also used to ignite combustion gases in the flare, and these are typically fired on propane or natural gas.

Per section 3.47 of District Rule 1020, an emissions control device is not a source operation. Consequently, an emissions control device does not meet the definition of an emissions unit per section 3.18 of District Rule 2201. A landfill gas flare is an emissions control device intended to reduce VOC emissions from landfill gas. Therefore, the combustion emissions of the flare are not subject to BACT, and this proactive BACT determination will only address the control of VOC emissions from LFG collection systems, and NO_X emissions from the combustion of the collected landfill gas.

III. Top-Down BACT Analysis

A. BACT Analysis for VOC Emissions

Step 1 - Identify All Possible Control Technologies

The following published BACT Guidelines were reviewed to determine potential control technologies for this class and category of operation:

- The U.S. Environmental Protection Agency (USEPA) RACT/BACT/LAER Clearinghouse
- California Air Resources Board (CARB) BACT Clearinghouse
- Santa Barbara County Air Pollution Control District (SBCAPCD)
- South Coast Air Quality Management District (SCAQMD)
- Sacramento Metropolitan Air Quality Management District (SMAQMD)
- Bay Area Air Quality Management District (BAAQMD)
- San Joaquin Valley Air Pollution Control District (SJVAPCD)

1. Survey of BACT Guidelines:

USEPA RACT/BACT/LAER Clearinghouse:

The USEPA RACT/BACT/LAER clearinghouse does not include general guidelines, only determinations made by individual agencies. This database was searched using process code 19.320 (Digester and Landfill Gas Flares). The determinations found in the search establish that the use of a flare is required to control landfill gas emissions, and they establish limits to the emission factors for NO_X, PM, and CO. As discussed in Section II of this proactive BACT analysis, only VOC and NO_X emissions are being considered. The NO_X limit established by determinations found in the database is 0.06 lb/MMBtu.

Also returned in the search were daily and annual emission limits for a landfill gas flare permitted by the Pennsylvania Department of Environmental Protection:

EPA BACT Clearinghouse Pennsylvania Hourly Emission Limits	
Pollutant	**Emissions (pounds/hour)**
NO_X	4.54
VOC	1.63

A survey of SJVAPCD permits reveals that the average heat input rating of a landfill gas flare permitted by the District is 35 MMBtu/hr. Therefore, the Pennsylvania determination's hourly emission limits can be converted into estimates for flare emission factors as follows:

Emission Factor = Emissions (lb/hour) ÷ 35 MMBtu/hr

EPA BACT Clearinghouse Pennsylvania Emission Factors	
Pollutant	**EF (lb/MMBtu)**
NO_X	0.13
VOC	0.05

Comparing the estimates above against the 0.06 lb/MMBtu NO_X limit found by searching the USEPA BACT database, The minimum emission factors for NO_X and VOC emissions from a landfill gas flare are as follows:

EPA BACT Clearinghouse Landfill Gas Flare Emission Factors	
Pollutant	**EF (lb/MMBtu)**
NO_X	0.06
VOC	0.05

CARB BACT Clearinghouse:

The CARB BACT clearinghouse was searched for BACT determinations related to landfill gas flares. Two applicable determinations were found from the SCAQMD. The emission limits set by these determinations are presented in the table below:

CARB BACT Clearinghouse Landfill Gas Flare Emission Factors		
Determination	**Emission Factors**	
	NO_X (lb/MMBtu)	**VOC (lb/MMBtu**
South Coast 6/8/01	0.06	--
South Coast 3/17/17 (2)	0.025	--

Therefore, the most stringent requirements from the CARB BACT clearinghouse will be considered to be the following:

CARB BACT Clearinghouse Landfill Gas Flare Emission Factors	
Pollutant	**EF (lb/MMBtu)**
NO_X	0.025
VOC	--

SBCAPCD BACT Clearinghouses:

The SBCAPCD BACT clearinghouse was searched for landfill gas fired flares, and no applicable BACT guidelines were found.

SCAQMD, SMAQMD, BAAQMD, and SJVAPCD BACT Clearinghouses:

The applicable BACT guidelines from the SCAQMD (for both major and non-major polluting facilities), SMAQMD, BAAQMD, and SJVAPCD are shown in the tables below for VOC and NO_X, respectively. All control technologies listed are considered achieved in practice, unless stated otherwise:

Agency	Guideline	Process and Range	VOC Control Technology
SCAQMD	Major Polluting Facilities (Part B, Section 1, A/N 491442)	Landfill Gas, Active Solid Waste Landfill, Non-Hazardous Waste	• 98% by weight destruction efficiency for VOC or less than 20 ppmvd @ 3% O_2 (as hexane) (3/17/17). • 99% by weight destruction efficiency for methane (3/17/17).
	Non-Major Polluting Facilities (Part D, Page 52)	Digester Gas or Landfill Gas from Non-Hazardous Waste Landfill	• Ground Level, Shrouded, ≥ 0.6 seconds retention time at ≥ 1,400 ^{O}F, Auto Combustion Air Control, Automatic Shutoff Gas Valve and Automatic Re-Start System (1988).
		Landfill Gas from Hazardous Waste Landfill	• Ground Level, Shrouded, ≥ 0.6 seconds retention time at ≥ 1,500 ^{O}F, Auto Combustion Air Control, Automatic Shutoff Gas Valve and Automatic Re-Start System (1988).
SMAQMD	BACT Determination Number 198 (expired)	Landfill Gas Flare for Non-Hazardous Landfill	• 98% by weight destruction efficiency for VOC or less than 20 ppmvd @ 3% O_2 (as hexane) (1/11/19).
BAAQMD	Section 8: Waste Processing Industry Landfills	Flare – Digester Gas or Landfill from Non-Hazardous Waste Landfill (Document #80.1)	• Ground Level, Enclosed, ≥ 0.6 second retention time at ≥ 1,400 ^{O}F, Auto Combustion Air Control, Automatic Shutoff Gas Valve and Automatic Re-Start System (12/16/91).
		Flare – Digester Gas or Landfill from Hazardous Waste Landfill (Document #81.1)	• Ground Level, Enclosed, ≥ 0.6 second retention time at ≥ 1,500 ^{O}F, Auto Combustion Air Control, Automatic Shutoff Gas Valve and Automatic Re-Start System (10/18/91).
SJVAPCD	1.4.3.	Landfill Gas Vapor Collection System	• Use of an enclosed ultra-low NO_X flare with a control efficiency of ≥ 98% for VOC or a controlled VOC emissions concentration of ≤ 20 ppmvd @ 3% O_2 (as hexane) (1/12/21).

Agency	Guideline	Process and Range	Flare Burner NO_X Emission Rate
SCAQMD	Major Polluting Facilities (Part B, Section 1, A/N 491442)	Landfill Gas, Active Solid Waste Landfill, Non-Hazardous Waste	• 0.025 lb-NO_X/MMBtu (3/17/17).
	Non-Major Polluting Facilities (Part D, Page 52)	Digester Gas or Landfill Gas from Non-Hazardous Waste Landfill	• 0.06 lb/MMBtu (1988).
		Landfill Gas from Hazardous Waste Landfill	• 0.06 lb/MMBtu (1988).
SMAQMD	BACT Determination Number 198 (expired)	Landfill Gas Flare for Non-Hazardous Landfill	Achieved in Practice: • 0.05 lb/MMBtu (1/11/19). Technology Feasible/Cost Effective: • Not specified.
BAAQMD	Section 8: Waste Processing Industry Landfills	Flare – Digester Gas or Landfill from Non-Hazardous Waste Landfill (Document #80.1)	• 0.06 lb/MMBtu (12/16/91).
		Flare – Digester Gas or Landfill from Hazardous Waste Landfill (Document #81.1)	• 0.06 lb/MMBtu (10/18/91).
SJVAPCD	BACT Guideline 1.4.3	Landfill Gas Vapor Collection System	• ≤ 0.025 lb/MMBtu (1/8/01).

2. Survey of Permitted Sources:

The District currently has permitted 27 landfills that utilize flares to control VOC emissions from landfill gas vapor collection systems. The most stringent VOC control requirement on these permits is 98% control by weight of VOCs, or emission concentration of no more than 20 ppmv @ 3% O_2 as hexane. For NO_X emissions, the permitted limits range from 0.025 lb-NO_X/MMBtu to 0.098 lb-NO_X/MMBtu.

3. List of Control Options:

Based on the above survey of BACT determinations and permitted operations, the following control option is commonly utilized, and represents the most stringent achieved in practice standard for NO_X and VOC emissions across all surveyed landfill flare operations:

- Use of an enclosed ultra-low NO_X flare with a control efficiency of ≥ 98% or a controlled VOC emissions concentration of ≤ 20 ppmvd @ 3% O2 (as hexane) and a NO_X emissions rate of ≤ 0.025 lb-NO_X/MMBtu. (Achieved-in-Practice)

A VOC emission concentration of 20 ppmv @ 3% O2 (referenced as hexane) is equivalent to an emission factor of 0.038 lb-VOC/MMBtu, as will be determined below. The following equation represents the complete combustion reaction for methane, including atmospheric levels of nitrogen present in the intake air which are not combusted:

$CH_4 + 2\ O_2 + 7.57\ N_2 \rightarrow CO_2 + 2\ H_2O + 7.57\ N_2$

Moles of nitrogen = (79.1/20.9) × 2
= 7.57
Dry exhaust volume = 1 CO_2 + 7.57 N_2
= 8.57 dscf-exhaust/scf-CH_4
Methane heating value = 1,020 Btu/scf-CH_4
Methane dry F-factor = 8.57 dscf-exhaust/scf-CH_4 / 0.00102 MMBtu/scf-CH_4
= 8,402 dscf-exhaustMMBtu

Therefore, 20 ppmv @ 3% O2 (as hexane) is equivalent to:

EF(VOC) = (20 × 10^{-6} scf-hexane/scf-exhaust) × (86.18 lb-hexane/lb-mole) × (1 lb-mole/379.5 scf-hexane) × (8,402 scf-exhaust/MMBtu)
= 0.038 lb-VOC/MMBtu

Step 2 - Eliminate Technologically Infeasible Options

There are no technologically infeasible options listed in Step 1. The only emission control option under consideration is based on current BACT requirements, and permitted operations. Therefore, no further discussion is required.

Step 3 - Rank Remaining Control Technologies by Control effectiveness

Rank	Control Efficiency or Emission Rate	Achieved in Practice
1	Use of an enclosed ultra-low NO_X flare with a control efficiency of ≥ 98% or a controlled VOC emissions concentration of ≤ 20 ppmvd @ 3% O_2 (as hexane) and a NO_X emissions rate of ≤ 0.025 lb-NO_X/MMBtu.	Yes

Step 4 - Cost Effectiveness Analysis

This is a proactive determination that is not part of a permitting action. Therefore, a cost effective analysis is not necessary.

Step 5 - Select BACT

This is a proactive determination that is not part of a specific permitting action. The following VOC emission control standard has been determined to be achieved in practice.

- Use of an enclosed ultra-low NO_X flare with a control efficiency of ≥ 98% or a controlled VOC emissions concentration of ≤ 20 ppmvd @ 3% O2 (as hexane, equivalent to 0.038 lb-VOC/MMBtu) and a NO_X emissions rate of ≤ 0.025 lb-NO_X/MMBtu. (Achieved-in-Practice)

IV. Recommendation

Upon approval, adopt the proposed draft revised BACT guideline in Appendix A into the District's BACT Clearinghouse.

V. Appendices

Appendix A: Draft BACT Guideline 1.4.3
Appendix B: Current SJVAPCD BACT Guideline 1.4.3

Appendix A

Draft BACT Guideline 1.4.3

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Best Available Control Technology (BACT) Guideline 1.4.3*

Emissions Unit: Landfill Gas Vapor Collection System **Industry Type:** Municipal Solid Waste Landfill

Equipment Rating: All **Last Update:** 9/21/2026

Pollutant	Achieved in Practice or contained in SIP	Technologically Feasible	Alternate Basic Equipment
VOC	Use of an enclosed ultra-low NOx flare with a control efficiency of ≥ 98% or a controlled VOC emissions concentration of ≤ 20 ppmvd @ 3% O2 (as hexane, equivalent to 0.38 lb-VOC/MMBtu) and a NOx emissions rate of ≤ 0.025 lb-NOx/MMBtu.		

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Appendix B

Current BACT Guideline 1.4.3

San Joaquin Valley
Unified Air Pollution Control District

Best Available Control Technology (BACT) Guideline 1.4.3*

Last Update: 1/12/2021

Landfill Gas Vapor Collection System

Pollutant	Achieved in Practice or contained in the SIP	Technologically Feasible	Alternate Basic Equipment
VOC	Use of an enclosed ultra-low NOx flare with a control efficiency of ≥ 98% or a controlled VOC emissions concentration of ≤ 20 ppmvd @ 3% O2 (as hexane, equivalent to 0.038 lb-VOC/MMBtu) and a NOx emissions rate of ≤ 0.025 lb-NOx/MMBtu		

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.

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