SMAQMD BACT CLEARINGHOUSE

ACTIVE

CATEGORY Type: **IC ENGINE SPARK - STANDBY**

BACT Category: Minor Source BACT

BACT Determination Number: 341	**BACT Determination Date:** 3/8/2024

Equipment Information

Permit Number: N/A -- Generic BACT Determination
Equipment Description: IC ENGINE
Unit Size/Rating/Capacity: < 500 BHP
Equipment Location:

BACT Determination Information

District Contact: Joe Carle Phone No.: (279) 207-1121 email: jcarle@airquality.org

ROCs	**Standard:**	See Description
	Technology Description:	Rich Burn: 60 ppmvd @ 15% O2 as methane; Lean Burn: 206 ppmvd @ 15% O2 as methane
	Basis:	Achieved in Practice
NOx	**Standard:**	See Description
	Technology Description:	Rich Burn: 25 ppmvd @ 15% O2 or 96% reduction by weight; Lean Burn: 1.0 g/bhp-hr
	Basis:	Achieved in Practice
SOx	**Standard:**	See Description
	Technology Description:	Use of natural gas fuel or equivilant and good combustion practices
	Basis:	Achieved in Practice
PM10	**Standard:**	See Description
	Technology Description:	Use of natural gas fuel or equivilant and good combustion practices
	Basis:	Achieved in Practice
PM2.5	**Standard:**	See Description
	Technology Description:	Use of natural gas fuel or equivilant and good combustion practices
	Basis:	Achieved in Practice
CO	**Standard:**	See Description
	Technology Description:	2.0 g/bhp-hr
	Basis:	Achieved in Practice
LEAD	**Standard:**	
	Technology Description:	
	Basis:	

Comments: T-BACT is equivalent to BACT for VOC

Printed: 3/11/2024

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BACT Category: Minor Source BACT

BACT Determination Number: 342	**BACT Determination Date:** 3/8/2024

Equipment Information

Permit Number: N/A -- Generic BACT Determination
Equipment Description: IC ENGINE
Unit Size/Rating/Capacity: ≥ 500 BHP
Equipment Location:

BACT Determination Information

District Contact: Joe Carle Phone No.: (279) 207-1121 email: jcarle@airquality.org

ROCs	**Standard:**	See Description
	Technology Description:	Rich Burn: 60 ppmvd @ 15% O2 as methane; Lean Burn: 206 ppmvd @ 15% O2 as methane
	Basis:	Achieved in Practice
NOx	**Standard:**	See Description
	Technology Description:	Rich Burn: 25 ppmvd @ 15% O2; Lean Burn: 0.5 g/bhp-hr
	Basis:	Achieved in Practice
SOx	**Standard:**	See Description
	Technology Description:	Use of natural gas fuel or equivalent and good combustion practices
	Basis:	Achieved in Practice
PM10	**Standard:**	See Description
	Technology Description:	Use of natural gas fuel or equivalent and good combustion practices
	Basis:	Achieved in Practice
PM2.5	**Standard:**	See Description
	Technology Description:	Use of natural gas fuel or equivalent and good combustion practices
	Basis:	Achieved in Practice
CO	**Standard:**	See Description
	Technology Description:	1.5 g/bhp-hr
	Basis:	Achieved in Practice
LEAD	**Standard:**	
	Technology Description:	
	Basis:	

Comments: T-BACT is equivalent to BACT for VOC

Printed: 3/11/2024

777 12th Street, Suite 300

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Sacramento, CA 95814

BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION

DETERMINATION NOS.: 341 & 342

DATE: 03/08/2024

ENGINEER: J. Carle

Category/General Equip Description:	Internal Combustion (I.C.) Engine
Equipment Specific Description:	I.C. Engine Spark Ignited – Standby, Gaseous-fueled (Excluding Biogas)
Equipment Size/Rating:	Engines < 500 BHP (BACT #341) Engines ≥ 500 BHP (BACT #342)
Previous BACT Det. No.:	BACT #284 (Engines < 500 BHP) BACT #285 (Engines ≥ 500 BHP)

These Best Available Control Technology (BACT) determinations will update BACT Determination # 284 & 285 for I.C. Engine Spark Ignited – Standby, Gaseous-fueled (Excluding Biogas) for engines rated less than 500 bhp and 500 bhp or greater respectively, which went into effect August 11, 2021.

Spark Ignited I.C. Engines – Standby use gaseous fuel to operate and provide emergency electrical power, emergency water pumping for flood control or firefighting, emergency potable water pumping, or emergency sewage pumping. Engines permitted as emergency standby are used in two ways: 1) as part of a generator system or 2) as a direct drive pump. As part of a generator, typical uses include providing power to life safety systems, building equipment, or computer equipment. As part of a direct drive pump, typical uses are for fire suppression, potable water supply or sewage pumping, the use of which is tied to an emergency event.

This determination will also include Best Available Control Technology for Toxics (T-BACT) for the hazardous air pollutants (HAP) associated with gaseous fuel combustion.

BACT/T-BACT ANALYSIS

A. ACHIEVED IN PRACTICE (Rule 202, §205.1a):

The following control technologies are currently employed as BACT/T-BACT for standby, spark ignited, gaseous-fueled, I.C. engines by the following agencies and air pollution control districts:

Note: Tables 3.2-1, 3.2-2, and 3.2-3 of AP-42 list benzene, formaldehyde, PAHs, naphthalene, acetaldehyde, acrolein, propylene, toluene, xylenes, ethyl benzene, and hexane as the primary drivers for health risks associated with natural gas combustion. These HAPs/organic compounds are emitted as VOC and the same control technologies that control VOCs also control the listed HAPs.

US EPA

BACT
Source: EPA RACT/BACT/LAER Clearinghouse (See Attachment A)

The most stringent standards from the EPA RBL Clearinghouse for VOC, NOx, and CO are listed below. All standards in the clearinghouse listed for PM or SO_2 were based on burning clean fuel and using good combustion practices. The numeric standards listed in the clearing house vary from agency to agency and depend heavily on their calculation methodology. SMAQMD staff use emission limits from EPA AP-42 for PM and SOx when pollution prevention measures are required for BACT.

Emergency Standby, Natural Gas-fired (including propane and LPG), < 500 BHP, IC Engines					
Pollutant	Standard	Control Technology	Engine Burn Type	Permit Date	RBLC ID
VOC	1.0 g/bhp-hr	Only fire natural gas and compliance with 40 CFR 60 Subpart JJJJ	Lean	12/10/2019	WI-0297
NOx	1.38 g/bhp-hr	No controls	Unknown	4/25/2014	CA-1225
CO	4.0 g/bhp-hr	Designed to comply with NSPS	Unknown	2/14/2019	AR-0171

Emergency Standby, Natural Gas-fired (including propane and LPG), ≥ 500 BHP, IC Engines					
Pollutant	Standard	Control Technology	Engine Burn Type	Permit Date	RBLC ID
VOC	0.5 g/bhp-hr	Oxidation catalyst	Lean	12/5/2016	MI-0424
NOx	0.5 g/bhp-hr	Good combustion practices	Unknown	4/16/2013	IN-0167
CO	0.8 g/bhp-hr	Oxidation catalyst	Lean	12/5/2016	MI-0424

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
40 CFR Part 60 Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engines: This regulation applies to owners/operators of new stationary spark ignition engines (SI ICE) that commenced construction after June 12, 2006. [40 CFR §60.4230(a)(4)]

40 CFR §60.4233(d)
Owners and operators of stationary SI ICE with a maximum engine power greater than 19 KW (25 BHP) must comply with the emission standards of Table 1 to this subpart for their emergency stationary SI ICE (applies to both lean and rich burn engines).

40 CFR Subpart JJJJ Table 1: Emission Standards					
Engine Type and Fuel	Maximum Engine Power	Manufacture Date	Emission Standards (A) g/bhp-hr (ppmvd at 15% O_2)		
			NOx	CO	VOC (C)
Emergency (B)	25 < HP < 130	1/1/200	10	387	N/A
	HP ≥ 130	-	2.0 (160)	4.0 (540)	1.0 (86)

(A) Owners and operators of stationary non-certified SI engines may choose to comply with the emission standards in units of either g/bhp-hr or ppmvd at 15% O_2
(B) The emission standards applicable to emergency engines between 25 BHP and 130 BHP are in terms of NOx + HC. This category applies to both lean and rich burn engines
(C) For purposes of this subpart, when calculating emissions of VOC compounds, emissions of formaldehyde should not be included.

40 CFR Part 63 Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines: This regulation applies to owners/operators of stationary reciprocating internal combustion engines (RICE) located at both major and area sources of Hazardous Air Pollutant (HAP) emissions. [40 CFR §63.6585]

40 CFR §63.6590(c)
An affected source that meets any of the criteria in paragraphs (1) through (7) of this section must meet the requirements of this part by meeting the requirements of 40 CFR part 60 subpart IIII, for compression ignition engines or 40 CFR part 60 subpart JJJJ, for spark ignition engines. No further requirements apply for such engines under this part.

California Air Resource Board (CARB)

BACT

BACT Guidelines
Source: CARB BACT Guideline List

Other than the guidelines that are already outlined in this determination from the five air districts listed below, there is only one guideline that covers this equipment category.

SBCAPCD BACT Guideline 3.2: SBCAPCD staff were contacted for background information regarding the origin of their determination. In response SBCAPCD staff stated that the determination was derived from emission guarantees from a single project their air district approved. The permitting documents were eventually cancelled prior to installation and, therefore, the standards were never achieved in practice. SBCAPCD will be revoking the achieved in practice standards that are currently listed in their Guideline 3.2.

BACT Determinations
Source: CARB BACT Determination List (See Attachment B)

Currently there are two BACT determinations in the CARB BACT Clearinghouse, which are summarized in Attachment B. The District has concluded that these determinations have not been achieved in practice for this equipment category for the reasons described below.

SCAQMD ID 361525: The unit detail on the CARB website for this determination is listed as backup/emergency, although it is categorized on the SCAQMD LAER/BACT webpage as non-emergency. The actual SCAQMD Determination A/N 361525 states that although the engine is used for backup purposes, it is permitted to operate as a non-emergency engine and, therefore, would not fit under the equipment category of this BACT determination.

SCAQMD ID 359876: SCAQMD Determination A/N 359876 states that the AQMD is reconsidering the BACT requirement for future applications of this type. As shown later in this determination the SCAQMD BACT guidelines for non-major facilities category for emergency, spark-ignited, IC engines was updated in 2016 and the standards listed A/N 359876 were not listed to be achieved in practice. Additionally, determination A/N 359876 states that source testing was not required and, therefore, the standards were never verified in the field.

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
CARB does not have a statewide rule for control of stationary spark-ignited IC engines. However, the state develops, when necessary, guidelines that set Reasonable Available Control Technology (RACT) and Best Available Retrofit Technology (BARCT). These guidelines establish the minimum requirements for RACT and BARCT that Districts must consider when developing all feasible measures for attainment of the California Ambient Air Quality Standards.

CARB RACT/BARCT Guidelines for Stationary Spark-Ignited Internal Combustion Engines (11/2001):
This document presents the determination of reasonably available control technology (RACT) and best available retrofit control technology (BARCT) for controlling NOx, VOC, and CO from stationary, spark-ignited reciprocating internal combustion engines. On page IV-14 of the document, emergency standby engines are listed as exempt from the recommended emission limits. Therefore, this guideline is not applicable to this BACT determination.

Sacramento Metropolitan AQMD

BACT
Source: SMAQMD BACT Clearinghouse – BACT Determination #284 & 285 (8/11/21)

BACT Determination #284 - IC Engine, Spark-ignited, Standby, < 500 BHP (A)		
Pollutant	Rich Burn Standard	Lean Burn Standard
VOC	60 ppmv @ 15% O_2 as methane (0.29 g/bhp-hr)	206 ppmv @ 15% O_2 as methane (1.0 g/bhp-hr)
NOx	25 ppmvd @ 15% O_2 (0.44 g/bhp-hr); or 96% reduction by weight	1.0 g/bhp-hr
SOx	Natural gas fuel or equivalent	Natural gas fuel or equivalent
PM10	Natural gas fuel or equivalent	Natural gas fuel or equivalent
PM2.5	Natural gas fuel or equivalent	Natural gas fuel or equivalent
CO	2.0 g/bhp-hr	2.0 g/bhp-hr

(A) The standards in the parentheses are for reference purposes and listed only to compare with other agency BACT standards that use different units.

The origin of the numeric PM emission standard of 0.0099 lb/MMBtu for the SMAQMD BACT Determination #285 was reviewed as this standard is slightly less than the total PM emission factors (filterable and condensable) in EPA AP-42 for both rich and lean burn 4-stroke engines. The standard has been listed as the achieved in practice standard for several BACT determinations since it was adopted under BACT Determination #123 in 2016. In BACT #123 the standard was listed as achieved in practice and taken from a determination found in the EPA RBL Clearinghouse with the ID MD-0036 for a natural gas emergency generator. The standard is listed as filterable PM10 and is equivalent to the AP-42 emission factor for filterable PM for 4-stroke lean-burn engines. The determination also lists the control method used as good combustion practices and use of low sulfur natural gas.

Although the numeric standard has been listed since 2016 the actual achieved in practice control measure is use of natural gas and good combustion practices. Therefore, in order to eliminate confusion surrounding the use of a numeric standard that was originally based on AP-42 emission factors the control method will be used instead.

BACT Determination #285 - IC Engine, Spark-ignited, Standby, ≥ 500 BHP (A)		
Pollutant	Rich Burn Standard	Lean Burn Standard
VOC	60 ppmv @ 15% O_2 as methane (0.29 g/bhp-hr)	206 ppmv @ 15% O_2 as methane (1.0 g/bhp-hr)
NOx	25 ppmvd @ 15% O_2 (0.44 g/bhp-hr)	0.5 g/bhp-hr
SOx	Natural gas fuel or equivalent	Natural gas fuel or equivalent
PM10	Natural gas fuel or equivalent and good combustion practices	Natural gas fuel or equivalent and good combustion practices
PM2.5	Natural gas fuel or equivalent and good combustion practices	Natural gas fuel or equivalent and good combustion practices
CO	1.5 g/bhp-hr	1.5 g/bhp-hr

(A) The standards in the parentheses are for reference purposes and listed only to compare with other agency BACT standards that use different units.

T-BACT
T-BACT is equivalent to BACT for VOC.

RULE REQUIREMENTS:
Rule 412 – Stationary Internal Combustion Engines Located at Major Stationary Sources of NOx (6/1/95)

This rule applies to any stationary internal combustion engine rated at more than 50 BHP located at a major stationary source of NOx. Section 110 of this rule states that operation of stationary internal combustion engines used for emergency standby are exempt from the standards of this rule. Therefore, this rule is not applicable to this BACT determination.

Rule 420 – Sulfur Content of Fuels (8/13/81)

No person shall burn any gaseous fuels containing sulfur compounds in excess of 50 grains per 100 cubic feet, calculated as hydrogen sulfide at standard conditions, or any liquid fuel or solid fuel having a sulfur content in excess of 0.5% by weight.

South Coast AQMD

BACT
Source: SCAQMD BACT Guidelines for Non-Major Polluting Facilities, pages 73-74 (9/2/22)

I.C. Engine, Stationary, Emergency, Spark Ignition					
Rating/Size	VOC	NOx	SOx	CO	PM
< 130 HP	1.5 g/bhp-hr (10/20/2000)	1.5 g/bhp-hr (10/20/2000)	See Clean Fuels Policy (10/20/2000) (A)	2.0 g/bhp-hr (10/20/2000)	See Clean Fuels Policy (10/20/2000) (A)
≥ 130 HP	1.0 g/bhp-hr (12/02/2016)	1.5 g/bhp-hr (10/20/2000)	See Clean Fuels Policy (10/20/2000) (A)	2.0 g/bhp-hr (10/20/2000)	See Clean Fuels Policy (10/20/2000) (A)

(A) SCAQMD's Clean Fuels Policy defines a Clean Fuel as one that produces air emissions equivalent to or lower than natural gas. The requirement of a clean fuel is based on engineering feasibility. Engineering feasibility considers the availability of a clean fuel and safety concerns associated with that fuel. SCAQMD's Clean Fuel Policy lists natural gas, methanol, liquid petroleum gas (LPG), and hydrogen as clean fuels.

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
Reg XI, Rule 1110.2 – Emissions from Gaseous- and Liquid-Fueled Engines (11/1/19)

Subdivision (i)(1)(B) exempts emergency engines with permit conditions that limit operation to 200 hours or less per year.

San Joaquin Valley APCD

BACT
Source: SJVAPCD BACT Guideline 3.1.5 (7/16/18)

Emergency Gas-Fired IC Engines (A)			
Pollutant	Engine Burn Type	Rating	Standard
VOC	Lean Burn	All	206 ppmv @ 15% O2 (1.0 g/bhp-hr)
	Rich Burn	All	60 ppmv @ 15% O2 (0.29 g/bhp-hr)
NOx	Lean Burn	< 500 BHP	1.0 g/bhp-hr
		≥ 500 BHP	0.5 g/bhp-hr
	Rich Burn	All	25 ppmv @ 15% O2 (0.44 g/bhp-hr)
SOx	All	All	Natural Gas, LPG, or Propane as fuel
PM10	All	All	Natural Gas, LPG, or Propane as fuel
PM2.5	All	All	Natural Gas, LPG, or Propane as fuel
CO	All	All	2.0 g/bhp-hr

(A) All standards are listed as achieved in practice. No standards were listed as technologically feasible.

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:
Rule 4702 – INTERNAL COMBUSTION ENGINES (Amended 8/19/21)

Section 4.2 exempts emergency standby engines from the emission standards established in this rule.

San Diego County APCD

BACT
Source: NSR Requirements for BACT (November 2023)

There are no BACT standards published in the clearinghouse for this category.

T-BACT
There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:

Regulation 4, Rule 69.4.1 – Stationary Reciprocating Internal Combustion Engines – Best Available Retrofit Control Technology (7/8/20)

This rule applies to stationary I.C. Engines ≥ 50 BHP.

A person shall not operate a **new or replacement emergency standby** stationary internal combustion engine subject to this rule unless:

Uncontrolled NOx emissions are reduced with add-on control equipment by not less than the following:

Engine Category	Weight Percent Reduction
Rich-burn engines using fossil derived gaseous fuel or gasoline	96%
Lean-burn engines using fossil derived gaseous fuel	90%
Rich-burn engines used exclusively in agricultural operations	80%
Lean-burn engines used exclusively in agricultural operations	70%

OR

Emissions are not greater than the following:

Engine Category	Concentration of NOx (A)	Concentration of VOC (B)	Concentration of CO (C)
Rich-burn engines using gaseous fuel	25 ppmv	86 ppmv	540 ppmv
Lean-burn engines using gaseous fuel	2.0 g/bhp-hr or 160 ppmv	1.0 g/bhp-hr or 86 ppmv	4.0 g/bhp-hr or 540 ppmv
Black start engines using gaseous fuel	2.0 g/bhp-hr or 160 ppmv	1.0 g/bhp-hr or 86 ppmv	4.0 g/bhp-hr or 540 ppmv

(A) Calculated as nitrogen dioxide in ppmv corrected to 15% oxygen on a dry basis, or in grams of NOx per brake horsepower-hour, as indicated
(B) Calculated as methane in ppmv corrected to 15% oxygen on a dry basis, or in grams of VOC per break horsepower-hour, as indicated, excluding emissions of formaldehyde.
(C) Calculated as carbon monoxide in ppmv corrected to 15% oxygen on a dry basis, or in grams of CO per break horsepower-hour, as indicated.

Bay Area AQMD

BACT

Source: BAAQMD BACT Guideline 96.3.4 (5/7/03)

IC Engine – Spark Ignition, Natural Gas Fired, Emergency Engine, ≥ 50 bhp		
Pollutant	Standard (A)	Typical Technology
VOC	1.0 g/bhp-hr	Lean burn technology
NOx	1.0 g/bhp-hr	Lean burn technology
SOx	No standard	Natural gas
PM10	No standard	Natural gas
CO	2.75 g/bhp-hr	Lean burn technology

(A) All standards listed are achieved in practice. No standards were listed that are technologically feasible and cost effective.

T-BACT

There are no T-BACT standards published in the clearinghouse for this category.

RULE REQUIREMENTS:

Reg 9, Rule 8 – Nitrogen Oxides and Carbon Monoxide from Stationary Internal Combustion Engines (7/25/07)

Section 110.5 of this rule exempts emergency standby engines from the emissions standards in the rule.

Summary of Achieved in Practice Control Technologies

The following control technologies have been identified and are ranked based on stringency:

UNIT CONVERSION FOR NOx, VOC & CO

Depending on the agency, VOC, NOx, and CO emission standards were listed in either ppmvd @ 15% O_2 or in g/bhp-hr. For purposes of comparison standards have been converted to the units used in the current SMAQMD BACT standard. The factors used for the NOx and VOC conversion are based on the ppmvd @ 15% O_2 to g/bhp-hr equivalencies used in the previous SMAQMD BACT standard. The conversion factor for CO is based on Santa Barbara County APCD's Piston IC Engine Technical Reference Document for turbocharged natural gas engines.

$$EF_{ppmvd} = (g/bhp\text{-}hr)_P * CF_P$$

Where:

$(g/bhp\text{-}hr)_P$ = emission rate of pollutant in exhaust
CF_P = conversion factor of pollutant
CF_{VOC} = 206
CF_{NOx} = 57
CF_{CO} = 97

RICH BURN ENGINES – NOx, VOC & CO

The control method for all rich burn engine BACT determinations achieved in practice was through non-selective catalytic reduction (NSCR) or also commonly called a 3-way catalyst. NSCR reduces the emissions for NOx, VOC, and CO using one control device. The level of reduction for each pollutant depends on the air to fuel ratio that is driving the engine. As the air to fuel ratio gets more lean, NOx reduction goes down but VOC and CO reduction goes up. Due to each individual pollutant reduction being interdependent, determinations will be ranked for these three pollutants, with an emphasis on NOx reduction, rather than emission levels for individual pollutants. The table below shows the ranking for achieved in practice standards for both engines less than 500 bhp and engines 500 bhp and greater as the raking of achieved in practice standards is the same for both categories and there are minimal variations in the standards between the two brake horsepower categories.

Achieved in Practice Standards for NOx, VOC & CO for Rich Burn Engines			
Rank	Pollutant	Standard (A)	Source
1	NOx	25 ppmvd (0.44 g/bhp-hr) or 96% reduction by weight	SMAQMD BACT 8/11/2021
	VOC	60 ppmvd (0.29 g/bhp-hr)	
	CO	< 500 bhp: 2.0 g/bhp-hr ≥ 500 bhp: 1.5 g/bhp-hr	
2	NOx	25 ppmv (0.44 g/bhp-hr)	SJVAPCD BACT 7/16/2018
	VOC	60 ppmv (0.29 g/bhp-hr)	
	CO	2.0 g/bhp-hr	
3	NOx	25 ppmvd	SDCAPCD Rule 7/8/2020
	VOC	86 ppmvd	
	CO	5.6 g/bhp-hr (540 ppmvd)	
4	NOx	57 ppmvd (1.0 g/bhp-hr)	BAAQMD BACT 5/7/2003
	VOC	206 ppmvd (1.0 g/bhp-hr)	
	CO	2.75 g/bhp-hr	
5	NOx	85.5 ppmvd (1.5 g/bhp-hr)	SCAQMD BACT 9/2/2022
	VOC	< 130 bhp: 309 ppmvd (1.5 g/bhp-hr) ≥ 130 bhp: 206 ppmvd (1.0 g/bhp-hr)	
	CO	2.0 g/bhp-hr	
6	NOx	2.0 g/bhp-hr	EPA NSPS
	VOC	1.0 g/bhp-hr	
	CO	4.0 g/bhp-hr	

Achieved in Practice Standards for NOx, VOC & CO for Rich Burn Engines			
Rank	Pollutant	Standard (A)	Source
7	All	No determinations listed specifically for rich burn engines	EPA RBLC

(A) All PPM values are corrected to 15% oxygen. VOC PPM standards are calculated as methane.

LEAN BURN ENGINES – NOx, VOC & CO

NOx reduction in spark ignited engines can be reduced through leaning the air/fuel ratio of the engine and use of good combustion practices. Although, as the air/fuel ratio gets leaner and the NOx emissions decrease, the VOC and CO emissions will increase, and engine power decreases. Therefore, emission reduction when operating a lean burn engine is a balance between these three pollutant levels and the engine power. Due to each individual pollutant reduction being interdependent, determinations will be ranked for these three pollutants as a set, with an emphasis on NOx reduction, rather than emission levels for NOx, VOC, and CO individually.

Unlike engines with a rich air/fuel ratio, NSCR cannot be used on engines with a lean air/fuel ratio due to the composition of the exhaust stream. To achieve further NOx reduction, the air/fuel ratio would need to be further leaned which increases other pollutants and compromises the performance of the engine or through add-on Selective Catalytic Reduction (SCR). There are currently no achieved in practice standards that require SCR. It is discussed later in this determination on the technological feasibility of SCR in this application.

Achieved in Practice Standards for NOx, VOC & CO for Lean Burn Engines < 500 BHP			
Rank	Pollutant	Standard (A)	Source
1	NOx	1.0 g/bhp-hr	SMAQMD BACT 8/11/2021
	VOC	206 ppmv (1.0 g/bhp-hr)	
	CO	2.0 g/bhp-hr	
2	NOx	1.0 g/bhp-hr	SJVAPCD BACT 7/16/2018
	VOC	206 ppmv (1.0 g/bhp-hr)	
	CO	2.0 g/bhp-hr	
3	NOx	1.0 g/bhp-hr	BAAQMD BACT 5/7/2003
	VOC	206 ppmvd (1.0 g/bhp-hr)	
	CO	2.75 g/bhp-hr	
4	NOx	1.38 g/bhp-hr	EPA RBLC CA-1225 (B)
	VOC	No standard listed	
	CO	4.0 g/bhp-hr	

Achieved in Practice Standards for NOx, VOC & CO for Lean Burn Engines < 500 BHP			
Rank	Pollutant	Standard (A)	Source
5	NOx	1.5 g/bhp-hr	SCAQMD BACT 9/2/2022
	VOC	206 ppmvd (1.0 g/bhp-hr)	
	CO	2.0 g/bhp-hr	
6	NOx	2.0 g/bhp-hr or 160 ppmv	SDCAPCD Rule 7/8/2020
	VOC	86 ppmv or 1.0 g/bhp-hr	
	CO	4.0 g/bhp-hr or 540 ppmv	
7	NOx	2.0 g/bhp-hr	EPA NSPS
	VOC	1.0 g/bhp-hr	
	CO	4.0 g/bhp-hr	

(A) All PPM values are corrected to 15% oxygen. VOC PPM standards are calculated as methane.
(B) Although there were no specific indicators of the air/fuel ratio of the engine the determination listed no controls were feasible. Lower NOx emissions without an add-on control device are achieved through leaning the air/fuel ratio. Therefore, for purposes of comparison of emission standards it will be assumed that this engine is lean-burn.

Achieved in Practice Standards for NOx, VOC & CO for Lean Burn Engines ≥ 500 BHP			
Rank	Pollutant	Standard (A)	Source
1	NOx	0.5 g/bhp-hr	SMAQMD BACT 8/11/2021
	VOC	206 ppmv (1.0 g/bhp-hr)	
	CO	1.5 g/bhp-hr	
2	NOx	0.5 g/bhp-hr	SJVAPCD BACT 7/16/2018
	VOC	206 ppmv (1.0 g/bhp-hr)	
	CO	2.0 g/bhp-hr	
3	NOx	0.5 g/bhp-hr	EPA RBLC IN-0167
	VOC	No standard	
	CO	No standard	
4	NOx	1.0 g/bhp-hr	BAAQMD BACT 5/7/2003
	VOC	206 ppmvd (1.0 g/bhp-hr)	
	CO	2.75 g/bhp-hr	

Achieved in Practice Standards for NOx, VOC & CO for Lean Burn Engines ≥ 500 BHP			
Rank	Pollutant	Standard (A)	Source
5	NOx	1.5 g/bhp-hr	SCAQMD BACT 9/2/2022
	VOC	206 ppmvd (1.0 g/bhp-hr)	
	CO	2.0 g/bhp-hr	
6	NOx	2.0 g/bhp-hr	EPA RBLC MI-0424
	VOC	103 ppmv (0.5 g/bhp-hr)	
	CO	0.8 g/bhp-hr	
7	NOx	2.0 g/bhp-hr or 160 ppmv	SDCAPCD Rule 7/8/2020
	VOC	86 ppmv or 1.0 g/bhp-hr	
	CO	4.0 g/bhp-hr or 540 ppmv	
8	NOx	2.0 g/bhp-hr	EPA NSPS
	VOC	1.0 g/bhp-hr	
	CO	4.0 g/bhp-hr	

(A) All PPM values are corrected to 15% oxygen. VOC PPM standards are calculated as methane.

PM10 & PM2.5

Typically, PM control for spark ignited engines involve the use of clean fuels and good combustion practices. When permitting, the District assumes all PM emissions are PM2.5 and, therefore, PM10 and PM2.5 standards are equivalent.

Achieved in Practice Standards for PM for Engines < 500 bhp			
Rank	Standard/Control Method	Source	Comments
1	Use of natural gas fuel or equivalent	SMAQMD BACT 8/11/2021	
1	Follow SCAQMD Clean Fuels Policy (policy states use natural gas or equivalent fuel)	SCAQMD BACT 9/2/2022	
1	Use natural gas, LPG, or propane as fuel	SJVAPCD BACT 7/16/2018	
1	Use natural gas	BAAQMD BACT 5/7/2003	BACT only applies to natural gas fired engines

Achieved in Practice Standards for PM for Engines < 500 bhp			
Rank	Standard/Control Method	Source	Comments
1	Use of clean fuel and good combustion practices	EPA RBLC	Many determinations list use of clean burning fuel and good combustion practices
2	No standard	SDCAPCD Rule 7/8/2020	

Achieved in Practice Standards for PM for Engines ≥ 500 bhp			
Rank	Standard/Control Method	Source	Comments
1	Use of natural gas fuel or equivalent and good combustion practices	SMAQMD BACT 8/11/2021	
1	Follow SCAQMD Clean Fuels Policy (policy states use natural gas or equivalent fuel)	SCAQMD BACT 9/2/2022	
1	Use natural gas, LPG, or propane as fuel	SJVAPCD BACT 7/16/2018	
1	Use natural gas	BAAQMD BACT 5/7/2003	BACT only applies to natural gas fired engines
1	Use of clean fuel and good combustion practices	EPA RBLC	Many determinations list use of clean burning fuel and good combustion practices
2	No standard	SDCAPCD Rule 7/8/2020	

SOx

Typically, SOx control for spark ignited engines involves the use of clean fuels and good combustion practices.

Achieved in Practice Standards for SOx			
Rank	Standard	Source	Comments
1	Use of natural gas fuel or equivalent	SMAQMD BACT 8/11/2021	

Achieved in Practice Standards for SOx			
Rank	Standard	Source	Comments
1	Follow SCAQMD Clean Fuels Policy (policy states use natural gas or equivalent fuel)	SCAQMD BACT 9/2/2022	
1	Use natural gas, LPG, or propane as fuel	SJVAPCD BACT 7/16/2018	
1	Use natural gas	BAAQMD BACT 5/7/2003	BACT only applies to natural gas fired engines
1	Use of natural gas and good combustion practices	EPA RBLC ID: IN-0167 & IN-0185	
2	No standard	SDCAPCD Rule 7/8/2020	

Toxics

HAPs are emitted as VOC and the same control technologies that control VOCs also control the HAPs and, therefore, the achieved in practice standards for HAPs are the same as for VOC.

Summary Table

The following control technologies have been identified as the most stringent, achieved in practice control technologies:

Best Control Technologies Achieved in Practice for Engines < 500 bhp			
Pollutant	Equipment/Operation Subcategory	Standard	Source
VOC	Rich Burn	60 ppmvd (0.29 g/bhp-hr)	SMAQMD BACT
	Lean Burn	206 ppmv (1.0 g/bhp-hr)	
NOx	Rich Burn	25 ppmvd (0.44 g/bhp-hr) or 96% reduction by weight	SMAQMD BACT
	Lean Burn	1.0 g/bhp-hr	
SOx	All Engines	Use of natural gas fuel or equivalent	SMAQMD BACT
PM10	All Engines	Use of natural gas fuel or equivalent	SMAQMD BACT
PM2.5	All Engines	Use of natural gas fuel or equivalent	SMAQMD BACT
CO	All Engines	2.0 g/bhp-hr	SMAQMD BACT

Best Control Technologies Achieved in Practice for Engines < 500 bhp			
Pollutant	Equipment/Operation Subcategory	Standard	Source
VHAPs (A) (T-BACT)	Rich Burn	60 ppmvd (0.29 g/bhp-hr)	SMAQMD BACT
	Lean Burn	206 ppmv (1.0 g/bhp-hr)	

(A) A full list of the volatile hazardous air pollutants (VHAP) from natural gas combustion can be found in AP-42, Section 3.2 Natural Gas-fired Reciprocating Engines, Tables 3.2-1, 3.2-2, and 3.2-3.

Best Control Technologies Achieved in Practice for Engines ≥ 500 bhp			
Pollutant	Equipment/Operation Subcategory	Standard	Source
VOC	Rich Burn	60 ppmvd (0.29 g/bhp-hr)	SMAQMD BACT
	Lean Burn	206 ppmv (1.0 g/bhp-hr)	
NOx	Rich Burn	25 ppmvd (0.44 g/bhp-hr) or 96% reduction by weight	SMAQMD BACT
	Lean Burn	0.5 g/bhp-hr	
SOx	All Engines	Use of natural gas fuel or equivalent	SMAQMD BACT
PM10	All Engines	Use of natural gas fuel or equivalent and good combustion practices	SMAQMD BACT
PM2.5	All Engines	Use of natural gas fuel or equivalent and good combustion practices	SMAQMD BACT
CO	All Engines	1.5 g/bhp-hr	SMAQMD BACT
VHAPs (A) (T-BACT)	Rich Burn	60 ppmvd (0.29 g/bhp-hr)	SMAQMD BACT
	Lean Burn	206 ppmv (1.0 g/bhp-hr)	

(A) A full list of the volatile hazardous air pollutants (VHAP) from natural gas combustion can be found in AP-42, Section 3.2 Natural Gas-fired Reciprocating Engines, Tables 3.2-1, 3.2-2, and 3.2-3.

B. TECHNOLOGICALLY FEASIBLE AND COST EFFECTIVE (Rule 202, §205.1.b.):

Technologically Feasible Alternatives:

Any alternative basic equipment, fuel, process, emission control device or technique, singly or in combination, determined to be technologically feasible by the Air Pollution Control Officer.

The table below shows the technologically feasible alternatives identified as capable of reducing emissions beyond the levels determined to be “Achieved in Practice” as per Rule 202, §205.1.a.

Technologically Feasible Alternatives			
Pollutant	**Emission Source Category**	**Standard**	**Source of Standard**
VOC	All Engines	No other technologically feasible option identified	N/A
NOx	Lean Burn Engines All Sizes	SCR	N/A
SOx	All Engines	No other technologically feasible option identified	N/A
PM10	All Engines	No other technologically feasible option identified	N/A
PM2.5	All Engines	No other technologically feasible option identified	N/A
CO	All Engines	No other technologically feasible option identified	N/A

Accurate cost data for equipping SCR to a spark-ignited lean burn emergency standby engine, especially for engines under 500 bhp, is extremely limited. As load rates and exhaust gas temperatures can vary greatly for emergency standby engines SCR is looked at as a last resort for emission reduction.

Typically, staff will use cost data from the EPA Air Pollution Control Cost Manual. The current section on SCR states, “The procedures for estimating costs presented in this report are based on cost data for SCR retrofits on existing coal-, oil-, and gas-fired boilers for electric generating units larger than 25 MWe (approximately 250 MMBtu/hr). Thus, this report’s procedure estimates the cost for typical retrofits of such boilers. The methodology for utility boilers also has been extended to large industrial boilers by modifying the capital cost equations and power consumption (electricity costs) equations to use the heat input capacity of the boiler instead of electrical generating capacity. The procedures to estimate capital costs are not directly applicable to other sources other than utility and industrial boilers.” Because the SCR section in the EPA Air Pollution Cost Manual for SCR control devices specifically states that the methodology for calculating capital costs is only applicable to utility and industrial boilers the SMAQMD will not apply this information to use of SCR on emergency standby spark-ignited engines.

Recently the SMAQMD adopted BACT Determination #330 for emergency standby compression-ignition engines. In the determination a cost effectiveness analysis was done using SCR. Due to the lack of cost information regarding use of SCR on emergency standby spark-ignited engines the SMAQMD will assume that the cost of adding SCR to an emergency standby compression-ignition engine is similar to adding SCR to an emergency standby spark-ignited lean-burn engine.

In BACT Determination #330 the SMAQMD reviewed cost information from the September 2010 amendments to the Airborne Toxic Control Measure for Stationary Compression Ignition Engines and adjusted the assumptions to reflect permitted emissions for maintenance and testing (50 hr/year). The SMAQMD concluded that conducting the cost analysis using 200 hours per year for total operation (maintenance, testing, and emergency use) was not representative of actual engine operation, since emergency use is not predictable or routine. The results are presented in the table below, which is taken from BACT Determination #330 and not edited to preserve the original reference. The table considers costs for both particulate control with a diesel particulate filter (DPF) and NOx control with SCR. For the purpose of this BACT Determination technology assessment only the costs for

NOx control will be considered.

Cost-Effectiveness Associated with the Application of DPF and SCR on Emergency Standby Engines (50 hours/year) (A)							
Regulatory Scenario			HP Range				
			50-174	175-749	750-1,206	1,207-1,999	>2,000
	Average Horsepower:		112	462	978	1604	2630
Scenario 1: DPF Retrofit of Tier 2/3 engine	Cost Effectiveness ($/ton)	PM	$660,000	$662,000	$658,000	$656,000	$656,000
		NOx	N/A	N/A	N/A	N/A	N/A
Scenario 2: DPF/SCR Retrofit of Tier 2/3 engine	Cost Effectiveness ($/ton)	PM	$682,000	$684,000	$682,000	$680,000	$678,000
		NOx	$110,000	$108,000	$68,000	$68,000	$68,000
Scenario 3: Tier 4 Final engine	Cost Effectiveness ($/ton)	NOx	$340,000	$260,000	$140,000	$140,000	$100,000

(A) Cost increases due to controls are from Table B-7 of the Initial Statement of Reasons for Proposed Rulemaking: Proposed Amendments to the Airborne Toxic Control Measure for Stationary Compression Ignition Engines, Appendix B, September 2010. Emission reductions have been adjusted from 31 hours/year of operation to 50 hours/year of operation. Cost effectiveness numbers were converted from dollars per pound to dollars per ton for comparison to the District's cost effectiveness thresholds. Refer to Appendix A for additional details.

As stated in the referenced CARB document, emissions are calculated based on a load factor of 30% and a control factor of 85%. The operational time of the SCR is 20 hrs of the initial 31 hrs/year of operation. Cost effectiveness is calculated based on an equipment life of 25 years of service. Additional information from CARB can be found in the referenced document. SMAQMD cost effective methodology takes into account other factors such as interest rate, labor, insurance, maintenance, energy usage, lower equipment life, etc. that would increase the costs summarized in the table above. In conclusion, SCR after treatment equipment costs alone is not considered cost effective since both the cost effectiveness for reducing the pollutants exceeds the SMAQMD's threshold of $35,300/ton for NOx for direct drive engines. Adding additional operating costs would drive the cost effectiveness further above the thresholds. The details of this analysis can be found in Appendix A of SMAQMD BACT Determination #330.

C. SELECTION OF BACT:

Based on the above analysis, BACT for VOC, NOx, SOx, PM10, PM2.5 and CO will remain at what is currently achieved in practice. The PM standards for engines 500 bhp and greater will be changed to reflect the control standard and not a specific emission limit as discussed above. Additionally, for consistency, all standards for PM and SOx will be changed to "Use

of natural gas fuel and good combustion practices," as good combustion practices are always feasible and typically already required by permit conditions.

Volatile hazardous air pollutants (VHAP) are the primary driver for health risks associated with gaseous fueled engines. VHAPs are emitted as VOC, and the same control technologies that control VOC also control VHAPs. Therefore, the BACT for VOC and T-BACT for HAPs are the same. See the tables below for a summary of the BACT Determinations.:

BACT FOR I.C. ENGINES, STANDBY, SPARK IGNITED, GASEOUS-FUELED (EXCLUDING BIOGAS), < 500 BHP		
Pollutant	**Standard**	**Source**
VOC	Rich Burn Engines: 60 ppmvd @ 15% O_2 as methane Lean Burn Engines: 206 ppmvd @ 15% O_2 as methane	SMAQMD
NOx	Rich Burn Engines: 25 ppmvd @ 15% O_2 or 96% reduction by weight Lean Burn Engines: 1.0 g/bhp-hr	SMAQMD
SOx	Use of natural gas fuel or equivalent and good combustion practices	SMAQMD
PM10	Use of natural gas fuel or equivalent and good combustion practices	SMAQMD
PM2.5	Use of natural gas fuel or equivalent and good combustion practices	SMAQMD
CO	2.0 g/bhp-hr	SMAQMD

T-BACT FOR I.C. ENGINES, STANDBY, SPARK IGNITED, GASEOUS-FUELED (EXCLUDING BIOGAS), < 500 BHP		
Pollutant	**Standard**	**Source**
HAP(A)	Rich Burn Engines: 60 ppmvd Lean Burn Engines: 206 ppmv	SMAQMD

(A) A full list of the hazardous air pollutants (HAP) from natural gas combustion can be found in AP-42, Section 3.2 Natural Gas-fired Reciprocating Engines, Tables 3.2-1, 3.2-2, and 3.2-3.

BACT FOR I.C. ENGINES, STANDBY, SPARK IGNITED, GASEOUS-FUELED (EXCLUDING BIOGAS), ≥ 500 BHP		
Pollutant	**Standard**	**Source**
VOC	Rich Burn Engines: 60 ppmvd @ 15% O_2 as methane Lean Burn Engines: 206 ppmvd @ 15% O_2 as methane	SMAQMD
NOx	Rich Burn Engines: 25 ppmvd @ 15% O_2 or 96% reduction by weight Lean Burn Engines: 0.5 g/bhp-hr	SMAQMD
SOx	Use of natural gas fuel or equivalent and good combustion practices	SMAQMD
PM10	Use of natural gas fuel or equivalent and good combustion practices	SMAQMD

BACT FOR I.C. ENGINES, STANDBY, SPARK IGNITED, GASEOUS-FUELED (EXCLUDING BIOGAS), ≥ 500 BHP		
PM2.5	Use of natural gas fuel or equivalent and good combustion practices	SMAQMD
CO	1.5 g/bhp-hr	SMAQMD

T-BACT FOR I.C. ENGINES, STANDBY, SPARK IGNITED, GASEOUS-FUELED (EXCLUDING BIOGAS), ≥ 500 BHP		
Pollutant	**Standard**	**Source**
HAP(A)	Rich Burn Engines: 60 ppmvd @ 15% O_2 as methane Lean Burn Engines: 206 ppmvd @ 15% O_2 as methane	SMAQMD

(A) A full list of the hazardous air pollutants (HAP) from natural gas combustion can be found in AP-42, Section 3.2 Natural Gas-fired Reciprocating Engines, Tables 3.2-1, 3.2-2, and 3.2-3.

APPROVED BY: *Brian F Krebs* **DATE:** 03-08-2024

Attachment A

Review of BACT Determinations published by EPA

List of BACT determinations published in EPA's RACT/BACT/LAER Clearinghouse (RBLC) for Natural Gas (includes propane & liquefied petroleum gas) I.C. Engines:

Spark-Ignited, Emergency Standby, IC Engines < 500 BHP (Process Code: 17.230)								
RBLC#	**Permit Date (A)**	**Rating (B)**	**Fuel**	**Engine Burn Type**	**Pollutant**	**Standard (C)**	**Control Technology**	**Case-By-Case Basis**
AR-0171 (D)	2/14/2019	Unknown	Natural Gas	Unknown	CO	4.0 g/hp-hr	Good operating practices	BACT-PSD
					NOx	2.0 g/hp-hr	Good operating practices	BACT-PSD
					PM10	0.25 g/kw-hr (0.34 g/hp-hr)	Good operating practices	BACT-PSD
					PM2.5	0.25 g/kw-hr (0.34 g/hp-hr)	Good operating practices	BACT-PSD
					SO2	0.0006 lb/MMbtu	Good operating practices	BACT-PSD
					VOC	1.0 g/hp-hr	Good operating practices	BACT-PSD
CA-1225	4/25/2014	256 BHP	Natural Gas	Unknown	CO	4.0 g/hp-hr	No controls	BACT-PSD
					NOx	0.78 lb/hr (1.38 g/hp-hr)	No controls	BACT-PSD
					PM10	0.0216 lb/hr (0.038 g/hp-hr)	No controls	BACT-PSD
IL-0132 (E)	1/25/2021	Unknown	Natural Gas	Lean	CO	2.0 g/hp-hr	Designed comply with NSPS	BACT-PSD
					NOx	1.0 g/hp-hr	Designed comply with NSPS	BACT-PSD
					VOC	0.7 g/hp-hr	Designed comply with NSPS	BACT-PSD
IN-0288	6/25/2018	100 KW (134 BHP)	Natural Gas	Unknown	CO	0.317 lb/MMBtu (F)	No controls	BACT-PSD
					VOC	0.36 lb/MMBtu	No controls	BACT-PSD
LA-0276	12/15/2016	150 KW (201 BHP)	Natural Gas	Unknown	VOC	1.0 g/hp-hr	Comply with NSPS	BACT-PSD

Spark-Ignited, Emergency Standby, IC Engines < 500 BHP (Process Code: 17.230)								
RBLC#	**Permit Date (A)**	**Rating (B)**	**Fuel**	**Engine Burn Type**	**Pollutant**	**Standard (C)**	**Control Technology**	**Case-By-Case Basis**
LA-0311	7/15/2013	300 BHP	Natural Gas	Unknown	CO	3.31 lb/hr (5.0 g/hp-hr)	Good combustion practices and design compliant with 40 CFR 60 Subpart JJJJ	BACT-PSD
SC-0182	10/31/2017	Unknown	LPG	Unknown	CO	4.0 g/hp-hr	Good combustion practices	BACT-PSD
					NOx	2.0 g/hp-hr	Good combustion practices	BACT-PSD
					PM10	N/A	Good combustion practices	BACT-PSD
					PM2.5	N/A	Good combustion practices	BACT-PSD
					VOC	1.0 g/hp-hr	Good combustion practices	BACT-PSD
VA-0321	3/12/2013	100 KW (134 BHP)	LPG	Unknown	CO	4.0 g/hp-hr	Good combustion practices and use of clean fuel	BACT-PSD
VA-0325	6/17/2016	150 KW (201 BHP)	LPG	Unknown	CO	4.0 g/hp-hr	Good combustion practices	N/A
					NOx	2.0 g/hp-hr	Good combustion practices	N/A
					PM10	0.19 g/hp-hr	No controls feasable	N/A
					PM2.5 (filterable)	0.019 g/hp-hr	Low sulfur fuel and good combustion practices	N/A
					VOC	1.0 g/hp-hr	Good combustion practices	N/A
WI-0297	12/10/2019	375 BHP & 230 BHP	Natural Gas	Lean	VOC	1.0 g/hp-hr	Only fire natural gas and compliance with 40 CFR 60 Subpart JJJJ	BACT-PSD
WI-0267	9/6/2018	80 BHP	Natural Gas	Unknown	VOC	1.0 g/hp-hr	Compliance with 40 CFR 60 Subpart JJJJ	BACT-PSD

(A) Due to the large number of entries only determinations made (based on Permit Date) entered since 01/01/2011 are included in the above table.
(B) Break horsepower in parenthesis are converted from the listed kilowatt rating using a factor of 1.341 kw per hp.
(C) Standards in parenthesis are converted from the listed standard in some cases using the listed horsepower and/or a conversion factor of 1.341 kw per hp.
(D) Some of the standards listed in the EPA RBLC look to be entered incorrectly. Correct units have been taken directly from the issued permit # 1139-AOP-R24.
(E) The standards listed are equivalent to those in 40 CFR 60 Subpart JJJJ for a non-emergency spark-ignited lean-burn engine. Although the BACT Determination for the emergency engines of Illinois EPA Permit # 19120024 Subpart 2.6.2.a requires NOx, VOC, and CO to comply with the limits of 40 CFR Subpart JJJJ for emergency engines. Because of this discrepancy this determination will not be considered when choosing the most stringent determination.
(F) This standard is equivalent to the EPA AP-42, Table 3.2-3 for 4-stroke, lean burn engines, uncontrolled emission standard for CO at a 90 – 105% Load (7/00).

= Selected as the most stringent BACT determination achieved in practice. The most recent determination selected if multiple determinations are the most stringent.

= Not considered due to reason listed in footnote.

Spark-Ignited, Emergency Standby, IC Engines ≥ 500 BHP (Process Code: 17.130)								
RBLC#	**Permit Date (A)**	**Rating (B)**	**Fuel**	**Engine Burn Type**	**Pollutant**	**Standard (C)**	**Control Technology**	**Case-By-Case Basis**
AL-0301	7/22/2014	400 KW (539 BHP)	Propane	Unknown	CO	7.5 lb/1000 gal	No controls feasible	BACT-PSD
					NOx	13 lb/1000 gal	No controls feasible	BACT-PSD
					FPM	0.7 lb/1000 gal	No controls feasible	BACT-PSD
FL-0368	2/14/2019	2000 KW (1491 BHP)	Natural Gas	Unknown	CO	4.0 g/hp-hr	Good combustion practices	BACT-PSD
					NOx	2.0 g/hp-hr	Good combustion practices	BACT-PSD
					VOC	1.0 g/hp-hr	Good combustion practices	BACT-PSD
IN-0167	4/16/2013	620 BHP	Natural Gas	Unknown	NOx	0.5 g/hp-hr	Good combustion practices	BACT-PSD
					SO2	0.0015 g/kw-hr (0.0011 g/hp-hr)	Good combustion practices	BACT-PSD
					PM10	0.2 g/kw-hr (0.15 g/hp-hr)	Good combustion practices	BACT-PSD
					PM2.5	0.2 g/kw-hr (0.15 g/hp-hr)	Good combustion practices	BACT-PSD
IN-0185	4/24/2014	620 BHP	Natural Gas	Unknown	PM10	0.2 g/kw-hr (0.15 g/hp-hr)	No controls feasible	BACT-PSD
					PM2.5	0.2 g/kw-hr (0.15 g/hp-hr)	No controls feasible	BACT-PSD
					SO2	0.0015 g/kw-hr (0.0011 g/hp-hr)	Use of natural gas and good combustion practices	BACT-PSD
KS-0030	3/31/2016	604 BHP	Natural Gas	Unknown	CO	4.0 g/hp-hr	No controls feasible	BACT-PSD
					NOx	2.0 g/hp-hr	No controls feasible	BACT-PSD
					PM10	0.0001 g/hp-hr (E)	No controls feasible	BACT-PSD
					PM2.5	0.0001 g/hp-hr (E)	No controls feasible	BACT-PSD
					VOC	1.0 g/hp-hr	No controls feasible	BACT-PSD

Spark-Ignited, Emergency Standby, IC Engines ≥ 500 BHP (Process Code: 17.130)								
RBLC#	**Permit Date (A)**	**Rating (B)**	**Fuel**	**Engine Burn Type**	**Pollutant**	**Standard (C)**	**Control Technology**	**Case-By-Case Basis**
KY-0110	7/23/2023	636 BHP	Natural Gas	Lean	CO	4.0 g/hp-hr	Good combustion practices	BACT-PSD
					NOx	2.0 g/hp-hr	Good combustion practices	BACT-PSD
					VOC	1.0 g/hp-hr	Good combustion practices	BACT-PSD
LA-0287	7/21/2014	1175 BHP	Natural Gas	Unknown	NOx	2.0 g/hp-hr	Good combustion practices	BACT-PSD
					PM10	0.004 lb/hr (D) (0.0015 g/hp-hr)	Good combustion practices	BACT-PSD
					PM2.5	0.005 lb/hr (D) (0.0019 g/hp-hr)	Good combustion practices	BACT-PSD
LA-0311	7/15/2013	2500 BHP	Natural Gas	Unknown	CO	27.56 lb/hr (5.0 g/hp-hr)	Good combustion practices	BACT-PSD
MI-0412 (G)	12/4/2013	1000 KW (1341 BHP)	Natural Gas	Lean	CO	0.8 g/hp-hr	Oxidation catalyst	BACT-PSD
					NOx	2.0 g/hp-hr	Good combustion practices	BACT-PSD
					PM10	0.01 lb/mmbtu	Good combustion practices	BACT-PSD
					PM2.5	0.01 lb/mmbtu	Good combustion practices	BACT-PSD
					VOC	0.5 g/hp-hr	Oxidation catalyst	BACT-PSD
MI-0420	6/3/2016	1506 KW (2020 BHP)	Natural Gas	Unknown	CO	9.6 lb/hr (2.2 g/hp-hr)	Good combustion practices	BACT-PSD
					NOx	4.8 lb/hr (1.1 g/hp-hr)	Good combustion practices	BACT-PSD
					PM10	0.01 lb/mmbtu	Good combustion practices	BACT-PSD
					PM2.5	0.01 lb/mmbtu	Good combustion practices	BACT-PSD

Spark-Ignited, Emergency Standby, IC Engines ≥ 500 BHP (Process Code: 17.130)								
RBLC#	**Permit Date (A)**	**Rating (B)**	**Fuel**	**Engine Burn Type**	**Pollutant**	**Standard (C)**	**Control Technology**	**Case-By-Case Basis**
MI-0424	12/5/2016	1462 BHP	Natural Gas	Lean	CO	0.8 g/hp-hr	Oxidation catalyst	BACT-PSD
					NOx	2.0 g/hp-hr	Good combustion practices	BACT-PSD
					PM10	0.01 lb/mmbtu	Good combustion practices	BACT-PSD
					PM2.5	0.01 lb/mmbtu	Good combustion practices	BACT-PSD
					VOC	0.5 g/hp-hr	Oxidation catalyst	BACT-PSD
MI-0426	12/4/2017	1818 BHP	Natural Gas	Lean	CO	11.0 lb/hr (2.7 g/hp-hr)	Good combustion practices	BACT-PSD
					NOx	4.0 lb/hr (1.0 g/hp-hr)	Turbo charger & after cooler	BACT-PSD
					PM10	0.01 lb/mmbtu	Good combustion practices	BACT-PSD
					PM2.5	0.01 lb/mmbtu	Good combustion practices	BACT-PSD
MI-0441	12/21/2018	1500 BHP	Natural Gas	Unknown	CO	4.0 g/hp-hr	Burn natural gas; be NSPS compliant	BACT-PSD
					NOx	2.0 g/hp-hr	Burn natural gas; be NSPS compliant	BACT-PSD
					PM10	0.13 lb/hr (0.039 g/hp-hr)	Burn pipeline quality natural gas	BACT-PSD
					PM2.5	0.13 lb/hr (0.039 g/hp-hr)	Burn pipeline quality natural gas	BACT-PSD
					VOC	1.0 g/hp-hr	Burn natural gas; be NSPS compliant	BACT-PSD

Spark-Ignited, Emergency Standby, IC Engines ≥ 500 BHP (Process Code: 17.130)								
RBLC#	**Permit Date (A)**	**Rating (B)**	**Fuel**	**Engine Burn Type**	**Pollutant**	**Standard (C)**	**Control Technology**	**Case-By-Case Basis**
MI-0441	12/21/2018	6000 BHP	Natural Gas	Unknown	CO	4.0 g/hp-hr	Burn natural gas; be NSPS compliant	BACT-PSD
					NOx	2.0 g/hp-hr	Burn natural gas; be NSPS compliant	BACT-PSD
					PM10	0.5 lb/hr (0.038 g/hp-hr)	Burn pipeline quality natural gas	BACT-PSD
					PM2.5	0.5 lb/hr (0.038 g/hp-hr)	Burn pipeline quality natural gas	BACT-PSD
					VOC	1.0 g/hp-hr	Burn natural gas; be NSPS compliant	BACT-PSD
MI-0443	4/26/2019	≥ 500 BHP	Natural Gas	Unknown	VOC	0.5 g/hp-hr	None listed	LAER
MI-0449	6/23/2021	≥ 500 BHP	Natural Gas	Unknown	VOC	0.5 g/hp-hr	Pipeline quality natural gas	LAER
OK-0153 (G)	3/1/2013	2889 BHP	Natural Gas	Lean	CO	0.43 g/hp-hr	Oxidation catalyst	BACT-PSD
					NOx	0.5 g/hp-hr	Lean burn combustion	BACT-PSD
					PM2.5	0.01 lb/mmbtu	Natural gas combustion	BACT-PSD
					VOC	0.44 g/hp-hr	Oxidation catalyst	BACT-PSD
TN-0183 (F)	4/25/2022	2682 BHP	Natural Gas	Unknown	CO	2.2 g/hp-hr	No controls feasible	BACT-PSD
					NOx	1.2 g/hp-hr	No controls feasible	BACT-PSD
					PM10 (filterable)	0.0160 g/hp-hr	No controls feasible	BACT-PSD
					PM2.5 (filterable)	0.0160 g/hp-hr	No controls feasible	BACT-PSD
					SO2	0.0005 g/hp-hr	No controls feasible	BACT-PSD
					VOC	1.0 g/hp-hr	No controls feasible	BACT-PSD
TX-0642	12/20/2013	1328 BHP	Natural Gas	Lean	CO	1.3 g/hp-hr	None listed	BACT-PSD
					NOx	2.0 g/hp-hr	None listed	BACT-PSD

Spark-Ignited, Emergency Standby, IC Engines ≥ 500 BHP (Process Code: 17.130)								
RBLC#	**Permit Date (A)**	**Rating (B)**	**Fuel**	**Engine Burn Type**	**Pollutant**	**Standard (C)**	**Control Technology**	**Case-By-Case Basis**
WI-0297	12/10/2019	675 BHP	Natural Gas	Lean	VOC	1.0 g/hp-hr	Fire only natural gas; Meet requirements in 40 CFR 60, Subpart JJJJ	BACT-PSD
WI-0314	3/10/2022	1520 BHP	Natural Gas	Unknown	CO	4.0 g/hp-hr	Good combustion practices	BACT-PSD
					VOC	1.0 g/hp-hr	Good combustion practices	BACT-PSD

(A) Due to the large number of entries only determinations made (based on Permit Date) entered since 01/01/2011 are included in the above table.
(B) Break horsepower in parenthesis is converted from the listed kilowatt rating using a factor of 1.341 kw per hp.
(C) Standards in parenthesis are converted from the listed standard in some cases using the listed horsepower and/or a conversion factor of 1.341 kw per hp.
(D) BACT was determined to be use of natural gas fuel and good combustion practices. There is no associated BACT emission standard listed on Permit PSD-LA-787 for Alexandria Compressor Station by Louisiana Department of Environmental Quality.
(E) The determination for total PM10 and PM2.5 lists “no controls feasible”. Therefore, the standards listed be equivalent to standards listed in AP-42, which are roughly 0.08 g/hp-hr (0.019 lb/mmbtu) for 4-stroke rich-burn engines or 0.04 g/hp-hr (0.010 lb/mmbtu) for 4-stroke lean-burn engines. The numeric PM standards listed in this determination are several orders of magnitude lower than those of AP-42 and could not be achieved without some kind of control technology. Staff are unaware of control technology for PM for spark-ignited engine other than that of good combustion practices and, therefore, must conclude that an error has been made listing the standards in the EPA RBLC.
(F) This determination lists in the pollutant notes: Company may use manufacturer’s certified emission factors instead of test. Additionally, the standard for filterable PM and total PM are the same value. Total particulate matter is usually higher than that of filterable particulate matter as it contains condensable particulate matter as well as filterable. Therefore, the values for PM10 and PM2.5 will be considered filterable PM only.
(G) The engine in this determination powers an emergency generator but is allowed to operate more than 200 hours per year. Under Sac Metro AQMD regulation this engine would be considered prime power and, therefore, the standards will not be considered in this BACT determination.

= Selected as the most stringent BACT determination achieved in practice. The most recent determination selected if multiple determinations are the most stringent.

= Not considered due to reason listed in footnote

Attachment B

Review of BACT Determinations published by ARB

List of BACT determinations published in ARB's BACT Clearinghouse for: IC Engine - Stationary, Natural Gas Fuel:

IC Engines – Stationary, Natural Gas Fueled, Emergency Standby, < 500 BHP						
Source	**Date**	**Rating**	**Function**	**Pollutant**	**Standard (A)**	**Control Technology**
SCAQMD (ID 361525)	1/17/2002	93.8 BHP	Driving an Electrical Generator	NOx	0.15 g/bhp-hr	Three-Way Catalytic Converter and Air/Fuel Ratio Controller
				CO	0.6 g/bhp-hr	Three-Way Catalytic Converter and Air/Fuel Ratio Controller
				VOC	0.15 g/bhp-hr	Three-Way Catalytic Converter and Air/Fuel Ratio Controller

IC Engines – Stationary, Natural Gas Fueled, Emergency Standby, ≥ 500 BHP						
Source	**Date**	**Rating**	**Function**	**Pollutant**	**Standard**	**Control Technology**
SCAQMD (ID 359876)	10/2/1999	750 BHP	Emergency Flood Control Pump	NOx	0.15 g/bhp-hr	Three-Way Catalytic Converter and Air/Fuel Ratio Controller
				CO	0.6 g/bhp-hr	Three-Way Catalytic Converter and Air/Fuel Ratio Controller
				VOC	0.15 g/bhp-hr	Three-Way Catalytic Converter and Air/Fuel Ratio Controller