SMAQMD BACT CLEARINGHOUSE

ACTIVE

CATEGORY Type:	**Engine used for training**		
BACT Category:	Minor Source BACT		
BACT Determination Number:	377	**BACT Determination Date:**	11/12/2024

Equipment Information

Permit Number:	N/A - Generic BACT Determination
Equipment Description:	IC ENGINE COMPRESSION - PRIME
Unit Size/Rating/Capacity:	Engines greater 50 HP and less than 749 HP
Equipment Location:	N/A - Generic BACT Determination

BACT Determination Information

District Contact: Venk Reddy **Phone No.:** 279-207-1146 **Email:** vreddy@airquality.org

ROCs	**Standard:**	Diesel: Tier 4 emission standards for the HP range Rich Burn Engines: 60 ppmvd @ 15% O2 as methane Lean Burn Engines: 206 ppmvd @ 15% O2 as methane
	Technology Description:	
	Basis:	Achieved in Practice
NOx	**Standard:**	Diesel: Tier 4 emission standards for the HP range Rich Burn Engines: 25 ppmvd @ 15% O2 or 96% reduction by weight Lean Burn Engines: 1.0 g/bhp-hr
	Technology Description:	
	Basis:	Achieved in Practice
SOx	**Standard:**	Diesel fuel with a sulfur content no greater than 0.0015% by weight. Use of natural gas fuel or equivalent and good combustion practices
	Technology Description:	
	Basis:	Achieved in Practice
PM10	**Standard:**	Diesel: Tier 4 emission standards for the HP range Use of natural gas fuel or equivalent and good combustion practices
	Technology Description:	
	Basis:	Achieved in Practice
PM2.5	**Standard:**	Diesel: Tier 4 emission standards for the HP range Use of natural gas fuel or equivalent and good combustion practices
	Technology Description:	
	Basis:	Achieved in Practice

	CO	**Standard:**	Diesel: Tier 4 emission standards for the HP range Gaseous Fueled <500 BHP 2.0 g/hp-hr Gaseous Fueled ≥500 BHP 1.5 g/hp-hr
		Technology Description:	
		Basis:	Achieved in Practice
	LEAD	**Standard:**	Diesel: Tier 4 emission standards for the HP range
		Technology Description:	
		Basis:	Achieved in Practice

Comments:	This is a generic BACT determination based on BACT determinations made, and published, by other air agencies in California and/or other States.

Printed: 11/18/2024

777 12th Street, Ste. 300 SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT Sacramento, CA 95814

BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION

DETERMINATION NOS.:	377
DATE:	8/2/2024
ENGINEER:	Venk Reddy

Category/General Equip Description:	Internal Combustion (I.C.) Engine, low use prime for training.
Equipment Specific Description:	I.C. Engine, Diesel-fueled any HP, Natural Gas fueled less than 749 HP used exclusively for training at a fixed location like a training center, used less than 100 hr/yr.
Equipment Size/Rating:	Minor Source BACT
Previous BACT Det. No.:	none

This BACT determination is for engines used to power electrical generators (gensets) for the purposes of training technicians on how to operate and maintain them. This BACT does not cover in-situ training, nor does it cover portable gensets. It covers stationary gensets located at a school that are used for teaching and training. Although the equipment will produce electricity, the gensets used in a training capacity will not be connected to any electrical system. The equipment may be connected to a load bank if needed. This BACT determination will only be applicable to equipment operating less than 100 hours per year.

The facilities involved with training operations are not major sources. Therefore, only minor source BACTs and rules will be considered. For the purposes of rule review, the engines will be considered a limited use prime power engines unless specifically exempted by a rule.

SMAQMD has reviewed gensets used for standby electrical generation under BACT 330, 341 & 342. These BACTs for compression ignition and spark ignited engines are currently active and have been reviewed to ensure that there have been no significant changes since their publication. Additional investigation on standby engines will not be reviewed from other air districts or sources. The conclusions from SMAQMD BACTs 330, 341 and 342 will be considered achieved in practice and the highest standard for standby engines. Investigation from other judications will be focused on the limited use prime power engines used for training. All standby engine standards will be taken into account through the consideration of the published SMAQMD BACT reviews.

BACT/T-BACT ANALYSIS

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

The following control technologies are currently employed as BACT/T-BACT for engines used for training by the following agencies and air pollution control districts:

US EPA

Projects entered in the EPA RACT/BACT LAER clearinghouse between the period of 1/1/2014 and 8/3/2024 were reviewed for this BACT determination. There were no projects involved with training.

RULE REQUIREMENTS:

40 CFR Part 60 Subpart IIII – Standards of Performance for Stationary Compression Internal Combustion Engines: This regulation applies to owners/operators of new stationary compression ignition engines that commenced construction after July 11, 2005. [40 CFR §60.4200]

40 CFR §60.4204(b)
Owners and operators of 2007 model year and later non-emergency stationary Compression Ignition Internal Combustion Engines (CI ICE) with a displacement of less than 30 liters per cylinder must comply with the emission standards for new nonroad CI engines in §60.4201, for all pollutants, for the same model year and maximum engine power for their 2007 model year and later stationary CI ICE. Section §60.4201 refers to 40 CFR 1039.101. This section is written for manufactures of IC engines after 2014 and later. The requirements are basically Tier IV engine standards, with exceptions given for engine family rounding and banking.

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-100 HP) must comply with the emission standards of 40 CFR 1048.101 (c) field testing which is 3.8 g/kw-hr for HC + NOx and CO is 6.5g/kW-hr.

40 CFR §60.4233(e)
For SI ICE greater than or equal to 100 HP, compliance is determined by Table 1. (except rich burn LPG)

Table 1 to this subpart for stationary SI ICE (applies to both lean and rich burn natural gas engines).

40 CFR Subpart JJJJ Table 1: Emission Standards					
	Maximum Engine Power	Manufacture Date	Emission Standards (A) g/bhp-hr (ppmvd at 15% O_2)		
			NOx	CO	VOC (B)
Non-Emergency SI Natural Gas and Non-Emergency SI Lean Burn LPG	100≤ HP < 500	1/1/2011	1.0 (82)	2.0 (270)	0.7 (60)
Non-Emergency SI Lean Burn Natural Gas and LPG	500≤HP<1,350	7/1/2010	1.0 (82)	2.0 (270)	0.7 (60)
Non-Emergency SI Natural Gas and Non-Emergency SI Lean Burn LPG (except lean burn 500≤HP<1,350)	HP≥500	7/1/2010	1.0 (82)	2.0 (270)	0.7 (60)

(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) 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 new and existing stationary IC engines. New engines that comply with 40 CFR 60 Subpart IIII or Subpat JJJJ already meet the requirements of this NESHAP, as noted below.

40 CFR §63.6590(c)
Stationary RICE subject to Regulations under 40 CFR Part 60. An affected source that meets any of the criteria in paragraphs (c)(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 subpart.

California Air Resource Board (CARB)

BACT
There are no BACT determinations that involve training.

Source: ARB BACT Clearinghouse

T-BACT
There are no T-BACT standards published in the clearinghouse for this category. However, the ATCM standards (see Rule Requirements Below) represent BACT for toxic air contaminants (TACs) and can therefore be considered T-BACT.

RULE REQUIREMENTS:
Title 17, Cal. Code Regs. Sections 93115 through 93115.15 – Airborne Toxic Control Measure (ATCM) for Stationary Compression Ignition (CI) Engines: This regulation applies to owners/operators of new and existing stationary compression ignition engines greater than 50 bhp.

§93115.7(a): New Prime Diesel-Fueled CI Engine (>50 bhp) emission standards.

(1) *Emission Standards:* All new stationary prime diesel-fueled CI engines (>50 bhp) shall meet the applicable emission standards for all pollutants for the model year and maximum horsepower rating as specified in Table 4 Emission Standards for New stationary Prime Diesel-Fueled CI Engines, in effect on the date of acquisition or submittal as defined in section 93115.4

Table 4: Emission Standards for New Stationary Emergency Standby Diesel-Fueled CI Engines – g/bhp-hr (g/kW-hr) (A)

Maximum Engine Power	Model year(s)	PM	NMHC + NOx	NOx	NMHC	CO
50 ≤ HP < 75 (37 ≤ kW < 56)	2013+	0.02 (0.03)	3.5 (4.7)			3.7 (5.0)
75 ≤ HP < 100 (56 ≤ kW < 75)	2015+	0.01 (0.02)		0.3 (0.4)	0.14 (0.19)	3.7 (5.0)
100 ≤ HP < 175 (75 ≤ kW < 130)	2015+	0.01 (0.02)		0.3 (0.4)	0.14 (0.19	3.7 (5.0)
175 ≤ HP < 750 (130 ≤ kW < 560)	2014+	0.01 (0.02)		0.3 (0.4)	0.14 (0.19)	2.6 (3.5)
750 ≤ HP <1207 (560 ≤ kW < 900) Gensets	2015+	0.02 (0.03)		0.5 (0.67)	0.14 (0.19)	2.6 (3.5)
HP > 1,207 (kW > 900)	2015+	0.02 (0.03)		0.5 (0.67)	0.14 (0.19)	2.6 (3.5)

Sacramento Metropolitan AQMD

BACT
There are no BACT determinations regarding training with engines. Since these engines will be used as training for gensets and gensets are used on standby engines the existing BACT for standby engine requirements will be considered.

From SMAQMD BACT 330

BACT FOR I.C. ENGINES, EMERGENCY STANDBY, DIESEL-FUELED FOR ELECTRICAL GENERATION	
Pollutant	**Standard**
VOC	Tier 4 emission standards for the HP range
NOx	Tier 4 emission standards for the HP range
SOx	Diesel fuel with a sulfur content no greater than 0.0015% by weight.
PM10	Tier 4 emission standards for the HP range
PM2.5	Tier 4 emission standards for the HP range.
CO	Tier 4 emission standards for the HP range

T-BACT FOR I.C. ENGINES, EMERGENCY STANDBY, DIESEL-FUELED		
Pollutant	**Standard**	**Source**
Diesel PM	BACT 330 Standards listed for PM10 & PM2.5 (A)	SMAQMD
	Particulate filter (B)	SCAQMD

(A) Since the current BACT standards are more health protective than previously published T-BACT standards, T-BACT standards will be updated to follow the BACT standards.
(B) Applicable to major sources. This is included in the event that an emergency direct drive pump is placed at a major source which will be determined on a case by case basis if a particulate filter is technologically feasible at the time of application.

From SMAQMD BACT 341 & BACT 342

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

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

(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**
VOC	Rich Burn Engines: 60 ppmvd @ 15% O_2 as methane Lean Burn Engines: 206 ppmvd @ 15% O_2 as methane
NOx	Rich Burn Engines: 25 ppmvd @ 15% O_2 or 96% reduction by weight Lean Burn Engines: 0.5 g/bhp-hr
SOx	Use of natural gas fuel or equivalent and good combustion practices
PM10	Use of natural gas fuel or equivalent and good combustion practices
PM2.5	Use of natural gas fuel or equivalent and good combustion practices
CO	1.5 g/bhp-hr

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

(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.

The standards above for a rich burn engine are typically achieved with a three way catalyst or non selective catalytic reduction (NSCR) and air to fuel ratio controller. There are times at low horse power where the air to fuel ratio controller is not used to achieve the same results. SMAQMD has removed the requirements for equipment and use the emission standard to drive the technology.

RULE REQUIREMENTS:
Rule 412 Stationary Internal Combustion Engines Located at Major Stationary Sources of NOx (Adopted 06-01-1995) Since the equipment is not located at a major source, this rule is not applicable.

South Coast AQMD

BACT There are no BACTs for engines used for training.

RULE REQUIREMENTS:

Regulation II Rule 219 Equipment Not Requiring a Written Permit Pursuant to Regulation II (Amended April 7-2023)

Per Section (d)(2)(I), Internal combustion engines used exclusively for training at educational institutions are exempt from a written permit.

San Joaquin Valley APCD

BACT
There are no BACT assessments listed for engines used for training.

RULE REQUIREMENTS:

Rule 4701 – INTERNAL COMBUSTION ENGINES – PHASE I (AMENDED August 21, 2003)

Per section 5.2 for low use engines, engines that operate less than 1,000 hr/year must meet the following emissions. (section 5.1.2)

Engine Type	NOx @ 15% O_2	CO @ 15% O_2
Rich Burn	90 ppmv or 80% reduction	2,000 ppmv
Lean-Burn	150 ppmv or 70% reduction	2,000 ppmv
Diesel	600 ppmv or 20% reduction	2,000 ppmv

Rule 4702 – INTERNAL COMBUSTION ENGINES (Amended August 19, 2021)

This rule defines low use engine as a less than 200 hours per calendar year with some exceptions to when the engine is connected to the power grid. Per section 4.2, this rule does not apply to a low use engine.

San Diego County APCD

BACT
Source: NSR Requirements for BACT (June 2023)
There are no BACT determinations for engines used for training.

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 – (Rev. adopted & Effective July 8, 2020)
This rule applies to stationary I.C. Engines ≥ 50 BHP located at a stationary source.

Per section (b)(3)(ii) The provisions of this rule do not apply for engines that operate less than 200 hours per calendar year.

Bay Area AQMD

BACT/T-BACT
There are no BACT standards that are applicable to this category.

RULE REQUIREMENTS:
Reg 9, Rule 8 – Nitrogen Oxides and Carbon Monoxide from Stationary Internal Combustion Engines (Revised 10/15/2019)

Per section 9-8-111 engines that operate less than 100 hours are exempt from this rule.

Summary of Achieved in Practice Control Technologies

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

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES For Limited Use Engines used in Gensets for Training – Diesel fueled engine	
Pollutant	**Standard**
VOC	1. Applicable Tier 4 emission requirements for all HP ranges. [SMAQMD, CARB, EPA] 2. No Standard [BAAQMD, SJVAPCD, SDAPCD]
NOx	1. Applicable Tier 4 emission requirements for all HP ranges (SMAQMD, CARB, EPA) 2. 600 ppmv for diesel @ 15% O2 [SJVAPCD]
SOx	1. Diesel fuel with a sulfur content no greater than 0.0015% by weight [SMAQMD]

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES For Limited Use Engines used in Gensets for Training – Diesel fueled engine	
Pollutant	**Standard**
PM10	1. Applicable Tier 4 emission requirements for all HP ranges [SMAQMD, EPA, CARB] 2. No Standard [BAAQMD,SJVAPCD,SDAPCD]
PM2.5	1. Applicable Tier 4 emission requirements for all HP ranges [SMAQMD, EPA, CARB] 2. No Standard [BAAQMD,SJVAPCD,SDAPCD]
CO	1. Applicable CO emission standard for horsepower range (A),(B) based on the ATCM for Stationary CI Engines. [ARB, SMAQMD, EPA, EPA] 2. No standard [BAAQMD, SDAPCD]
Diesel PM (T-BACT)	1. Use of a particulate filter [SMAQMD] 2. Applicable PM emission standard for horsepower range based on 40 CFR 60 subpart IIII, 40 CFR 63 Subpart ZZZZ. [EPA]

(A) SCAQMD Rule 1470 requires new engines (as of January 1, 2013) located within 50 meters of a sensitive receptor that are not replacement engines to meet Tier 4 emission standards for PM.

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES For Limited Use Engines used in Gensets for Training – Natural Gas fueled Engine	
Pollutant	**Standard**
VOC	1. 60 ppmvd @ 15% or 0.7 g/bhp-hr (EPA) 2. Rich Burn Engines: 60 ppmvd @ 15% O_2 as methane Lean Burn Engines: 206 ppmvd @ 15% O_2 as methane (SMAQMD) (A) 3. Rich Burn Engines: 90 ppmvd or 80% reduction @ 15% O_2 as methane Lean Burn Engines: 150 ppmvd or 70% reduction @ 15% O_2 as methane [SJVAPCD] 4. No standard [BAAQMD, SDAPCD]
NOx	1. Rich Burn Engines: 25 ppmvd @ 15% O_2 or 96% reduction by weight Lean Burn Engines: 0.5 g/bhp-hr ≥ 500 hp Lean Burn Engines 1,0 g/bhp-hr <500 hp [SMAQMD] (A) 2. 82 ppmvd @ 15% O_2 or 1 g/hp-hr[EPA] 3. Rich Burn Engines: 90 ppmv or 80% reduction Lean Burn 150 ppmv or 70% reduction [SJVAPCD] 4. No standard [BAAQMD, SDAPCD]
SOx	1. Use of natural gas fuel or equivalent and good combustion practices [SMAQMD]
PM10	1. Use of natural gas or equivalent and good combustion practices [SMAQMD] 2. No Standard [BAAQMD,SJVAPCD,SDAPCD]

SUMMARY OF ACHIEVED IN PRACTICE CONTROL TECHNOLOGIES **For Limited Use Engines used in Gensets for Training – Natural Gas fueled Engine**	
Pollutant	**Standard**
PM2.5	1. Use of natural gas or equivalent and good combustion practices [SMAQMD] 2. No Standard [BAAQMD,SJVAPCD,SDAPCD]
CO	1. 2.0 g/hp-hr < 500 BHP, 1.5 g/hp-hr ≥ 500 BHP [SMAQMD, EPA] 2. 2,000 ppmv at 15% O_2 [SJVAPCD] 3. No standard [BAAQMD, SDAPCD]
T-BACT (A)	1. VOC limit of 60 ppmvd at 15% O_2 for a rich burn engine and 206 ppmvd at 15% O_2 for a lean burn engine.

(A) <u>Rich burn engine standards are typically achieved with an NSCR or 3 way catalyst and if needed an air to fuel ratio controller.</u>

<u>Summary Table</u>

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

BEST CONTROL TECHNOLOGIES ACHIEVED IN PRACTICE **For Limited Use Engines used in Gensets for Training – Diesel fueled engine**		
Pollutant	**Standard**	**Source**
VOC	Applicable Tier 4 emission requirements for all HP ranges.	EPA, CARB, SMAQMD
NOx	Applicable Tier 4 emission requirements for all HP ranges.	CARB, SMAQMD,
SOx	Diesel fuel with a sulfur content no greater than 0.0015% by weight. Compliance with BACT 330	SMAQMD,
PM10	Applicable Tier 4 emission requirements for all HP ranges.	CARB, SMAQMD,
PM2.5	Applicable Tier 4 emission requirements for all HP ranges.	SMAQMD;
CO	Applicable Tier 4 emission requirements for all HP ranges.	ARB, SMAQMD,
Diesel PM (T-BACT)	Applicable Tier 4 emission requirements for all HP ranges.	ARB, SMAQMD,

BEST CONTROL TECHNOLOGIES ACHIEVED IN PRACTICE **For Limited Use Engines used in Gensets for Training – Natural Gas Fueled Engine < 500 BHP**		
Pollutant	**Standard**	**Source**
VOC (A)	Rich Burn Engines: 60 ppmvd @ 15% O_2 as methane Lean Burn Engines: 206 ppmvd @ 15% O_2 as methane	SMAQMD
NOx (A)	Rich Burn Engines: 25 ppmvd @ 15% O_2 or 96% reduction by weight Lean Burn Engines: 1.0 g/bhp-hr (SMAQMD)	SMAQMD
SOx	Diesel fuel with a sulfur content no greater than 0.0015% by weight	SMAQMD
PM10	Use of natural gas or equivalent and good combustion practices	SMAQMD
PM2.5	Use of natural gas or equivalent and good combustion practices	SMAQMD
CO	2.0 g/hp-hr	SMAQMD, EPA
T-BACT	VOC limit of 60 ppmvd at 15% O_2 for a rich burn engine and 206 ppmvd at 15% O_2 for a lean burn engine.	SMAQMD

A) Standards typically are achieved with an NCRC or three way catalyst and air to fuel ratio controller.

BEST CONTROL TECHNOLOGIES ACHIEVED IN PRACTICE **For Limited Use Engines used in Gensets for Training – Natural Gas Fueled Engine ≥ 500 BHP**		
Pollutant	**Standard**	**Source**
VOC (B)	Rich Burn Engines: 60 ppmvd @ 15% O_2 as methane Lean Burn Engines: 206 ppmvd @ 15% O_2 as methane	SMAQMD
NOx (B)	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
PM2.5	Use of natural gas fuel or equivalent and good combustion practices	SMAQMD
CO	1.5 g/bhp-hr	SMAQMD
T-BACT	HAP limit of 60 ppmvd at 15% O_2 for a rich burn engine and 206 ppmvd at 15% O_2 for a lean burn engine. (A)	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.
(B) Typically achieved with the use of an NSCR or three way catalyst and an air to fuel ratio controller.

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

Discussion:

The use of Tier 4 or equivalent engines rated greater than or equal to 50 HP used for electrical generation has been shown to be achieved in practice.

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.

Since Tier 4 engines are considered the highest available controls for compression ignition engines, no other alternatives were investigated.

For natural gas engines that are rich burn, it has been shown that the use of an NSCR or three way catalyst and if necessary an air to fuel ratio controller are needed to achieve the standards identified. Since it has been achieved in practice, the use of these control devices will not be further considered.

For natural gas fired spark ignited engines:

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

Cost Effective Determination:
After identifying the technologically feasible control options, a cost analysis is performed to take into consideration economic impacts for all technologically feasible controls identified.

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
	Average Horsepower:		112	462
Scenario 1: DPF Retrofit of Tier 2/3 engine	Cost Effectiveness ($/ton)	PM	$660,000	$662,000
		NOx	N/A	N/A

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**
	Average Horsepower:		112	462
Scenario 2: DPF/SCR Retrofit of Tier 2/3 engine	Cost Effectiveness ($/ton)	PM	$682,000	$684,000
		NOx	$110,000	$108,000
Scenario 3: Tier 4 Final engine	Cost Effectiveness ($/ton)	NOx	$340,000	$260,000

(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, the use of SCR has not been shown to be cost effective for spark ignited engines as shown in SMAQMD BACT 341 and 342 as well as 330. Although the analysis was done based on 50 hours/year, increasing the hours increases the duty of the controls and will decrease the cost effectiveness by doubling the amount of pollutants controlled. The lowest cost effective number would be $108,000/ton controlled for an SCR & DPF retrofit. When divided by 2 to take into account the added usage, the cost effective number would be $54,000. The current cost effectiveness level established on 7-1-24 is $35,300/ton for NOx. This shows that the NOx controls are not cost effective.

C. SELECTION OF BACT:

Based on the above analysis, BACT for VOC, NOx, SOx, PM10, and CO will remain at what is currently achieved in practice and BACT for PM2.5 will be set to be the same as for PM10.

BACT FOR I.C. ENGINES, EMERGENCY STANDBY, DIESEL-FUELED FOR ELECTRICAL GENERATION		
Pollutant	**Standard**	**Source**
VOC	Tier 4 emission standards for the HP range	SMAQMD
NOx	Tier 4 emission standards for the HP range	SMAQMD
SOx	Diesel fuel with a sulfur content no greater than 0.0015% by weight.	SMAQMD
PM10	Tier 4 emission standards for the HP range	SMAQMD
PM2.5	Tier 4 emission standards for the HP range.	SMAQMD
CO	Tier 4 emission standards for the HP range	SMAQMD

T-BACT FOR I.C. ENGINES, EMERGENCY STANDBY, DIESEL-FUELED		
Pollutant	**Standard**	**Source**
Diesel PM	BACT 330 standards listed for PM10 & PM2.5 (A)	SMAQMD

(A) Since the current BACT standards are more health protective than previously published T-BACT standards, T-BACT standards will be updated to follow the BACT standards.

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

BACT FOR I.C. ENGINES, STANDBY, SPARK IGNITED, GASEOUS-FUELED (EXCLUDING BIOGAS), < 500 BHP		
CO	2.0 g/bhp-hr	SMAQMD

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
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)		
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.

APPROVED BY: Brian F Krebs **DATE:** **11-12-2024**

Appendix A

CARB Cost Effectiveness Analysis Discussion

During the most recent rulemaking for updates to the Airborne Toxic Control Measure for Stationary Compression Ignition Engines (Title 17, Cal. Code. Regs., §93115 to §93115.15), ARB conducted a cost effectiveness analysis to determine if selective catalytic reduction (SCR) and/or diesel particulate filters (DPF) were technologically feasible and cost effective for emergency use applications (Initial Statement of Reasons for Proposed Rulemaking: Proposed Amendments to the Airborne Toxic Control Measure for Stationary Compression Ignition Engines, Appendix B, September 2010).

The analysis concluded that DPFs were technologically feasible with some additional operational and monitoring conditions. These conditions would include either operating the engine for additional hours to allow the filter to regenerate (Passive DPF) or regenerating the filter during scheduled down-time (Active DPF), and monitoring for backpressure, cold starts, and 30-minute idle sessions.

The analysis also concluded that SCR was technologically feasible but had some additional challenges. Because emergency standby engines routinely operate only for scheduled maintenance and testing, the engines do not operate more than 15-30 minutes, and do operate at no or low load. Because of this the exhaust would not likely reach the temperature (260 °C to 540 °C) required for the catalyst to function properly. To circumvent this problem, the engine would need to be operated with higher loads and in many cases for longer periods of time. This could be a challenge for most emergency standby applications as most businesses do not have load banks in house and would have to create a larger load on the engine to get the catalyst up to operational temperature.

Urea handling and maintenance is also an important consideration. Urea crystallization in the lines can cause damage to the SCR system and to the engine itself. Crystallization in the lines is more likely in emergency standby engines due to their periodic and low hours of usage. Urea also has a shelf life of approximately two years. This could increase the cost of operating a SCR for emergency standby engines since the low number of annual hours of operation experienced by most emergency standby engines could lead to urea expiration. The urea would then have to be drained and replaced, creating an extra maintenance step and an increased cost to the end user.

ARB staff determined that while SCR systems may be technically feasible, there are significant operational hurdles to overcome before routine use of SCR on emergency standby engines is practical. This is because the majority of operating hours for emergency standby engines occur during short 15 to 30 minute maintenance and testing checks are at low engine loads. In most cases, the temperature needed for the SCR catalyst to function will not be reached during this operation and the SCR will not provide the expected NOx reductions.

ARB staff also reviewed the feasibility of requiring Tier 4 final engines in lieu of aftermarket treatment. ARB concluded that Tier 4 engines that rely on after-treatment technology for emergency standby applications will not be available from the original equipment manufacturers. Representatives from the Engine Manufacturer's Association (EMA) have indicated that it will not be economically viable for engine manufacturers to develop and maintain a Tier 4 emergency standby engine platform for California. At the time, ARB staff concluded that Tier 4 engines for emergency standby applications will not be available "off-the-shelf." Rather, each owner or operator will need to purchase a new Tier 2 or Tier 3 engine and then work with suppliers to retrofit the engine with a DPF and/or SCR to meet the Tier 4 emission standards for all pollutants. Subsequent to this, "off-the-shelf" Tier 4 final engines have become available for emergency purposes, and the District determined that Tier 4 final engines are technologically feasible. The District reviewed some engine list prices and determined that these prices were generally in line with the prices listed in Appendix B (Initial Statement of Reasons for Proposed Rulemaking: Proposed Amendments to the Airborne Toxic Control Measure for Stationary Compression Ignition Engines, Appendix B, September 2010).

Cost-Effectiveness Associated with the Application of DPF and SCR on Emergency Standby Engines (50 hours/year)							
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 Increase Due to Controls (A)	PM	$4,300	$17,600	$37,200	$60,900	$99,900
		NOx	N/A	N/A	N/A	N/A	N/A
	Emission Reductions (lb) (B)	PM	13	53	113	186	305
		NOx	N/A	N/A	N/A	N/A	N/A
	Cost Effectiveness ($/lb)	PM	$333	$331	$329	$328	$328
		NOx	N/A	N/A	N/A	N/A	N/A
Scenario 2: DPF/SCR Retrofit of Tier 2/3 engine	Cost Increase Due to Controls (A)	PM	$4,400	$18,200	$38,500	$63,100	$103,400
		NOx	$8,800	$36,300	$76,900	$126,100	$206,900
	Emission Reductions (lb) (B)	PM	13	53	113	186	305
		NOx	161	666	2240 (C)	3677	6032
	Cost Effectiveness ($/lb)	PM	$341	$342	$341	$340	$339
		NOx	$55	$54	$34	$34	$34

(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.
(B) Emission reductions have been adjusted from 31 hours/year of operation to 50 hours/year of operation.
(C) The referenced table shows the emission of NOx to be based on 0.3 g/hp-hr. The proposed value is based on 0.5 g/hp-hr

Cost-Effectiveness Associated with Installing Tier 4 Final Emergency Standby Engines (50 hours/year)							
Regulatory Scenario			HP Range				
			50-174	175-749	750-1,206	1207-1,999	>2,000
	Average Horsepower:		112	462	978	1604	2630
Tier 4 Final Engine	Cost Increase (A)	NOx	$28,000	$85,008	$156,480	$248,465	$328,750
	Emission Reductions (lb) (B)	NOx	161	666	2,240	3,677	6,032
	Cost Effectiveness ($/lb)	NOx	$170	$130	$70	$70	$50

(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.

(B) Emission reductions have been adjusted from 31 hours/year of operation to 50 hours/year of operation.