ACTIVE SMAQMD BACT CLEARINGHOUSE

CATEGORY: **IC ENGINE SPARK - PRIME**

BACT Size: Small Emitter BACT (PTE < 10 lb/day) **DEGASSING - IC ENGINE**

BACT Determination Number: 173	**BACT Determination Date:** 4/11/2018

Equipment Information

Permit Number: 25320
Equipment Description: DEGASSING - IC ENGINE
Unit Size/Rating/Capacity: 2 - 49 HP Spark Ignited Engines, at 998 hr
Equipment Location: PROACT FSI-FIELD SPECIALTIES INC

EXPIRED

BACT Determination Information

ROCs	**Standard:**	50 ppmvd @ 3% O2 as Hexane
	Technology Description:	See BACT for complete standard
	Basis:	Achieved in Practice
NOx	**Standard:**	None
	Technology Description:	3 way catalyst and air to fuel ratio controller
	Basis:	Cost Effective
SOx	**Standard:**	40 ppmvd
	Technology Description:	
	Basis:	Achieved in Practice
PM10	**Standard:**	None
	Technology Description:	Use of Natural Gas or LPG as secondary Fuel
	Basis:	Achieved in Practice
PM2.5	**Standard:**	None
	Technology Description:	Use of Natural Gas or LPG as secondary Fuel
	Basis:	Achieved in Practice
CO	**Standard:**	None
	Technology Description:	3 way catalyst and air to fuel ratio controller
	Basis:	Achieved in Practice
LEAD	**Standard:**	
	Technology Description:	
	Basis:	

Comments:

District Contact: Venk Reddy Phone No.: (916) 874 - 4861 email: vreddy@airquality.org

777 12th Street, Third Floor

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Sacramento, CA 95814

BEST AVAILABLE CONTROL TECHNOLOGY DETERMINATION

EXPIRED

DETERMINATION NO.: 173

DATE: 12/14/17

ENGINEER: Venk Reddy

Category/General Equip Description: Tank/Pipeline Degassing System

Equipment Specific Description: Spark ignited engine rated to less than 50 HP, fired on natural gas or LPG and VOC laden fuel flow.

Equipment Size/Rating: Minor Source BACT

Previous BACT Det. No.: N/A

This BACT was determined under the project for A/C 25320.

BACT ANALYSIS

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

The following control technologies are currently employed as BACT from an engine rated less than 50 HP used for VOC remediation.

District/Agency	Best Available Control Technology (BACT)/Requirements
US EPA	**BACT** Source: EPA RACT/BACT/LAER Clearinghouse

For portable tank degassing systems with an IC engine as the control.	
VOC	N/A – No BACT determinations found
NOx	N/A – No BACT determinations found
SOx	N/A – No BACT determinations found
PM10	N/A – No BACT determinations found
PM2.5	N/A – No BACT determinations found
CO	N/A – No BACT determinations found

RULE REQUIREMENTS:
None

There are no standards that cover portable spark ignited engines rated at 49 HP or degassing operations that use an engine for control.

<table>
<tr><th>District/Agency</th><th>Best Available Control Technology (BACT)/Requirements</th></tr>
<tr><td>ARB</td><td><u>BACT</u>
<u>Source: ARB BACT Clearinghouse</u>

<u>RULE REQUIREMENTS</u>:
None

<table>
<tr><td colspan="2">For a spark ignited engine rated less than 50 HP used for tank degassing</td></tr>
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</table>
<u>RULE REQUIREMENTS</u>:

Rule 420 Sulfur Content of Fuels (8/13/81)
Section 301 limits the sulfur content of any gaseous fuel to 50 gr/scf, calculated as H_2S at standard conditions (equivalent to 809 ppmv as H_2S).</td></tr>
</table>

South Coast AQMD

BACT

For a spark ignited engine rated less than 50 HP used for tank degassing	
VOC	No standard
NOx	No standard
SOx	No standard
PM10	No standard
PM2.5	No standard
CO	No standard

Per Ken Matsuda of SCAQMD (909-396-2656) the BACT listed for portable spark ignited engines is not applicable to a 49 HP engine nor for an engine used for degassing tanks. SCAQMD did not consider this BACT or Rule 1147 in the permitting of this unit in the SCAQMD and used the equipment specs and vendor data to determine permittable emission limits. No BACT determination was made as a result of the permitting of this equipment.

RULE REQUIREMENTS:

Regulation XI, Rule 1110.2 Emissions from Gaseous and Liquid fueled Engines (6/3/16) This rule is not applicable since it only applies to engines rated over 50 brake horsepower.

Regulation XI, Rule 1147 NOx Reduction from Miscellaneous Sources (7/7/17) This rule is not applicable to internal combustion engines.

Regulation XI, Rule 1149 Storage Tank and Pipeline Cleaning and Degassing (5/2/08)
Section 1149(c)(1)(B) requires the VOC concentration of the degassed tanks to be reduced to less than 5,000 ppmv, measured as methane at least 1 hour after degassing has ceased. Section 1149(c)(8) requires the VOC concentration in the exhaust stream of any control device to be less than 500 ppmv, measured as methane. This is equivalent to a control device efficiency of 90%.

Rule 431.1 Sulfur Content of Gaseous Fuels (6/12/98)
Section (c)(2) limits the sulfur content of a gaseous fuel to 40 ppmv as H_2S.

San Diego County APCD

BACT
Source: NSR Requirements for BACT.

For a spark ignited engine rated less than 50 HP used for tank degassing	
VOC	No standard
NOx	No standard

	SOx No standard **PM10** No standard **PM2.5** No standard **CO** No standard **RULE REQUIREMENTS**: **Rule 62 Sulfur Content of Fuels (10/21/81)** Section (b)(1) requires any gaseous fuel to contain no more than 10 grains of sulfur compounds, calculated as hydrogen sulfide, per 100 cubic feet of dry gaseous fuel at standard conditions (equivalent to 162 ppmv as H_2S).
Bay Area AQMD	**BACT** Source: BAAQMD BACT Guideline For a spark ignited engine rated less than 50 HP used for tank degassing **VOC** No standard **NOx** No standard **SOx** No standard **PM10** No standard **PM2.5** No standard **CO** No standard **RULE REQUIREMENTS**: **Reg 8, Rule 5 Section 328.1** For tanks larger than 75 m^3 the emissions of organic compounds resulting from degassing shall be controlled by an abatement device that collects and processes all organic vapors and gasses and has an abatement efficiency of at least 90% by weight and operate the degassing equipment until the concentration of organic compounds in the tank is less than 10,000 ppm expressed as methane.

San Joaquin Valley APCD

BACT
Source: SJVAPCD BACT Guideline

There is no achieved in practice requirements identified in BACT guideline 7.1.8. Technologically feasible options are discussed in the appropriate section.

For a spark ignited engine rated less than 50 HP used for tank degassing.	
VOC	No standard
NOx	No standard
SOx	No standard
PM10	No standard
PM2.5	No standard
CO	No standard

SMAQMD contacted SJCAPCD (Carlos Garcia 559-230-5893) regarding the validity of 7.1.8.A which lists standards that are not listed in the summary for this category. Per Mr. Garcia, the BACT was determined to be the control equipment and not the volumetric emission standard. They considered the control equipment as technologically feasible because of the age of the application.

RULE REQUIREMENTS:

Rule 4623 **Storage of Organic Liquids (5/19/05)**

Section 5.7.5.4.1 requires the operation of the degassing equipment until the organic vapor concentration is 5,000 ppmv or less, or is 10% or less of the lower explosion limit (LEL), whichever is less.

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

BEST CONTROL TECHNOLOGIES ACHIEVED		
Pollutant	**Standard**	**Source**
VOC	1. The operation of the APCD shall continue until the gaseous VOC concentration within the tank/pipeline is reduced to 5,000 ppmv, measured as methane, for at least one hour after degassing operations have ceased (A). 2. The operation of the APCD shall continue until the gaseous VOC concentration within the tank/pipeline is reduced to 5,000 ppmv or less, or is 10% or less of the lower explosion limit (LEL), whichever is less (B). 3. The operation of the APCD shall continue until the gaseous VOC concentration within the tank/pipeline is reduced to 10,000 ppmv.	SCAQMD (Rule 1149) SJVAPCD (Rule 4623) BAAQMD (Regulation 8 Rule 5)
NOx	None	N/A
SOx	40 PPMV as H2S	SCAQMD (Rule 431.1)
PM10	None	N/A
PM2.5	None	N/A
CO	None	N/A

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.

VOC	50 ppmvd @ 3% O2 as hexane 3 way catalyst and air to fuel ratio controller, use of natural gas or LPG as secondary fuel
NOx	1. 11 ppmvd @ 15% O2 2. 3-way catalyst and air to fuel ratio controller, use of natural gas or LPG as secondary fuel
SOx	None
PM10	Use of Natural gas or LPG as secondary fuel
PM2.5	Use of Natural gas or LPG as secondary fuel
CO	3 way catalyst and air to fuel ratio controller, use of natural gas or LPG as secondary fuel

The applicant has proposed the use of a 3 way catalyst and air to fuel ratio controller. Similar to the degassing operation using a thermal oxidizer, the applicant has shown that treating the fuel for sulfur is possible. The similar requirements will be added to this BACT determination.

VOC Control
SMAQMD has a BACT for degassing a tank with the use of a thermal oxidizer. (SMAQMD BACT #121). This BACT has established a VOC emission rate of 50 ppmvd @ 3% O2 as Hexane as the emission rate. This was determined by BACT determinations at other agencies that have emission standards for degassing with a thermal oxidizer as a control devise. It is therefore technically feasible for a degassing operation to meet this standard and is assumed to be cost effective.

NOx Control
Since the engines used in this degassing operation are very similar to 50 hp engines for which a BACT standard of 11 ppmvd at 15% O2 has been established, these engines will be evaluated for technological feasibility and cost effectiveness. Though a degassing engine faces specific challenges due to changing fuel quality and quantity that might make this type of emission standard not technically feasible, for the purposes of this evaluation, it will be assumed to be technically feasible and the analysis will be focused only on cost effectiveness. See below for the cost effectiveness determination

PM10 Control
The applicant has stated that propane will be used as the secondary fuel for the engine. Therefore it is technologically feasible and assumed to be cost effective.

PM2.5 Control
The applicant has stated that propane will be used as the secondary fuel for the engine. Therefore it is technologically feasible and assumed to be cost effective.

CO Control

The applicant has stated that propane will be used as the secondary fuel for the engine and is proposing an air to fuel ratio controller, therefore it is technologically feasible and assumed to be cost effective.

Cost Effective Determination:

Maximum Cost per Ton of Air Pollutants Controlled

1. A control technology is considered to be cost-effective if the cost of controlling one ton of that air pollutant is less than the limits specified below (except coating operations):

Pollutant	Maximum Cost ($/ton)
ROG	17,500
NO_X	24,500
PM_{10}	11,400
SO_X	18,300
CO	TBD if BACT triggered

Cost Effectiveness Analysis Summary

NOx Control

To meet a NOx emission standard of 11 ppmvd @ 15% O2, SMAQMD, as part of the proposed engine rule, has determined that the annualized cost to meet this standard is $3,359 per engine. The engine used to develop this cost was a 225 HP rich burn spark ignited engine. Though the engines that are the subject of this BACT determination are smaller, the control equipment would be similar (3-way catalyst and A/F ratio controller). Therefore this annualized cost estimate will be assumed to be equal for a smaller engine and will be doubled since there are two engines. As for baseline emissions, the SCAQMD, when permitting these degassing engines, determined the uncontrolled NOx emission limit to be 200 PPM.

Therefore, at 998 hours per year of operation for both engines, the mass emissions of NOx would be 580 lbs at 200 PPM and 32 lbs at 11 PPM. This results in approximately 0.274 tons of NOx reduced. With an annualized cost of $6,718, any operation of the engine set at 998 hours or less will result in a cost effectiveness value of greater than $24,500 and therefore will be not be cost effective. Therefore the operational limit will be set to 998 hours per year for the engine set.

Refer to attachment A for a complete cost analysis.

C. SELECTION OF BACT:

For a spark ignited engine rated less than 50 HP used for VOC remediation Operating less than 998 hours per year.		
Pollutant	**Standard**	**Source**
VOC	50 ppmvd @ 3% O_2 as Hexane; the operation of the control must continue until the gaseous VOC concentration within the tank/pipeline is reduced to 5,000 ppmvd, measured as methane, for at	SMAQMD

	least one hour after degassing operations have ceased. The use of a 3 way catalyst and air to fuel ratio controller and the use of natural gas or LPG as secondary fuel	
NOx	No Standard, 3 way catalyst and air to fuel ratio controller, use of natural gas or LPG as secondary fuel, limited to a maximum of 998 hours/year	New Determination
SOx	40 PPMVD of H2S in Fuel	SCAQMD
PM10	Use of Natural gas or LPG as secondary fuel	New Determination
PM2.5	Use of Natural gas or LPG as secondary fuel	New Determination
CO	No Standard, 3 way catalyst and air to fuel ratio controller, use of natural gas or LPG as secondary fuel	New Determination

REVIEWED BY: _____ **DATE:** _____

APPROVED BY: _____ **DATE:** 4/11/18

Attachment A Cost analysis to meet 11 PPMVD of NOx

NOx Emissions at 3030 Hrs./yr.	
200 ppm of NOx (A)	580.072727 lb./year
11 PPM of NOx (A)	31.904 lb./year
NOx controlled	548.168727 lb./year
	0.27408436 tons/year
Total cost per engine	$3,359
Total cost per equipment	$6,718
Cost/ NOx Controlled	**$24,510.70 $/ton**

(A) Volumetric emissions were converted to mass using the physical parameters of the engine exhaust which were 77 cfm per engine, 250F and 1 ATM MW of NOx was estimated at the molecular weight of NO2 or 46.01 g/mol and assuming the exhaust is 0% O2

NSCR Cost Estimate for California Resources Production, P/O 18844

Source: Phone conversation between Kevin Williams and Robert Bono, 4/12/17
plus follow-up email from Robert Bono, 4/12/17
Johnson Matthey
(949) 307-1265

Information obtained for a 225-hp rich burn engine fueled with natural gas:

Equipment Model:	Modulex W30, stainless steel w/ critical grade silencer
Equipment Cost:	$9,600
Installation:	$1,000
Catalyst Life:	2 years
Annual Maintenance Labor:	$500
Other Recurring Costs:	
Replace catalyst every 2 years:	$2,200
Wash catalyst every 2 years (In years catalyst not replaced):	$500
Assumed Inlet (uncontrolled) NOx:	13 g/hp-hr
Required Outlet NOx:	0.15 g/hp-hr

Initial Costs:

Equipment	$9,600
Installation	$1,000
Total Initial Cost	$10,600
Annualized Initial Cost	$1,509 per year

Annual Costs:

Maintenance Labor	$500
Catalyst Replacement	$1,100 1/2 of catalyst cost because it is replaced every two years
Catalyst Wash	$250 1/2 of wash cost because it is washed every two years
Total Annual Cost	$1,850 per year

Total Cost:

Annualized Initial Cost	$1,509
Annual Cost	$1,850
Total Cost	**$3,359 per year**

Note to file:

Response to comments to SMAQMD BACT #173 Degassing with Two 49 HP Engines

SMAQMD received one comment on 4/2/18 From Mike Joy.

Comment:

"RSI has extended considerable amount of effort in designing both the engine and air fuel controller to achieve desired emissions results. This alone makes it necessary (in my opinion) to call out the manufacturer of the engine and control system by name. Otherwise any 49 BHP engine with any air fuel controller would meet BACT as defined in this application. "

Response:

SMAQMD acknowledges the fact that the RSI engine system is the source of the BACT requirements. BACT requirements are not brand specific, but are based on emission rates. It would be up to future applicant that would be using the results of this BACT determination to meet the emission standards, with the chosen equipment.

Venk Reddy

4/11/18

Venk Reddy

From: Mike Joy <Mike.Joy@rsi-save.com>
Sent: Monday, April 2, 2018 11:47 AM
To: BACT Determinations
Subject: Bact # 173 - Tank/Pipeline Degassing System with 2 - 49 HP Engines used for Abatement
Attachments: V 4 specs 1-1-16.pdf; How is works - RSI air pollution and odor control equipment.pdf

To whom it may concern:

RSI is manufacturer of this proprietary LSG 875 engine rated at 49 BHP. That engine, coupled with its Phoenix 1000 A/F control system, is what designates the "achieved in practice" noted in the BACT application. I have attached RSI's V4 specification for your reference.

RSI has extended considerable amount of effort in designing both the engine and air fuel controller to achieve desired emissions results. This alone makes it necessary (in my opinion) to call out the manufacturer of the engine and control system by name. Otherwise any 49 BHP engine with any air fuel controller would meet BACT as defined in this application.

To my knowledge, there is no other manufacture of a 49 BHP engine with conventional A/F controller that will achieve the desired results because of the multiple fuel and oxygen source. See attached "How it works" to get a better understanding of the complexity of air pollution control using RSI's engine/control system.

Our engines were first given BACT recognition by SCAQMD in 1991 and has been improved ever since.

Air Resources Board

Statewide Best Available Control Technology (BACT) Clearinghouse

Remediation Services International Soil vapor extraction system	7/28/91 (App. no. 251289) A/N 30-544-02 District Contact: John Yee South Coast AQMD (909) 396-2531	RSI IC engine fired on propane No limit (Expected control efficiency of 99.8%)

Thank you for your consideration.

Michael (Mike) Joy, Principal
FSI Field Specialties, Inc.
Remediation Service, Int'l
4835 Colt Street, Unit D
Ventura, CA 93003
805.377.8619 CELL (preferred method of phone contact)
805.644.8382 x14
805.644.8378 FAX