VERMONT AGENCY OF NATURAL RESOURCES
Department of Environmental Conservation
Air Quality & Climate Division

DRAFT TECHNICAL ANALYSIS OF AN AIR CONTAMINANT SOURCE FOR A TITLE V PERMIT TO CONSTRUCT AND OPERATE

#AOP-14-034 / DEC PIN# SJ91-0001
#AOP-15-032 / DEC PIN# SJ91-0001

_____, 2015

Prepared By: Tony Mathis, Environmental Engineer

SOURCE / FACILITY:	Coventry Municipal Solid Waste Facility consisting of Coventry Landfill (Landfill Operation) and Landfill Gas to Energy Operation (LFGTE Operation) 21 Landfill Lane Orleans County Coventry, VT 05825
LANDFILL OPERATION OWNER/OPERATOR:	New England Waste Services of Vermont, Inc. (NEWSVT) 25 Greens Hill Lane Rutland, VT 05701
CONTACT:	Mr. John Gay, E.I. New England Waste Services of Vermont, Inc. 25 Greens Hill Lane Rutland, VT 05701 Tel: (802) - 223-7221
LFGTE OPERATION OWNER/OPERATOR:	Coventry Clean Energy Corporation (CCEC) 40 Church Street East Montpelier, VT 05651
CONTACT:	Mr. Dan Weston Coventry Clean Energy Corporation 40 Church Street East Montpelier, VT 05651 Tel: (802) - 224-2334
AREA DESIGNATION:	Attainment for PM_{10}, SO_2, NO_2, CO, & Pb / Unclassified for ozone
UTM COORDINATES:	$^{7}19^{170}$ m E, $^{49}76^{808}$ m N, Zone 18

This Technical Support Document by the Agency of Natural Resources, Department of Environmental Conservation, Air Quality & Climate Division (hereinafter "Agency") is intended to provide additional technical information, discussion and clarification in support of the Permit. It is not intended to provide a comprehensive review of the Facility or the permit process or to duplicate the information contained in the Permit or elsewhere.

1.0 INTRODUCTION

New England Waste Services of Vermont, Inc. (also referred to herein as "NEWSVT") owns and operates a municipal solid waste (MSW) landfill (Landfill Operation) on Landfill Lane in the town of Coventry, Vermont. Coventry Clean Energy Corporation (also referred to herein as "CCEC" or "Permittee") owns and operates a landfill gas (LFG) to energy facility (LFGTE Operation) that is located on property leased from NEWSVT at the unlined area of the Landfill Operation. The LFGTE Operation combusts LFG from the Landfill Operation in internal combustion engines, and uses these LFG-fired engines to power electrical generators, generating electrical power for sale on the regional electric grid.

The Landfill Operation and the LFGTE Operation are considered to be a single source of air emissions, and are collectively referred to herein as "Facility". The Landfill Operation is comprised of the original unlined landfill, also referred to as Areas A & B, that operated from approximately 1970 until 1992 when it was closed and capped. In 1993 a new, lined landfill began operations near the original landfill and consists of Phases I, II, III and IV. Phase III reached its capacity and Phase IV began acceptance of waste in 2006. A Phase V expansion and its associated gas volumes are accounted for in this permit herein but the expansion has not yet been approved by the Waste Management Division. The LFGTE Operation was constructed in 2005, with the installation of three (3) CAT G3520C LE LFG fired internal combustion engines (CAT G3520C engines) that begin operating on July 12, 2005. A fourth CAT G3520C engine was installed and began operating of January 12, 2007, and a fifth CAT G3520C engine was installed and begin operating on June 22, 2009.

NEWSVT is required to actively collect LFG generated by waste decomposition at the Landfill Operation and route the LFG to a combustion device to thoroughly destroy the non-methane organic compounds (NMOCs) contained in the LFG. The LFG collection system consists of a series of LFG collection points including vertical wells drilled into refuse-containing areas of the Landfill Operation as well as horizontal collection trenches and leachate cleanout piping, all connected by piping to a vacuum blower that maintains a negative pressure in the lines to extract LFG from the Landfill Operation.

Collected LFG is either combusted in a flare or flares owned and operated by NEWSVT, or sold to CCEC. CCEC treats the LFG with a dewatering, chilling, and filtration treatment system to remove impurities in the LFG before using the treated LFG as gaseous fuel in the five (5) CAT G3520C engines at the LFGTE Operation. The five (5) CAT G3520C engines at the LFGTE Operation are rated to generate a maximum of 8.0 megawatts (MW) of electrical power.

NEWSVT has proposed to the Solid Waste division to increase the waste acceptance rate for the Landfill Operation, and has also incorporated as part of their Air Permit application, a potential increase in LFG generation associated with the proposed Cell 5 expansion at the Landfill Operation. The composition of the waste received by the Landfill Operation likely will change in the immediate future, as Act 148 is phased in. Act 148 bans disposal of recyclables (metal, glass, plastics #1 & #2, and paper/cardboard) by July 1, 2015; leaf and yard debris and clean wood by July 1, 2016; and food scraps by July 1, 2020. The decreasing amounts of decomposable material in the waste may result in lower rates of

LFG generation. However, to address a potential increase in LFG generation, NEWSVT has proposed to evaluate Facility emissions based on the generation of 5,545 standard cubic feet per minute (scfm) of LFG, and the capture of 5,000 scfm of LFG.

CCEC has proposed to increase the carbon monoxide (CO) emission rate from the CAT 3520C engines to 3.5 grams per brake horsepower hour (g/bhp-hr) from the previously permitted 2.75 g/bhp-hr. This increased emission rate results in a significant increase in annual CO emissions, and triggers review as a major modification. As a result of this major modification review, CCEC has proposed to increase the stack heights at the LFGTE Operation.

CCEC has also proposed to install a siloxane removal system (SRS) as part of the LFGTE Operation to remove siloxanes in LFG, and minimize the formation of siliceous deposits in the CAT G3520C engines. Reducing combustion chamber deposits and wear in the engines is anticipated to reduce engine maintenance costs.

This review of the Facility and its associated air emissions includes the following:

#AOP-14-034: Permit to Operate renewal and the Permit to Construct for modification of the LFG emission rate from the Landfill Operation to include the generation of 5,545 standard cubic feet per minute (scfm) of LFG, and the capture of 5,000 scfm of LFG.

#AOP-15-032: Permit to Operate issuance and the Permit to Construct for modification of the Most Stringent Emission Rate (MSER) for carbon monoxide (CO) emissions from the five (5) CAT G3520C LFG-fired internal combustion engine generators at the Facility, and for the installation of an enclosed ground flare associated with the SRS.

Administrative Milestones

Table 1-1: Administrative Summary

Administrative Item	Result or Date
Date Application(s) Received:	09/11/2014
Date Application(s) Administratively Complete:	09/11/2014
Date Application(s) Technically Complete:	xx/xx/2015
Affected State(s) Noticed & Date(s) Noticed of Application Receipt:	Connecticut, Maine, Massachusetts, New Hampshire and New York. (__/__/2015)
Date Proposed Decision::	xx/xx/2015
Date & Location Draft Decision/Comment Period Noticed:	xx/xx/2015
Date & Location Public Meeting Noticed:	Not Requested
Date & Location of Public Meeting:	Not Requested
Deadline for Public Comments:	xx/xx/2015
Date Submitted to U.S. EPA:	__/__/2015
Total Application Fees:	$15,000.00
Total Application Review Fees:	$15,000.00

Table 1-1: Administrative Summary	
Administrative Item	**Result or Date**
Classification of Source Under §5-401:	§5-401(16) (Any source …which would otherwise be subject to regulation pursuant to the Clean Air Act, as amended (42 USC 7401, et seq.) §5-401(17 [Such other sources as may be designated as air contaminant sources by the Air Pollution Control Officer on a case-by-case basis]
Classification of Application:	Major Modification / Renewal
Construction and Operating Permit: Designation of Facility:	Title V
Facility SIC/NAIC Code(s):	4953 / 562212 and 4931/221129
Facility SIC/NAIC Code Description(s):	Refuse Systems, Solid Waste Landfills and Electric and other Services Combined, Other Electric Power Generation

Table 1-2: Future Allowable Facility Air Contaminant Emissions (tons/year)[1]						
$PM/PM_{10}/PM_{2.5}$ [2]	**SO_2**	**NO_x**	**CO**	**VOCs**	**HAPs [3]**	**CO_2e [3]**
<19.8	<40	76.0	495	<50	>10/25	544,305

[1] $PM/PM_{10}/PM_{2.5}$ - particulate matter and particulate matter of 2.5 micrometers in size or smaller; SO_2 - sulfur dioxide; NO_x - oxides of nitrogen measured as NO_2 equivalent; CO - carbon monoxide; VOCs - volatile organic compounds; HAPs - hazardous air pollutants as defined in §112 of the federal Clean Air Act.

[3] Emissions of an individual HAP (formaldehyde) are estimated to be >10 tpy and emissions of total HAPs combined are estimated greater than 25 tpy.

[3] CO_2e - Carbon dioxide equivalent emissions. Includes where appropriate carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and other fluorinated greenhouse gases. Emissions are from both biogenic and non-biogenic sources. See Section 3.3 for further details.

2.0 FACILITY DESCRIPTION

2.1 Facility Locations and Surrounding Area

The Facility is located approximately 1.8 miles south southwest of downtown Newport. The area surrounding the Facility is primarily wooded areas and cultivated fields. The Newport State Airport is located approximately 1.5 miles south of the Facility, and the South Bay of Lake Memphremagog is located approximately 0.5 miles to the east. The Facility is located approximately 200 km from the Lye Brook Wilderness area in Manchester, Vermont and approximately 97 km from the Great Gulf and Dry River Wilderness areas in New Hampshire.

2.2 Facility Description

The Facility consists of two different activities the Landfill Operation and the LFGTE Operation, which are operated by different parties. Allowable emissions from the Facility are the aggregate of emissions from the Landfill Operation and the LFGTE Operation. The Landfill Operation is classified by the Standard Industrial Classification ("SIC") as 4953(Refuse Systems, Solid Waste Landfills) and by the North American Industrial Classification System (NAICS) as 562212 (Solid Waste Landfills). The LFGTE Operation is classified as SIC 4931 (Electric and Other Services Combined, Other Electric Power Generation), and NAICS 562212 (Solid Waste Landfills) and 221129 (Other Electric Power Generation).

The Landfill Operation and the LFGTE Operation are considered to be a single source of air emissions, and are collectively referred to herein as "Facility". Allowable emissions from the Facility are the aggregate of emissions from the Landfill Operation and the LFGTE Operation. The permit for this Facility was previously issued solely to NEWSVT. However, to better delineate responsibility between the two operations at the Facility, two separate permits have been prepared for this single Facility,

NEWSVT is responsible under #AOP-14-034 for the Landfill Operation, which consists of the original unlined landfill, the currently operating landfill, the LFG collection system, and flares operated by NEWSVT that are used to combust LFG without energy recovery. The area of the original landfill that operated from approximately 1970 until 1992 when it was closed and capped is also referred to as Areas A & B. LFG from Areas A & B is collected using a passive gas collection system, and combusted in two gas flares connected to the passive gas collection system.

In 1993 a new, lined landfill began operation near the original landfill and consists of Phases I, II, III and IV. Phase III reached its capacity and Phase IV began acceptance of waste in 2006. NEWSVT is required to actively collect the LFG that is generated from the decomposition of wastes within the lined landfill areas and route it to a combustion device to thoroughly destroy NMOCs contained in the LFG. The LFG collection system consists of a series of gas collection points including wells drilled into the landfill as well as horizontal collection trenches and leachate cleanout piping, all connected by piping to a blower that maintains a negative pressure in the lines to extract LFG from the landfill. A demister knock-out vessel is installed to remove moisture droplets from the gas is installed in the collection lines before these line enter the blower.

The collected LFG is sold to CCEC, who treats the LFG to remove impurities before using the treated LFG as a gaseous fuel in the internal combustion engines at the LFGTE Operation. Any LFG collected by the Landfill Operation that is not combusted in the engines at the LFGTE Operation, such as LFG generation excess to the needs of the engines or gas generated during periods the engines are off-line is routed to on-site flares operated by NEWSVT as part of the Landfill Operation to ensure continued complete combustion of the LFG.

NEWSVT has increased their waste acceptance rate, and has also proposed a Phase V expansion to excavate and relocate the unlined landfill Areas A & B, placing the approximately 146,000 Mg of excavated refuse into the lined landfill area. The proposed Phase V landfill expansion would be located in the 11 acre footprint of the former Areas A & B, and would have a capacity of approximately 1,943,650 Mg of refuse. Approval to relocate the refuse in Areas A & B and the Phase V expansion is contingent on NEWSVT obtaining all necessary permits, approvals and/or variances. At a minimum this would require a Solid Waste Certification approval from the Agency of Natural Resources, Department of Environmental Conservation, Waste Management and Prevention Division. As requested by NEWSVT, the review for the Facility has incorporated a potential increase in gas generation from the Phase V expansion.

The LFGTE Operation was originally installed under the authority of #AOP-03-044, which was issued to NEWSVT, and included approval for four (4) LFG-fired internal combustion engines. An additional LFG-fired internal combustion engine was installed under the authority of #AOP-06-060, which was also issued to NEWSVT

During the permit review process for this Facility, it was determined that CCEC is responsible for the LFGTE Operation, and #AOP-15-032 will be issued to CCEC to address their responsibilities for the LFGTE Operation.

The LFGTE Operation currently consists of five (5) LFG-fired internal combustion engines each rated at 2,221 hp and 1,600 kW of generation capacity, capable of producing a total of 8.0 megawatts of electric power. The LFGTE Operation also includes additional equipment for pressurizing, drying, and cleaning the LFG that is intended to improve gas quality and extend the service life of the engines, and a second blower to provide complete backup blower capability. The LFG is treated by the LFGTE Operation by passing the LFG through a non-contact heat exchanger that utilizes chilled water to cool the gas stream, removing additional moisture by condensation. The LFG is then treated with a liquid sorption dehumidification system that uses a series of glycol liquid (sorbent) sprays in the gas stream to absorb the remaining moisture from the LFG. The LFG then passes through four (4) coalescing polishing filters before being sent to the engines where it is combusted. A 100 kW backup generator is installed at the LFGTE Operation to provide electric power for lighting and system operation in the event of an electrical power loss. The LFGTE Facility has no black-start capability.

CCEC has proposed to increase the carbon monoxide (CO) emission rate from the engines at the LFGTE Operation to 3.5 grams per brake horsepower hour (g/bhp-hr) from the previously permitted 2.75 g/bhp-hr. This increased emission rate triggered review as a major modification, and as a result of this major modification review, CCEC has also proposed to increase the stack heights from the engines at the LFGTE Operation.

In addition, CCEC has proposed the installation of the SRS as part of the LFG conditioning before the LFG is combusted in the CAT 3520C engines. The SRS will include a new enclosed flare to combust offgas from the SRS treatment process. [Add more details of system when they are available]. This system is anticipated to be operational by late 2016 – early 2017.

Equipment and operations at the Facility are summarized in the following table.

Landfill Operation - Specifications			
Landfill Area/Phase	Years of Operation[1]	Refuse Capacity (Mg) [2] And Landfill Size (acres)	Cumulative Facility Refuse Capacity (Mg) [2] / Landfill size (acres) [3]
Unlined landfill Areas A & B	1970 - 1992	146,050 (11 acres)	146,050 / (11 acres)
Landfill Phases I, II, and III	1993 - 2006	2,423,504 (34 acres)	2,569,554 / (45 acres)
Landfill Phase IV	2006 - 2020	4,706,259 (45 acres)	7,275,813 / (90 acres)
Landfill Phase V	- 2021	1,943,650 (20 acres)	9,073,413 / (99 acres)

Landfill Operation - Miscellaneous Equipment		
Equipment	Rating	Location
Two (2) Used oil Furnaces	300,000 Btu/each	Maintenance garage
Four (4) No. 2 Fuel-oil fired Portable Space Heaters	2 x 110,000 Btu/each 1 x 175,000 Btu/each 1 x 215,000 Btu/each	Maintenance garage
One (1) Fuel-oil fired Portable Space Heater	85,000 Btu/each	Scale house
One (1) Safety-Kleen parts cleaner.	---	Maintenance garage
One (1) Used Oil Tank	2,000 gallons	Maintenance garage
Two (2) Used Oil Tanks	500 gallons each	Maintenance garage / Scale House
Two (2) Diesel Fuel Tanks	10,000 gallons each	Landfill depot / Contractor staging area
Various lubricating oil, hydraulic oil, heating oil and Used oil tanks	<500 gallons each	Various
Three (3) Leachate storage tanks	1 x 20,000 gallon each 1 x 30,000 gallon each 1 x 438,000 gallon each	

Landfill Operation - LFG Combustion Devices			
LFG Combustion Device	Size/Rating [4]	Gas capacity [5]	Location, stack height
One (1) John Zink Utility Ground Flare	12" dia. / 75 MMBtu/hr	2,500 scfm	Lined Landfill; 35' minimum.
One (1) Parnel Biogas Utility Ground Flare	12" dia. / 77.8 MMBtu/hr	2,500 scfm	Lined Landfill; 35' minimum.
Two (2) LTI Model CF-5 Passive Flares (to be removed with relocation of refuse in Areas A & B)	2" dia.	60 scfm each	Unlined Landfill: (1) at Area A, (1) at Area B. Minimum 8' stack height each.

LFGTE Operation - Equipment		
Equipment	Rating	Location
Five (5) CAT G3520C Engines Engine 1, 2, and 3: Installed March 2005 Engine 4: Delivered January 12, 2007 Engine 5: Delivered on June 17, 2009	2,221 bhp (1,600 kW) each engine 507 scfm LFG fuel flow each engine	LFGTE Operation; 28' minimum, proposed stack height 34' minimum installed no later than 12/31/2016.
Two (2) Ethylene Glycol Storage Tanks	1,000 gallons each	LFGTE Operation
One (1) Used Oil Tank	2,000 gallons	LFGTE Operation
One (1) Lube Oil Storage Tank	8,000 gallons	LFGTE Operation
One (1) Olympian DP100P1 100 kW emergency generator powered with a Perkins 1006-6TG manufactured April 28, 2005	140 bhp	LFGTE Operation
LFG pretreatment system: IES LFG scrubbing system including a demister knock-out vessel, four (4) gas blower units, three (3) gas cooling units, one (1) mechanical chiller for process water, two (2) glycol gas scrubber units, one (1) glycol regenerator system, and LFG polishing filters. *Please describe any changes to this equipment.*	2,500 scfm	LFGTE Operation
LFG Siloxane Removal System: Two (2) temperature swing adsorption silica beds, Electrically heated desorption hot air system, Enclosed flare for destruction of desorbed siloxanes, H_2S, and VOCs. *Please confirm and/or provide additional details of equipment as appropriate.*	2,500 scfm LFG inlet, 200 acfm desorption gas at 300F, 100 acfm LFG flare inlet. *Please confirm rating details.*	LFGTE Operation

[1] Years of operation are approximate and are estimated for Phase IV and V.

[2] Mg – Mega grams. To convert to English tons multiply the Mg value by 1.1025.

[3] The Phase V expansion will overlay Areas A and B so the Land fill area will be 99 acres instead of 110 acres.

[4] bhp – brake horsepower rated output as specified by the manufacturer. kW - kilowatt electrical output.

[5] scfm - standard cubic feet per minute of LFG. LFG is assumed to contain 40% - 60% methane with the balance predominately carbon dioxide but also includes ~524 ppm NMOCs based on prior testing at the Landfill. The maximum LFG generation rate is predicted to be 5,545 scfm in 2021 based on the LandGEM model ver. 3.02 with values of L_o of 130 and k of 0.06. LFG capture efficiency is assumed to be 85% over the life of the Landfill.

3.0 QUANTIFICATION OF POLLUTANTS

The quantification of emissions from a stationary source is necessary in order to establish the appropriate regulatory review process for the operating permit application and to determine applicability with various air pollution control requirements. These determinations are normally based upon allowable emissions. Allowable emissions are defined as the emission rate calculated using the maximum rated capacity of the source and, if applicable, either: (a) the applicable emission standard contained in the *Regulations*, if any, or (b) the emission rate or design, operational or equipment standard specified in any order or agreement issued under the *Regulations* that is state and federally enforceable. An applicant may impose in its application an emission rate or design, or an operational or equipment limitation which may be incorporated in the Permit to restrict operation to a lower level. Examples of such limitations may include, but are not limited to, fuel restrictions or production limits

Activities at the Facility with emissions that are not insignificant or exempt include the following:

(1) Fugitive emissions from the Landfill Operation that are not captured by the LFG collection system. These emissions consist of NMOCs and hydrogen sulfide that are present in the LFG.
(2) Emissions of combustion byproducts from destruction of LFG in the four (4) open utility flares, two which are located at the lined area of the Landfill Operation and two at the unlined area of the Landfill Operation. After the Phase V relocation of waste from the unlined area of the Landfill Operation, there will be two (2) flares remaining at the lined landfill. The flares on the lined landfill are currently used as a backup combustion device for the engines in the LFGTE Operation. The flares at the unlined area of the Landfill Operation operate continuously.
(3) Emissions of combustion byproducts from destruction of LFG in the five (5) CAT G3520C engines at the LFGTE Operation. Combustion byproducts include both criteria pollutants and VOCs formed by incomplete combustion.
(4) Emissions of combustion byproducts from operation of the SRS flare used to treat offgas from the SRS.
(5) Emissions of uncombusted NMOCs from the flares and engines at the Facility. These combustion device are not 100 percent effective in controlling NMOCs, and it is assumed that approximately 2 percent of the NMCOCs that pass through these devices are emitted to the ambient air.
(6) Emissions from the emergency generator at the LFGTE Operation.

Emissions were estimated on a Facility basis. The individual Permittees at this Facility will each be responsible for estimating their components of overall Facility emissions. The

estimation of potential to emit and allowable emissions of particulate matter ($PM/PM_{10}/PM_{2.5}$), sulfur dioxide (SO_2), oxides of nitrogen (NO_x), carbon monoxide (CO), volatile organic compounds (VOCs), hazardous air pollutants (HAPs) and hazardous air contaminants (HACs) from these sources are described below.

3.1 LFG Emissions:

The total amount of LFG generated by the Landfill Operation was estimated by NEWSVT with Version 3.02 of EPA's Landfill Gas Emission Model (LandGEM) model. The LandGEM model uses a first order decay equation identified in 40 Code of Federal Regulations (CFR) Part 60.754 to estimate LFG generation. Variables used in the equation include historical waste acceptance rates, proposed future waste acceptance rates, a methane generation rate constant and the methane generation potential of the waste.

Site-specific modeling parameters were used by NEWSVT to provide a likely estimate of gas generation rates from the landfill. The methane generation potential of the waste (L_0) was set at 130 cubic meters/megagram, and the methane generation rate constant (k) for the waste was established at 0.06/year. The future waste acceptance rate at the Landfill was assumed to be 600,000 tons per year. No adjustments were made to the modeling parameters to account for any decrease in decomposable material in the Landfill Operation as a result of Act 148.

The maximum LFG generation rate was estimated at 5,545 standard cubic feet per minute (scfm) of LFG. This generation rate is projected to occur in 2021, the year after the landfill is scheduled to be filled to permitted capacity. The landfill cover and gas collection system is estimated to collect approximately 85 percent of the LFG over the life of the landfill. The maximum LFG collection rate from the Landfill using the LANDGEM results and an 85 percent collection efficiency is approximately 4,700 scfm.

For purposes of estimating combustion emissions, it was assumed in the permit application that the maximum LFG collection rate was 5,000 scfm rather than 4,700 scfm. This assumption was intended to provide conservatively high combustion emission estimates. For purposes of estimating fugitive emissions, NEWSVT assumed that the capture efficiency of the Landfill Operation was 85 percent. Thus, fugitive emissions from the Landfill Operation were 15 percent of the maximum LFG generation rate of 5,545 scfm as estimated using LANDGEM. The emission rate for fugitive LFG estimated in this fashion is approximately 832 scfm.

LFG contains NMOCs, and the individual compounds comprising NMOCs may also be classified as volatile organic compounds (VOCs) and/or hazardous air pollutants (HAPs) and/or hazardous air contaminants (HACs). The concentration of NMOCs in LFG was estimated from LFG samples that were collected and analyzed for NMOCs in June 2002. These NMOC concentrations were reported as 561 parts per million by volume (ppmv) as hexane, and this value was used for subsequent estimates involving NMOCs.

The concentrations of VOCs contained in LFG were estimated by using waste acceptance records, an understanding of the landfill's operational and waste acceptance history, and the previously discussed NMOC concentration in LFG of 561 ppmv as hexane. This

evaluation indicated that the landfill likely contained only MSW or contained very little organic commercial/industrial wastes. Accordingly, it is likely that co-disposal did not occur at the landfill. Guidance published by the U.S. EPA in *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources (5th Edition including Supplements A, B and C), AP-42, Office of Air Quality Planning and Standards,* (AP-42), Chapter 2: Solid Waste Disposal, Section 2.4, Municipal Solid Waste Landfills, Table 2.4-2 (11/1998) indicates that an appropriate VOC concentration in LFG for landfills without co-disposal is 39% of the NMOC concentration in LFG.

The concentrations of HAPs/HACs in LFG were based on analytical results from Tier 2 testing performed by New England Air Quality Testing (NEAQT) at the Landfill in August 1993. Concentration data for 12 of the 14 HACs included in NEAQT's report were used to calculate emission rates. Non-detectable concentrations for two of the HACs (carbon tetrachloride and chloroform) were reported at each test probe during Tier 2 sampling by NEAQT. Therefore, the AP-42 default values for carbon tetrachloride, chloroform, and the remaining 19 HACs for which site-specific data were not available were used to calculate the HAC emission rates.

Estimated fugitive emissions are summarized in the following table. These are based on the measured concentrations discussed above and 15% of the maximum 5,445 scfm LFG generation being emitted fugitively from the Landfill. As the fugitive LFG emissions consist of uncombusted LFG, it has been assumed that there are no combustion emissions (SO_2 NOx, PM, and CO) associated with this emissions source.

Table 3-1 Fugitive Emissions from Landfill

Parameter					Landfill Gas Generation				Fugitive Emissions	
					Molecular Weight	Concentration in LFG (ppmv)	Landfill Generation (lb/scf)	Landfill Generation (lb/hr)	Fugitive Emissions (lb/hr)	Fugitive Emissions (ton/year)
NMOC					86.18	561	0.000128	42.52	6.381	27.95
Estimated Fugitive VOC Emissions from Landfill					86.18	219	4.989E-05	16.60	2.491	
CAS No.	VOC (Y/N)	HAP (Y/N)	HAC (Y/N)	VOCs, Hazardous Air Pollutants (HAPs) and Hazardous Air Contaminants (HACs)						
71-55-6	N	Y	Y	1,1,1-Trichloroethane	133.41	0.480	0.00000017	0.056325	0.008451	0.04
79-00-5	Y	Y	Y	1,1,2-Trichloroethane	133.41	0.100	0.00000004	0.011734	0.001761	0.01
79-34-5	Y	Y	Y	1,1,2,2-Tetrachloroethane	167.85	1.110	0.00000049	0.163877	0.024589	0.11
75-34-3	Y	Y	Y	1,1-Dichloroethane	98.97	2.350	0.00000061	0.204572	0.030695	0.13
75-35-4	Y	Y	Y	1,1-Dichloroethene (Vinylidene Chloride) (1,1-Dichloroethylene)	96.94	0.0981	0.00000003	0.008365	0.001255	0.01
107-06-2	Y	Y	Y	1,2-Dichloroethane (Ethylene Dichloride)	98.96	0.095	0.00000002	0.008252	0.001238	0.01
78-87-5	Y	Y	Y	1,2-Dichloropropane (Propylene Dichloride)	112.99	0.180	0.00000005	0.017889	0.002684	0.01
67-64-1	N	N	Y	Acetone	58.08	7.01	0.00000108	0.358112	0.053733	0.24
107-13-1	Y	Y	Y	Acrylonitrile	53.06	0.442	0.00000006	0.020628	0.003095	0.01
106-93-4	Y	Y	Y	1,2-Dibromoethane (Ethylene dibromide)	187.88	0.001	0.00000000	0.000165	0.000025	0.00
106-46-7	Y	Y	N	1,4-Dichlorobenzene (p-dichlorobenzene)	147.00	0.21	0.00000008	0.027153	0.004074	0.02
108-10-1	Y	Y	Y	4-Methyl-2-Pentanone (Methyl isobutyl ketone)	100.16	1.870	0.00000050	0.164744	0.024719	0.11
71-43-2	Y	Y	Y	Benzene	78.11	1.01	0.00000021	0.069391	0.010412	0.05
75-27-4	Y	N	Y	Bromodichloromethane	163.83	3.130	0.00000136	0.451036	0.067676	0.30
75-15-0	Y	Y	Y	Carbon disulfide	76.13	0.58	0.00000012	0.038838	0.005827	0.03
56-23-5	Y	Y	Y	Carbon tetrachloride	153.84	0.004	0.00000000	0.000541	0.000081	0.00
463-58-1	Y	Y	N	Carbonyl sulfide	60.07	0.49	0.00000008	0.025890	0.003885	0.02
108-90-7	Y	Y	Y	Chlorobenzene	112.56	0.0834	0.00000002	0.008257	0.001239	0.01
75-00-3	Y	Y	N	Chloroethane (Ethyl Chloride)	64.52	1.25	0.00000021	0.070938	0.010644	0.05
67-66-3	Y	Y	Y	Chloroform	119.39	0.03	0.00000001	0.003150	0.000473	0.00
75-71-8	N	N	Y	Dichlorodifluoromethane	120.91	15.70	0.00000502	1.669690	0.250529	1.10
75-09-2	N	Y	Y	Dichloromethane (Methylene Chloride)	84.94	38.40	0.00000862	2.868913	0.430466	1.89
75-08-1	Y	N	Y	Ethyl mercaptan (Ethanethiol)	62.13	2.28	0.00000037	0.124598	0.018695	0.08
100-41-4	Y	Y	Y	Ethylbenzene	106.16	1.28	0.00000036	0.119521	0.017934	0.08
50-00-0	Y	Y	Y	Formaldehyde	Not Applicable					
110-54-3	Y	Y	Y	Hexane	86.18	6.57	0.00000150	0.498019	0.074725	0.33
7783-06-4	N	N	Y	Hydrogen sulfide	34.08	308	0.00002775	9.232603	1.385307	6.07
7439-97-6	N	Y	Y	Mercury	200.61	0.000292	0.00000000	0.000052	0.000008	0.00
78-93-3	Y	N	Y	Methyl ethyl ketone	72.11	7.090	0.00000135	0.449692	0.067474	0.30
108-88-3	Y	Y	Y	Toluene	92.14	12.5	0.00000304	1.013053	0.152004	0.67
79-01-6	Y	Y	Y	Trichloroethylene (Trichloroethene)	131.4	0.508	0.00000018	0.058713	0.008810	0.04
75-01-4	Y	Y	Y	Vinyl chloride	62.50	0.376	0.00000006	0.020670	0.003101	0.01
108-38-3 / 106-42-3 / 95-47-6	Y	Y	Y	Xylenes	106.16	2.82	0.00000079	0.263320	0.039510	0.17
				Total Quantified NMOCs			0.0000542	18.03	2.71	11.85
				Total Quantified VOCs			0.0000116	3.84	0.58	2.53
				Total Quantified HAPs			0.0000173	5.74	0.86	3.77
				Total Quantified HACs			0.0000538	17.90	2.69	**11.77**

Commented [DE1]: Footnote?

3.2 LFG Combustion Emissions

Emissions from the combustion processes at the Facility, including the flares and the CAT G3520C engines were based on emission factors provided by manufacturers, site specific chemical analysis of the LFG, and emission factors published by the U.S. EPA in AP-42.

Emissions estimates were performed using a spreadsheet named caop.14034.xlsx, and the estimations performed with this spreadsheet are summarized in the following tables.

3.2.1 LFG Flare Emissions

Emissions of CO and NOx for the landfill flares were based on emission factors provided by the flare manufacturers. Emissions of SO_2 were estimated using site-specific total reduced sulfur (TRS) and hydrogen sulfide (H_2S) analytical results from LFG samples collected on July 8, 2014.

VOC and HAP emissions were based on chemical analytical results from LFG collected in August 1993 and June 2002, an assumed 85% collection efficiency for the LFG collection system, and an assumed 98% destruction efficiency in the combustion devices at the Facility. Chemical analytical results from the Landfill indicted that VOC concentrations in LFG were 4.99E-05 lb VOC/scf of LFG, and HAP concentrations in LFG were 1.73E-5 lb HAPs/scf of LFG.

Emissions of PM were estimated using the 0.017 lb/MMBtu emission factor for LFG flares published in AP-42, plus an additional factor to account for the silicon dioxide (SiO_2) PM created from the combustion of siloxanes in the LFG. The AP-42 emission factors for flares are based on data for landfills that, to the Agency's understanding, have lower siloxane contents when compared to the LFG generated from the Coventry Landfill. To account for this difference in siloxane concentrations, a separate factor was added to the AP-42 PM emission.

This additional PM emission factor was estimated based on the assumption that untreated LFG contains 35 milligrams of silicon per cubic meter (mg Si/m^3), and that all the Si contained in the LFG is oxidized to SiO_2 with an aerodynamic diameter that is less than the 60 µm PM threshold. Based on these assumptions, the LFG will produce 0.009 pounds of PM per million Btu of LFG. The emission factor for the flares will be the sum of these two factors (0.017 lb/MMBtu + 0.009 lb) or 0.026 lb/MMBtu.

Flare combustion emissions were estimated for two different operating conditions. One condition was for the entire estimated amount of collected LFG (5,000 scfm) to be combusted in the flares. The other condition assumed that 2,462.5 scfm of LFG was combusted in the flares, while the five CAT G3520C engines at the Facility combusted the remaining 2,537.5 scfm of collected LFG.

Table 3-2 - Estimated Emissions from Landfill Operation Flares Combustion of 5,000.scfm of LFG

Pollutant	Emission Factor			Estimated Emissions tons per year
	Factor	Units	Source	
SO_2	0.136	lb/MMBtu [1]	Site Specific Data - Application for #AOP-14-034	89.35
NO_x	0.068		Vendor Supplied – Application for #AOP-14-034	44.68
PM	26	lb/MMcf methane [2]	AP-42, Municipal Solid Waste Landfills, Table 2.4-5 (11/98) plus PM emissions from siloxane combustion	17.31
CO	0.37	lb/MMBtu [1]	Vendor Supplied – Application for #AOP-14-034	243.09
VOC	2.00E-03		Site Specific Data - Application for #AOP-14-034	1.31
HAPs	6.90E-04			0.45

[1] lb/MMBtu equals pounds of pollutant emitted per million British thermal units of heat input.
[2] lb/MMcf methane equals pounds of pollutant emitted per million cubic feet of methane input.

Table 3-3 - Estimated Emissions from Landfill Operation Flare Combustion of 2,462.5 scfm of LFG

Pollutant	Emission Factor			Allowable Emissions tons per year
	Factor	Units	Source	
SO_2	0.136	lb/MMBtu [1]	Site Specific Data - Application for #AOP-14-034	44.01
NO_x	0.068		Vendor Supplied – Application for #AOP-14-034	22.00
PM	26	lb/MMcf methane [2]	AP-42, Municipal Solid Waste Landfills, Table 2.4-5 (11/98) plus PM emissions from siloxane combustion	8.53
CO	0.37	lb/MMBtu [1]	Vendor Supplied – Application for #AOP-14-034	119.72
VOC	2.00E-03		Site Specific Data - Application for #AOP-14-034	0.65
HAPs	6.90E-04			0.22

[1] lb/MMBtu equals pounds of pollutant emitted per million British thermal units of heat input.
[2] lb/MMcf methane equals pounds of pollutant emitted per million cubic feet of methane input.

3.2.2 Reciprocating Internal Combustion Engine Combustion Emissions

CAT 3520C Engines

Emissions of NOx for the CAT 3520C LE engines were based on emission guarantees provided by the engine manufacturer, and emissions of CO were based on the revised MSER for these engines, which is a not-to-exceed emission rate of 3.5 g/bhp-hr. Emissions of PM were estimated using November 2012 stack test data from Engine No. 5 at the LFGTE Operation. Emissions of SO_2 were estimated using site-specific total reduced sulfur (TRS) and hydrogen sulfide (H_2S) analytical results from LFG samples collected on July 8, 2014.

With the exception of formaldehyde, VOC and HAP emissions were based on chemical analytical results from LFG collected in August 1993 and June 2002, and an assumed 98% destruction efficiency in the combustion devices at the Facility. Total LFG flow through the five (5) CAT 3520C LE engines is estimated at 2,537.5 scfm. Each engine is rated at 2,221 bhp for a total installed horsepower rating of 11,105 bhp. Chemical analytical results from the Landfill indicted that VOC concentrations in LFG were 4.99 E-05 lb VOC/scf of LFG, and HAP concentrations in LFG were 1.73E-05 lb HAPs/scf of LFG. Based on these assumptions, the VOC and HAP emission factor for the engines, (excluding formaldehyde) are 0.006 g/bhp-hr and 0.002 g/bhp-hr, respectively.

Formaldehyde is formed in the engines as a product of incomplete combustion, and the formaldehyde emissions were based on a formaldehyde emission factor of 5.28E-02 lb/MMBtu of heat input obtained from AP-42, *Chapter 3: Stationary Internal Combustion Sources, Section 3.2, Natural Gas-fired Reciprocating Engines, Table 3.2-2 Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines, (Supplement F, August 2000)*, and by assuming a fuel heat value of 500 Btu/scf, and an LFG supply rate to each engine of 507.5 scf of LFG. This results in an estimated emission factor for formaldehyde of 0.164 g/bhp-hr. The VOC and HAP emission factor for the engines including formaldehyde are therefore 0.170 g/bhp-hr and 0.166 g/bhp-hr, respectively.

It should be noted that these emission factors appear to be less than those obtained for similar engines operating on LFG. To provide a better estimate of the VOC and HAP emission factors for the CAT 3520C engines at the Facility, stack testing will be required to develop emission factors for compliance. The estimated emissions of a single HAP (formaldehyde) are greater than 10 tons per year, classifying the Facility as a major HAP source. Although the emissions for total HAPs estimated using the above methodology are less than 25 tons per year, allowable HAP emissions for the Facility will be assumed to be greater than 25 tons per year which is appropriate for a major HAP source.

Estimated emissions from the CAT 3520C engines and emission factors used for these estimates are summarized in Table 3.4.

Table 3-4 – Estimated Emissions from Five (5) CAT 3520C Engines Combustion of 2,462.5 scfm of LFG-

Pollutant	Emission Factor			Allowable Emissions tons per year
	Factor	Units	Source	
SO_2	0.42	g/bhp-hr [1]	Site Specific Data - Application for #AOP-14-034	45.14
NO_x	0.5		Vendor Supplied – Application for #AOP-14-034	53.62
PM	0.153		Site Specific Data - Application for #AOP-14-034	16.41
CO	3.5		MSER Limit for AOP-14-034	375.31
VOC	0.170		Site Specific Data - Application for #AOP-14-034	18.27
HAPs	0.166		Site Specific Data - Application for #AOP-14-034	17.84

[1] g/bhphr equals grams of pollutant emitted per brake horsepower hour at rated load and speed.

LFGTE Operation – Emergency Generator

Emissions for the approximately 140 bhp Perkins 1006-6TG engine powering the 100 kW emergency generator at the LFGTE operation were based on the engine being operated for 200 hours per year. Although the engine is allowed unrestricted hours of operation during actual emergencies, Agency policy for emissions estimation from emergency generators is to assume that emergency use would not exceed 100 hours per year. Engine readiness testing, operation for maintenance and similar activities are limited to 100 hours per year in the current permit.

Emission factors used to estimate emissions of SO_2, NOx, CO, PM, VOCs, and HAPs from this engine were the emission factors for uncertified engines as described in *AP-42, Chapter 3, Stationary Internal Combustions Sources, Section 3.3 –Gasoline and Diesel Industrial Engines, (October 1996)*. The engine was assumed to be fueled with No. 2 diesel fuel containing a maximum of 0.05% by weight sulfur with a heating value of 137,000 Btu per gallon. Fuel consumption for the engine was estimated at 7 gallons per hour.

Estimated emissions for the Perkins 1006-6TG engine and emission factors used for these estimates are summarized in Table 3.5.

Table 3-5 – Estimated Emissions from Perkins 1006-6TG engine 200 hours of Operation Annually-

Pollutant	Emission Factor			Allowable Emissions tons per year
	Factor	Units	Source	
SO_2	1.01S[1]	lb/MMBtu[2]	AP-42, Chapter 3, Stationary Internal Combustion Sources, Section 3.3 *Stationary Internal Combustions Sources, Section 3.3 – Gasoline and Diesel Industrial Engines* Table 3.3-1 (10/1996)	0.005
NO_x	4.41			0.42
PM	0.31			0.30
CO	0.95			0.09
VOC	0.36			0.03
HAPs	6.45E-03		AP-42, Chapter 3, Stationary Internal Combustion Sources, Section 3.3 *Stationary Internal Combustions Sources, Section 3.3 – Gasoline and Diesel Industrial Engines*, Table 3.3-2 (10/1996)	0.001

[1] S represents the weight % of sulfur in the oil. For example if the fuel is 0.05% sulfur, then S=0.05

[2] lb/MMBtu represents pounds of pollutant emitted per million British thermal units of heat input to the engine.

[3] g/bhp-hr represents grams of pollutant emitted per each brake horsepower-hour of engine operation.

3.3 Facility Greenhouse Gas (GHG) Emissions

The Facility has emissions of GHGs resulting from biological generation of CH_4 and CO_2 in the Landfill itself, and GHGs generated from the combustion of CH_4 contained in collected LFG. Biogenic CO_2 includes the CO_2 formed in the landfill and CO_2 resulting from the combustion of CH_4 formed in the Landfill. Emissions of CH_4 from the Landfill as fugitive emissions or as uncombusted CH_4 in the exhausts from the control devices (flares and/or CAT 3520C engines) is considered a non-biogenic emission. Nitrous oxide (N_2O) is also formed during combustion processes and is considered a GHG. However, even considering the global warming potential of (GWP) of N_2O which is approximately 298, the effect of N_2O emissions on total GHG emissions were considered to be negligible, and accordingly were not estimated.

Emissions include actual CO_2 emissions, and emissions of CH_4 adjusted to CO_2 equivalent (CO_2e). The GWP of CH_4 was assumed to be 25. Emissions of GHG's are presented in Table 3-6 for both total GHG emissions, and exclusive of biogenic CO_2 emissions.

Table 3-6 – Estimated Total Facility GHG Emissions [1]

Pollutant	GWP	Emissions by Emissions Source (tons per year)					Total Estimated Emissions (tons/year)	Total Estimated Emissions (tons/year CO_2e)
		Fugitive Emissions	Flare Combustion Emissions	Collected CO_2 Emitted from Flare	Engine Combustion Emissions	Collected CO_2 Emitted from Engines		
CO_2	1	9,665	36,887	28,606	38,010	29,477	142,646	142,646
CH_4	25	4,624	274	---	282	---	5,180	129,507
CO_2e (excluding biogenic)	---	115,611	6,844	---	7,052	---	---	272,152
CO_2e (including biogenic)	---	125,276	43,730	28,606	45,062	29,477	---	544,305

[1] Biogenic CO_2 emissions exclude the emissions of CO_2 formed in the Landfill that are emitted as fugitive emissions or are emissions of uncombusted CO_2 emitted as part of the exhaust stream from a combustion process. Emissions of GHGs from combustion of CH_4 and fugitive CH_4 emissions are not considered biogenic. These emissions are converted to CO_2e using the appropriate GWP, and reported as CO_2e emissions for the Facility

3.4 Combined Facility Emissions

Emissions from the Facility for fugitive LFG emissions and for both combustion scenarios (all LFG through the flares / all five CAT 3520C engines running at full capacity with the balance of LFG through a flare) are tabulated in Table 3-7. The scenario that resulted in the greatest emissions for a particular pollutant was used to establish allowable emissions.

The aggregated emissions of VOCs and HAPs from fugitive landfill emissions are also presented in this table, and are included in the proposed allowable emissions. Emissions of individual HAPs/HACs from the Facility are discussed in greater detail in Section 7.

Table 3-7 – Estimated and Allowable Emissions Summary (ton/yr)						
Activity	**PM / PM_{10}/$PM_{2.5}$**	**SO_2 [1]**	**NOx**	**CO**	**VOC[2]**	**HAP**
Fugitive Emissions - Landfill	---	---	---	---	**10.91**	**3.77**
Combustion Emissions						
Scenario A:						
All Collected LFG Combusted in Flares	17.31	**89.35**	44.68	243.09	1.31	0.45
Scenario B:						
All 5 Engines Operating,	**16.41**	45.14	**53.62**	**375.31**	**18.27**	**17.84**
Balance of LFG Combusted in Flare(s)	**8.53**	44.01	**22.00**	**119.72**	**0.65**	**0.22**
LFGTE Operation Emergency Engine	**0.03**	0.005	**0.42**	**0.09**	**0.03**	**0.001**
Total Estimated Emissions	24.96	89.35	76.04	495.13	29.83	21.83
Allowable Emissions [2]	**<19.8**	**<40**	**76.0**	**495.0**	**<50**	**21.8**

[1] Values for SO_2 emission between Scenario A and Scenario B are not equal because of rounding errors related to emission factors. The Permittee has proposed to limit allowable SO_2 emissions <40 tons per year.

[2] The Agency and Permittee have proposed to limit allowable PM emissions to less than 19.8 tpy, allowable SO_2 emissions to less than 40 tpy, and allowable VOC emissions <50 tons per year.

4.0. APPLICABLE REQUIREMENTS

Pursuant to §5-1006(e)(4) of the *Regulations,* the Owner and/or Operator of a stationary air contaminant source applying for a Permit to Operate is required to identify and certify compliance with all applicable state and federal air pollution control requirements before a permit may be issued. These requirements include state and federal regulations, state statutes, the federal Clean Air Act, and the requirements of any construction permit issued under 10 *V.S.A*. §556 and §5-501 of the *Regulations.* Applicable federal regulations may include Federal New Source Performance Standards (NSPS) or National Emission Standards for Hazardous Air Pollutants (NESHAP) found in 40 CFR, Parts 60, 61, and 63. The applicable requirements and the Agency's findings are presented below. Applicability of §5-261 (Control of Hazardous Air Contaminants) is discussed separately under Section 8 below.

The Agency will assess compliance with these regulations during any inspections of the Facility. The inspections will include confirmation of the proper operation and maintenance of equipment and air pollution control devices, visual observations of emission points, and review of any records required by the Permit

4.1 Vermont Air Pollution Control Regulations and Statutes

§§5-201, 5-202, and 5-203 - Open Burning Prohibited. "No person shall engage in any open burning except in conformity with the provisions of Section 5-201, 5-202, and 5-203".

Based on the application submittal, and information available to the Agency, no open burning is conducted at the Facility.

§5-211(1) - Prohibition of Visible Air Contaminants - Installations constructed prior to April 30, 1970. "No *person* shall cause, suffer, allow or permit the *emission* of any visible *air contaminant* from installations constructed prior to April 30, 1970, for more than a period or periods aggregating six (6) minutes in any hour, which has a shade, or density, greater than 40% *opacity* (No. 2 on the *Ringelmann Chart*). At no time shall the visible *air contaminants* have a shade, density, or appearance greater than 60% *opacity* (No. 3 of the *Ringelmann Chart*)."

These emission standards do not apply to the Facility, as the entire Facility was constructed subsequent to 1970.

§5-211(2) - Prohibition of Visible Air Contaminants - Installations constructed subsequent to April 30, 1970. "No *person* shall cause, suffer, allow or permit the *emission* of any visible *air contaminant* from installations constructed subsequent to April 30, 1970, for more than a period or periods aggregating six (6) minutes in any hour, which has a shade, or density, greater than 20% *opacity* (No. 1 of the *Ringelmann Chart*). At no time shall the visible *air contaminants* have a shade, density, or appearance greater than 60% *opacity* (No. 3 of the *Ringelmann Chart*)."

These emission standards apply to all installations at the Facility as the entire Facility was constructed subsequent to 1970. The applicant is expected to comply with these emission standards based on proper equipment design, operation and maintenance.

Any emission testing conducted to demonstrate compliance with the above emission limits shall be performed in accordance with 40 *CFR* Part 51, Appendix M, Methods 203B and 203C, respectively, or equivalent methods approved in writing by the Agency

§5-221(1)(a) - Prohibition of Potentially Polluting Materials in Fuel. "No *person* shall cause or permit the use, purchase, or sale for use in stationary combustion installations within the State of Vermont for heat or power generation of:

(i) , *fuels* containing more than 2.0% sulfur by weight, except as otherwise provided below;
(ii) No. 2 and lighter distillate oils and animal and vegetable fuel oils with a sulfur content greater than 0.05% by weight beginning on July 1, 2014, and ending on June 30, 2018;
(iii) No. 2 and lighter distillate oils and animal and vegetable fuel oils with a sulfur content greater than 0.0015% by weight, beginning on July 1, 2018"
(iv) No. 4 residual oil with a sulfur content greater than 0.25% by weight, beginning on July 1, 2018; and
(v) No. 5 and No. 6 residual oils and heavier residual oils and *used oils* with a sulfur content greater than 0.5% by weight, beginning on July 1, 2018.

Compliance with this standard is based on fuel analyses following the procedures prescribed by the American Society of Testing Materials ("ASTM").

This regulation applies to all stationary fuel burning equipment at the Facility including the five (5) CAT G3520C LE engines fired with LFG, all LFG flares, the No. 2 fuel oil and used oil fired space heating units, and the backup generator at the LFGTE Operation.

The Permittee is anticipated to comply with this regulation, as anticipated sulfur concentrations in LFG will be regularly monitored to maintain SO2 emissions at less than 40 tons per year, and with this limitation, the LFG will be less than 2.0 percent sulfur by weight. Permit conditions will restrict the sulfur content of No. 2 distillate fuel and used oil combusted at the Facility to comply with the limits contained in this regulation.

§5-221(2)(g) - Prohibition of Potentially Polluting Materials in Fuel – Used Oil – Small Fuel Burning Equipment. "Any person operating or owning fuel burning equipment used for space heating shall be permitted to burn used oil and is exempted from this section and Section 5-261 of these regulations, provided that:

(i) The maximum operating heat input of all fuel burning equipment designated for burning used oil at a single location aggregates to no more than 500,000 BTU per hour; and
(ii) The used oil has properties and constituents within the allowable limits set forth in Table A prior to blending; and
(iii) Emissions of visible air contaminants from the equipment comply with Section 5-211(2) of these regulations; and
(iv) The user complies with the requirements of Subchapter 8 of the Vermont Hazardous Waste Management Regulations; and
(vi) All fuel burning equipment must vent to the outside atmosphere in a manner as not to impede the upward dispersion of the exhaust.

TABLE A: USED OIL CONSTITUENTS AND PROPERTIES
(Prior to Blending)

Constituent/Property	Allowable
Polychlorinated Biphenyls (PCBs)	< 2 ppm maximum[1]
Total Halogens	1000 ppm maximum
Arsenic	5 ppm maximum
Cadmium	2 ppm maximum
Chromium	10 ppm maximum
Chlorine	500 ppm maximum
Lead	100 ppm maximum
Net Heat of Combustion	8000 BTU/lb minimum
Flash Point	140 degrees F minimum

[1]Note:units of parts per million (ppm) are by weight on a water free basis.

The used oil furnaces at the Facility are subject to these standards for burning used oil. The heat input rating of the furnaces is less than the maximum 500,000 MMBtu heat input rating for this type of equipment and a permit condition will require that used oil burned in the furnaces will comply with the limitations for used oil presented in Table A.

Based on the information available to the Agency, the Facility is currently in compliance with this regulation.

§5-231(2) - Prohibition of Particulate Matter; Incinerator Emissions. An *"Incinerator*" is defined in §5-101 of the Regulations as "any structure or furnace in which combustion takes place, the primary purpose of which is the reduction in volume and weight of an unwanted material." The landfill utility flares may be considered such a device. The CAT 3520C LE engines at the Facility are used to produce power, and accordingly are not regulated as incinerators in accordance with §5-231(2)(d).

PM emission limits for incinerators with a charging rate of less than 50 tons per day are defined §5-231(2)(a), and this limit is 0.1 pounds of PM per 100 pounds of refuse burnt (0.001 lb PM/pound refuse combusted). Incinerators with a charging rate of greater than 50 tons per day are limited to *emissions* of *particulate matter* not exceeding 0.08 grains per dry standard cubic foot corrected to 12 percent carbon dioxide.

The estimated LFG mass flowrate (assuming 50 percent CH_4, 38 percent CO_2, and 12 percent N) to the two flares for a flowrate of 5,000 scfm of LFG is approximately 21,000 pounds per hour, or approximately 10.5 tons per hour total for the two flares. Accordingly, the LFG flowrate through each flare would be approximately 5.8 tons per hour, which is greater than 50 tons per day. PM emissions from both flares at the emission limit of 17 lb/MMcf of CH_4 at a flowrate of 5,000 scfm are estimated to be 2.55 pounds per hour, and flare emissions have been estimated to be approximately 55,000 scfm. This would result in an emission rate of approximately 0.05 gr/dscf of exhaust gas. Accordingly, the emissions from the flares are anticipated to comply with this regulation.

Commented [TM2]: This will need to be revisited once we have the final details on the SRS flare.

§5-231(3)(a) - Prohibition of Particulate Matter; Combustion Contaminants. "A *person* shall not discharge, cause, suffer, allow or permit the *emission* of *particulate matter* caused by the combustion of *fossil fuel* in *fuel burning equipment* from any *stack* or chimney in excess of the following *emission* limits:

(i) 0.5 pounds per hour per million BTUs of *heat input* in combustion installations where the *heat input* is 10 million BTUs or less per hour.

(ii) For combustion installations where the *heat input* is greater than 10 million BTUs per hour, but where the *heat input* is equal to or less than 250 million BTUs per hour, the applicable limit is determined by using the following formula:

$$E_{PM} = 10^{[-0.47039(\log_{10} HI)+0.16936]}$$

where:

E_{PM} - is the *particulate matter emission* limit, expressed to the nearest hundredth pound per hour per million BTUs; and

HI - is the *heat input* in millions of BTUs per hour."

Compliance with this emission standard shall be determined in accordance with 40 CFR, Part 60, Appendix A, Reference Method 5 or an alternative method approved in writing by the Agency.

This emission standard applies to the No. 2 fuel oil and used oil fired heating units, and the emergency generator at the Facility, which have a heat input of less than 10 MMBtu/hr, and consequently an emission limitation of 0.5 pounds per hour per MMBtu of heat input will apply to these heating units.

The Agency has previously determined that the utility flares and CAT G3520C engines at the Facility are not subject to this requirement, as LFG is not a *fossil fuel*, and the Facility is shielded from this requirement.

§5-231(4) - Prohibition of Particulate Matter; Fugitive Particulate Matter. ."A *person* shall not cause, suffer, allow, or permit any process operation to operate that is not equipped with a *fugitive particulate matter* control system. A *person* shall not cause, suffer, allow, or permit any materials to be handled, transported, or stored; or a building, its appurtenances, or a road to be used, constructed, altered, repaired or demolished without taking reasonable precautions to prevent *particulate matter* from becoming airborne. Public roads will not be subject to this section unless a public nuisance is created."

This requirement applies to the entire Facility, and the Facility is therefore expected to comply with the fugitive emission limitations of this section.

§5-241(1) and (2) - Prohibition of Nuisance and Odor. "A *person* shall not discharge, cause, suffer, allow, or permit from any source whatsoever such quantities of *air contaminants* or other material which will cause injury, detriment, nuisance or annoyance to any considerable number of people or to the public or which endangers the comfort, repose, health or safety of any such *persons* or the public or which causes or has a natural tendency to cause injury or damage to business or property. A *person* shall not discharge, cause, suffer, allow, or permit any *emissions* of objectionable *odors* beyond the property line of a premises."

Based on the application submittal and information available to the Agency, the Facility is currently in compliance with this regulation.

§5-253.14- Solvent Metal Cleaning. This subsection shall apply to any solvent metal cleaning equipment, and contains several requirements designed to minimize the generation of VOCs from such equipment. Specifications are listed within this section for air pollution control devices and work practice standards.

Any solvent metal cleaning equipment operated at the Facility for equipment cleaning is subject to the standards for cold cleaning operations. Based on the information available to the Agency, the Facility is currently in compliance with this regulation

§5-403 - Circumvention. "No Person shall build, erect, install or use any article, machine, equipment or other contrivances, the use of which, without resulting in a reduction in the total release of air contaminants to the atmosphere, reduces or conceals an emission which otherwise would constitute a violation of these regulations."

Based on the application submittal and information available to the Agency, the Facility is currently in compliance with this regulation.

Subchapter VIII - Registration of Air Contaminant Source. "Each *operator* of a *source* which emits more than five *tons* of any and all *air contaminants* per year shall register the *source* with the *Secretary*, and shall renew such registration annually."

NEWSVT has been registering the Facility emissions with the Agency annually, and each Permittee will be responsible for registering their emissions from the Facility that are described in their individual Permits.

4.2. Federal Air Pollution Control Regulations and the CAA

Section 111 of the Clean Air Act establishes New Source Performance Standards (NSPS). NSPSs apply to new sources, and are promulgated under 40 CFR, Part 60. Section 112 of the Clean Air Act establishes National Emission Standards for Hazardous Air Pollutants (NESHAPs). NESHAPs are promulgated under 40 C.F.R. Part 61 and Part 63, and may apply to new or existing sources. Potentially applicable NSPSs and NESHAPs are summarized in Table 4-2.

Table 4-2 Review of Requirements from Federal Regulations and the Clean Air Act

40 CFR Part 60 Subpart Cc – Emission Guidelines for Municipal Solid Waste Landfills. Applies to existing landfills which commenced construction, modification, or reconstruction before May 30, 1991, and that have accepted waste at any time since November 8, 1987, or have additional capacity for future waste deposition. *This regulation is not applicable to the Facility. The Landfill Operation was modified subsequent to May 30, 1991 to increase its capacity, thus becoming subject to 40 CFR Part 60 Subpart WWW.*
40 *CFR* Part 63, Subpart AAAA - National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills. §63.1955 Standards - Requires gas collection and control system meeting the same standards as 40 *CFR* Part 60, Subpart WWW by referencing such. Applicable to all MSW landfills that are (1) a major source of Hazardous Air Pollutants (HAPs), or (2) are collocated with a major source of HAPs, or (3) are an area source with a design capacity of 2.5 million megagrams (Mg) or greater and have estimated uncontrolled emissions of NMOCs equal to or greater than 50 Mg/year. *The Facility is subject to this regulation. The Landfill Operation is not a major source of HAPs, but is collocated with the LFGTE Operation which is a major HAP source and the Landfill Operation has a design capacity of 2.5 million Mg or greater and has estimated uncontrolled emissions of NMOCs greater than 50 Mg/year. Compliance will be addressed by complying with the provisions of 40 CFR Part 60 Subpart WWW.*
40 CFR Part 60 Subpart WWW - Standards of Performance for Municipal Solid Waste Landfills. Applies to landfills which commenced construction, modification, or reconstruction after May 30, 1991, with a maximum design capacity equal to or greater than 2.5 million megagrams (Mg) and 2.5 million cubic meters. Landfill gas controls must be implemented if Non-Methane Organic Compounds (NMOC) exceed 50 Mg/year *The Facility is subject to this regulation. The Landfill Operation has an existing design capacity (unlined through Phases IV) of 7,275,813 Mg and Phase V will add an additional capacity of 1,943,650 Mg. Uncontrolled NMOC emissions were predicted to first exceed 50 Mg in the year 2001.*

Table 4-2 Review of Requirements from Federal Regulations and the Clean Air Act
40 *CFR* Part 60, Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced after July 23, 1984. Applicability: The affected facility to which this subpart applies is each storage vessel with a capacity greater than or equal to 75 m3 (19,804 gal) that is used to store volatile organic liquids (including petroleum). This subpart does not apply to the following: 1. Any storage vessel with a capacity less than 75 m^3 2. Any storage vessel storing a liquid with a vapor pressure less than 3.5 kPa 3. Any storage vessel with a capacity > 75 m^3 and <151 m^3 with a v.p. <15.0 kPa 4. Pressure vessels >29.7 psi and without emissions to the atmosphere. 5. Vessels permanently attached to mobile vehicles. 6. Vessels located at bulk gasoline plants. 7. Vessels located at gasoline service stations. For affected facilities, there are recordkeeping requirements and depending upon the material stored there may be standards for the tank's vent system. *The storage tanks at the Facility store No. 2 fuel oil, new and used engine oil, ethylene glycol, and landfill leachate, all of which have a vapour pressure of less than 3.5 kPa. Accordingly, the Facility has no storage tanks subject to this regulation.*
40 CFR Part 60, Subpart IIII - Standards of Performance for Stationary Compression Ignition Internal Combustion Engines (CI ICE). Applies to CI RICE model year 2007 and later as well as those ordered after July 11, 2005 and with an engine manufacture date after April 1, 2006. This standard also applies to stationary CI RICE that are modified or reconstructed after July 11, 2005. This regulation established emission rates for affected engines, requires routine engine maintenance and sets maximum sulfur content for the diesel fuel. Beginning October 1, 2010 applicable engines shall only use diesel fuel with a maximum sulfur content of 15 ppm (ULSD). *This regulation is not applicable to the CAT 3520C engines at the LFGTE Operation as these engines are spark ignition rather than compression ignition. .*
40 CFR Part 60, Subpart IIII - Standards of Performance for Stationary Compression Ignition Internal Combustion Engines (CI ICE). Applies to CI RICE model year 2007 and later as well as those ordered after July 11, 2005 and with an engine manufacture date after April 1, 2006. This standard also applies to stationary CI RICE that are modified or reconstructed after July 11, 2005. This regulation established emission rates for affected engines, requires routine engine maintenance and sets maximum sulfur content for the diesel fuel. Beginning October 1, 2010 applicable engines shall only use diesel fuel with a maximum sulfur content of 15 ppm (ULSD). *Subpart IIII is not applicable to the Perkins 1006-6TG engine powering the emergency generator at the LFGTE Operation. The engine was not ordered after July 11, 2005, and was manufactured before April 1, 2006*
40 CFR Part 60, Subpart JJJJ - Standards of Performance for Stationary Spark Ignition Internal Combustion Engines. Applies to new spark ignition engines ordered after June 12, 2006 AND manufactured on or after July 1, 2007. *Engines No 1, 2, and 3 were installed at the Facility in March 2005 therefore are not subject to this regulation.* *Engine No. 4 was ordered after June 12, 2006 (order date Nov.6, 2006) but the engine was manufactured before July 1, 2007 (build date Oct. 26, 2006), and was delivered on January 12, 2007. Accordingly, this engine is not subject to Subpart JJJJ.* *Engine No. 5 was delivered on June 17, 2009 and Subpart JJJJ applies to this engine.*

Table 4-2 Review of Requirements from Federal Regulations and the Clean Air Act
40 *CFR* Part 63, Subpart ZZZZ - National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines. Applies to new engines >500 hp that commenced construction (installed) on or after December 19, 2002 at a major sources of HAPs. Also applies to existing engines of greater than 500 bhp that commenced construction (installed) prior to December 19, 2002 located at major HAP sources. Engines <500 hp that are located at major sources of HAPs are considered existing if they were installed before June 12, 2006. A new or reconstructed stationary RICE with a site rating of more than 500 brake HP located at a major source of HAP emissions which combusts landfill or digester gas equivalent to 10 percent or more of the gross heat input on an annual basis must meet the initial notification requirements of §63.6645(f) and the requirements of §§63.6625(c), 63.6650(g), and 63.6655(c). These stationary RICE do not have to meet the emission limitations and operating limitations of Subpart ZZZZ. An existing emergency-use only stationary RICE with a rating of < 500 hp located at a major source of HAP emissions is subject to maintenance requirements, and must install an elapsed hour meter. *Engines No 1, 2, and 3 were installed at the Facility in March 2005, making the facility a major HAP source since HAP emissions from these three engines combined likely exceeded the 10 ton per year emission of a single HAP (formaldehyde). Thus these three engines are subject to the new engine requirements of a major HAP source under Subpart ZZZZ.* *Engine No. 4 was delivered on January 12, 2007 and Subpart ZZZZ at that time required new engines to comply with NSPS Subpart JJJJ. However the applicability of NSPS Subpart JJJJ was written to apply to engines manufactured on or after July 1, 2007. Thus Subpart ZZZZ applies to this engine but has no applicable requirements and the engine is not subject to NSPS Subpart JJJJ.* *Engine No. 5 was delivered on June 17, 2009 and complies with the requirements of Subpart ZZZZ by conforming to the requirements of 40 CFR Part 60, Subpart JJJJ.* *The Perkins 1006-6TG engine powering the emergency generator at the LFGTE Operation was installed before June 12, 2006, and is rated at approximately 140 hp. This engine is considered an existing emergency-use only stationary RICE < 500 hp, and must install an elapsed hour meter, and is subject to maintenance requirements including changing oil & filter and, inspecting and replacing if necessary, air filter, hoses and belts.*
Clean Air Act §§114(a)(3) Inspections, Monitoring and Entry; 502(b) Permit Programs; and 504(a)-(c) Permit Requirements and Conditions; 40 *CFR* Part 64 Compliance Assurance Monitoring; 40 *CFR* Part 70 §§70.6(a)(3)(i)(B) and 70.6(c)(1) State Operating Permit Programs - Permit content. Upon renewal of a Title V Permit to Operate, a facility must comply with enhanced monitoring and compliance assurance monitoring requirements if applicable. The CAM rule applies to each Pollutant Specific Emission Unit (PSEU) at a major source that is required to obtain a part 70 or part 71 permit if the unit satisfies all of the following criteria: **1)** The unit is subject to an emission limitation or standard for the applicable regulated air pollutant other than an emissions limitation or standard that is exempt under §64.2(b)(1) [exempt limitations include emission limitations or standards proposed by the Administrator after November 15, 1990 pursuant to Section 111 or 112 of the Act], **2)** The unit uses a control device to achieve compliance with any such limit or standard; and **3)** The unit has pre-control device emissions of the applicable regulated pollutant that are equal to or greater than 100 percent of the amount, in tons per year, required for a source to be classified as a major source. *The CAM rule applies to the CAT 3520C engines and flares at the Facility. The engines and flares are be considered an emission control device for VOCs. CAM is being established as continuous monitoring for the presence of a flame on the flares when they are combusting LFG and continuous monitoring and recording of engine exhaust temperature and compliance testing at least once every two years for combustion efficiency of 98% or outlet NMOC concentration of 20 ppmvd and CO emission rate.*

Table 4-2 Review of Requirements from Federal Regulations and the Clean Air Act
Clean Air Act §112r Prevention of Accidental Release; 40 *CFR* Part 68 Chemical Accident Prevention Programs. Facilities that have more than the threshold quantity of a regulated substance in a process are subject to these provisions including the requirements to conduct a hazard assessment, establish a prevention program and develop a risk management plan. *The Permittees have stated that the Facility does not store more than the threshold quantity of a regulated substance and thus is not subject to these requirements.*
Clean Air Act §608; 40 *CFR* Part 82, Subpart F – Recycling and Emissions Reductions. This requirement is applicable to any facility that owns, services, maintains, repairs, and disposes of appliances containing ozone depleting substances. *This regulation is applicable to the Trane RTAA 125-ton rotary chiller at the Facility.*
40 *CFR* Part 98 Mandatory Greenhouse Gas Reporting. Requires reporting of GHG emissions annually to EPA for **1)** facilities in source categories listed in §98.2(a)(1) including electric utility units subject to Acid Rain, MSW landfills that generate CH_4 in amounts equivalent to 25,000 metric tons of CO_2e or more per year and electrical transmission and distribution equipment at facilities where the total nameplate capacity of SF_6 and PFC containing equipment exceeds 17,820 pounds, **2)** facilities in source categories listed in §98.2(a)(2) including electronics manufacturing, iron and steel production and pulp and paper manufacturing that emit 25,000 metric tons of CO_2e or more per year from such source categories as well as all stationary combustion, **3)** facilities with stationary combustion sources that aggregate to 30 MMBTU/hr or more and which emit 25,000 metric tons of CO_2e or more per year from all stationary combustion sources combined, and **4)** fuel suppliers including all local natural gas distribution companies. *The U.S. EPA has retained the implementing authority for this regulation and is responsible for determining applicability. This regulation under Part 98 is not considered to be an applicable requirement per 40 CFR Part 70.2 and as noted in 74 FR 56260 (October 30, 2009). Part 98 is anticipated to apply to the Landfill Operation at the Facility and NEWSVT has been reporting emissions for applicable years.*

C. Non-Applicable Requirements for Which a Permit Shield Provision Has Been Requested

Pursuant to §5-1015(a)(14) of the *Regulations*, the Owner/Operator may request a *permit shield* from specific state or federally enforceable regulations and standards which are not applicable to the source.

The Permittee has requested a permit shield with respect to several potentially applicable requirements. The Agency has reviewed this request and is hereby granting a permit shield in accordance with §5-1015(a)(14) of the *Regulations* for the following requirements which have been determined not to be applicable to the Facility based on the information provided by the Permittee.

Table 4-3 Non-Applicable Requirements for which a Permit Shield is Granted
§5-231(1) - Prohibition of Particulate Matter: Industrial Process Emissions. The Agency has determined that the combustion of LFG is not considered an industrial process since gaseous fuels are not considered part of the *process weight* input into a process. Therefore, the combustion of LFG is not subject to this regulation
§5-231(3) - Prohibition of Particulate Matter: Combustion Contaminants. The Agency has determined that LFG is not a *fossil fuel* under the definition in the *Regulations* therefore this regulation is not applicable to flares or engines that combust LFG. However, the other fuel burning equipment at the facility including the No.2 fuel oil space heating units, the used oil furnace, and the backup generator at the LFGTE Operation are subject.
§5-241(3) - Prohibition of Nuisance and Odor: Control of Odors from Industrial Processes. While the Facility is subject to §5-241(1) and (2), the Agency has not previously classified all landfills as industrial processes subject to §5-241(3) and does not currently consider the Facility subject to this regulation. However, in order to ensure compliance with other applicable requirements for this Facility, most of these emission control measures are required under separate authority.

5.0 CONTROL TECHNOLOGY REVIEW FOR MAJOR SOURCES AND MAJOR MODIFICATIONS

Pursuant to §5-502 of the *Regulations* each new major source and major modification must apply control technology adequate to achieve the Most Stringent Emission Rate ("MSER") with respect to those air contaminants for which there would be a major or significant emission increase, respectively.

The approximately 91 ton per year increase in allowable CO emissions from the Caterpillar CAT 3520C LE engines as a result of re-evaluating the Most Stringent Emission Rate (MSER) would be considered a major emission increase.

The previous MSER of 2.75 g/bhp-hr at all times was found to not be achievable in practice, due to siliceous material deposition in the combustion chambers of the CAT 3520C LE engines from the combustion of siloxanes contained in the LFG. As these siliceous deposits accumulate over time, they degrade the emission characteristics of the engine. The engine manufacturer recommends annual removal of these deposits from the engine components followed by a more extensive on-site in-frame cleaning every three years and an even more extensive off-site overhaul every 6 years. The standard annual cleaning is expected to reduce carbon monoxide emissions to 3.1 g/bhp-hr or less but it is not until the 6 year cleaning that emissions are anticipated to reliably achieve compliance with the like-new 2.75 g/bhp-hr emission limit for CO.

Treatment options for the combustion gases are generally not practicable, as the siliceous deposits from siloxane combustion would likely render any catalytic control device ineffective. Based on the Agency's understanding of the capabilities of the proposed SRS, the Agency has determined the installation of any pollution control equipment downstream of the engines would be inappropriate at this time, as there is still sufficient uncertainty regarding siloxane concentrations in LFG supplied to the engines, and the subsequent

effects of these combusted siloxanes on pollution control equipment used for treatment of the engine exhaust. Accordingly, the revised MSER for CO the CAT 3520C LE engines will be as follows:

- 3.5 g/bhp-hr and 17.3 lb/hr (each) applies at all times
- 3.1 g/bhp-hr and 15.3 lb/hr (each) must be demonstrated every two years. The permit may not require each engine to be tested each year in which case the results of those being tested will be considered representative of those not tested that year.
- 2.75 g/bhp-hr and 13.5 lbs/hour (each) must be demonstrated every 6 years

The MSER for NOx emissions from the CAT G3520C LE engines fired with LFG was established as 0.5 g/bhp-hr and 2.45 lb/hour for each engine on December 16, 2004 under #AOP-03-044. This MSER is not subject to further review at this time since it is the Agency's understanding that NOx emissions have not increased since the original MSER was established.

The MSER for CO for the John Zink flare at the Facility was previously established as 0.37 lb/MMBtu on December 16, 2004 under #AOP-03-044 and is reaffirmed as part of this permit. Similarly, the MSER for NOx for the John Zink flare at the Facility was previously established at 0.068 lb/MMBtu, and this MSER is not subject to further review at this time since NOx emissions have not increased by a significant amount since the limit was established. The MSER for CO and NOx for the proposed Parnel Biogas flare and the SRS flare will be established at the same limits as the existing John Zink flare.

6.0. AMBIENT AIR QUALITY IMPACT EVALUATION

The Agency's implementation procedures concerning the need for an ambient air quality impact evaluation under §5-501 of the *Regulations* specifies that such analyses shall be performed when modifications result in an allowable emissions increase of 10 tpy or more of any air contaminant, excluding VOCs. Air quality impact evaluations are not required by the Agency for individual sources of VOCs.

Based on the proposed level of emissions increase from this Facility, the Agency required a revised AQIE for the pollutants CO, NOx, PM / PM_{10} / $PM_{2.5}$ and SO_2.

An AQIE was prepared for the Facility (*Air Dispersion Modeling Report, New England Waste Services of Vermont, Inc. Landfill, Coventry Vermont, prepared by Sanborn, Head, and Associates*) that was submitted to the Agency on October 1, 2014. The AQIE evaluated emissions from two different operating scenarios for the Landfill. Scenario A evaluated the impacts of air emissions from the combustion of 5,000 scfm of LFG containing 50 percent methane, with the gas flow divided equally between two landfill utility flares. Scenario B evaluated the emissions from the combustion of approximately 5,000 scfm of LFG at 50 percent methane, with of approximately 2,537 scfm of LFG being combusted in five CAT 3520C LE engines at the Facility with the balance of the LFG being combusted in a single flare. The emissions from Scenario B were greater than for Scenario A, and accordingly, Scenario B was used for evaluating Facility emissions.

Since CO emission increases also exceed the significance threshold of fifty (50) tons per year, the Agency's implementation procedures require the AQIE to determine which other nearby sources, if any, must be included in the analysis. Any other nearby source that has a significant impact area for a respective pollutant that overlaps with the proposed Facility's significant impact area for that same pollutant must be included in the AQIE. All other nearby sources are assumed to be included in the ambient background value for the pollutant. The ambient background value is determined from the Agency's ambient monitoring network throughout the State. For PM, the nearby sources potentially required to be included in the AQIE were the Columbia Forest Products facility (CFP) in Newport, Vermont and the Ethen Allen, Inc. facility (EAO) in Orleans, Vermont. However, since the significant impact areas for CFP or EAO did not overlap with the Facility's significant impact area for $PM_{2.5}$, these facilities were not included in the AQIE.

Based on the results of the AQIE, it was proposed to increase the stack height for the CAT 3520C engines at the Facility from 28-feet to 34-feet. With this change, the Facility was found to comply with all applicable ambient air quality standards and prevention of significant deterioration increments.

Table 6-1 NAAQS Review – AOP-14-034 / AOP-15-032 - ????. 2015

Pollutant	Averaging Period	Modeled Concentration ($\mu g/m^3$)	Background ($\mu g/m^3$)	Sum ($\mu g/m^3$)	AAQS ($\mu g/m^3$)	Pass?
CO	8-hr	480.5	1,260	1,740.5	10,305	Yes
NOx	1-hr	104.1	65.8	169.9	188	Yes
	Annual	2.1	13.4	15.5	100	Yes
$PM_{2.5}$	24-hr	7.5	18.0	25.5	35	Yes
	Annual	0.86	6.8	7.7	15	Yes
PM_{10}	24-hr	8.3	34.0	42.3	150	Yes
SO_2	1-hr	139.8	47.1	186.9	196	Yes
	3-hr	103.3	47.1	150.4	1,309	Yes

Table 6-2 PSD Increment Review – AOP-14-034 / AOP-15-032 - ????. 2015

Pollutant	Averaging Period	Modeled Concentration ($\mu g/m^3$)	Maximum Allowable Class II PSD Increment Standard ($\mu g/m^3$)	Previously Consumed Class II PSD Increment ($\mu g/m^3$)	Class II PSD Increment Available ($\mu g/m^3$)	Pass?
NOx	Annual	2.1	25	7.4	11.8	Yes
$PM_{2.5}$	24-hr	6.4	9	0	6.8	Yes
	Annual	0.64	4	0	1.0	Yes

Table 6-2 PSD Increment Review – AOP-14-034 / AOP-15-032 - ????. 2015						
Pollutant	Averaging Period	Modeled Concentration (µg/m^3)	Maximum Allowable Class II PSD Increment Standard (µg/m^3)	Previously Consumed Class II PSD Increment (µg/m^3)	Class II PSD Increment Available (µg/m^3)	Pass?
PM_{10}	24-hr	8.3	30	0	22.5	Yes
SO_2	3-hr	103.3	512	0	512	Yes

7.0 HAZARDOUS AIR CONTAMINANTS

Pursuant to §5-261 of the *Regulations*, any stationary source whose current or proposed actual emission rate of a hazardous air contaminant ("HAC") is equal to or greater than the respective Action Level (found in Appendix C of the *Regulations*) shall achieve the Hazardous Most Stringent Emission Rate ("HMSER") for the respective HAC.

The Facility is anticipated to have emissions of several hazardous air contaminants (HACs). Some HACS are present as NMOCs in the LFG, and these HACS are emitted as fugitive emission from the Landfill Operation. Some fraction of these NMOCs are also emitted from the control devices (flares and CAT 3520C engines) at the Facility, as these control devices are assumed to destroy approximately 98 percent of the NMOCs contained in the LFG. The estimated HACs emitted from the operation of the Facility, and those HACs that were identified as having estimated emissions in excess of their respective Action Levels are presented in Table 7-1.

The CAT 3520C engines also create formaldehyde as a combustion byproduct. The emissions of formaldehyde were estimated based on a formaldehyde emission factor of 0.164 g/bhp-hr as discussed in Section 3.2.2, and emissions testing will be performed at the Facility to provide a site-specific emission factor for VOC emissions from the CAT 3520C engines. This emission factor will be based on a speciated analysis of the VOCs contained in the exhaust from the CAT 3520C engines.

Another combustion byproduct is silicon dioxide (SiO_2) that is emitted from the engines and flares from the combustion of siloxanes contained in the LFG. It is unclear at this time if the uncontrolled emissions of SiO_2 will exceed the Action Level, as the crystallographic structure and particle size of SiO_2 particles affects their toxicity. If the SiO_2 particles are crystalline silica (CAS # 14808-60-7) or fused silica (CAS # 60676-86-0), then estimated SiO_2 emissions likely will exceed the ALs for these forms of SiO_2, which are 0.010 lb/8-hr and 0.007 lb-8 hr respectively . If the SiO_2 particles are amorphous silica (CAS # 61790-53-2), it is likely that SiO_2 emissions will remain below the AL of 2.0 lb/8 hr. A condition will be added to the permit as part of the PM testing for the engines at the Facility to evaluate the composition of PM found in the exhaust from the CAT 3520C engines to provide further insight into the particle composition emitted from these engines.

Emissions of SiO_2 from the CAT 3520C LE engines and/or flares may be controlled by

removing the siloxanes from the LFG with the SRS before combusting the LFG. The siloxanes removed from the LFG will include some percentage of H_2S and other NMOCs, and this gas mixture will.be flared to provide for destruction of the H_2S and other NMOCs. Unfortunately, flaring of the offgas from the SRS will also result in the formation of SiO_2 particles, and it is unlikely that there will be any reduction in the emission of SiO_2 particles with the installation and operation of the SRS

Table 7-1 HAC Emissions from Facility Operation

Parameter					Total Emissions (Fugitive + One Flare + All Engines)			VT HAC Action Level (lbs/8-hr)	Percentage of VT HAC Action Level	VT HAC Action Level Exceeded?
					(lb/hr)	(lb/8-hr)	(ton/yr)			
NMOC (Flare / Fugitive)					7.15	Not Applicable	31.3			
VOC (Flare / Fugitive/Engines) - Excluding formaldehyde emissions from engines					2.79		12.2			
CAS No.	**VOC (Y/N)**	**HAP (Y/N)**	**HAC (Y/N)**	**VOCs, HAPs) and HACs [1, 2, 3, 4, 5]**						
71-55-6	**N**	**Y**	**Y**	**1,1,1-Trichloroethane**	**0.009467**	**0.075737**	**0.041**	**0.0052**	**1456.5%**	**Yes**
79-00-5	**Y**	**Y**	**Y**	**1,1,2-Trichloroethane**	**0.001972**	**0.015779**	**0.009**	**0.0052**	**303.4%**	**Yes**
79-34-5	**Y**	**Y**	**Y**	**1,1,2,2-Tetrachloroethane**	**0.027544**	**0.220355**	**0.121**	**0.0015**	**14690.3%**	**Yes**
75-34-3	Y	Y	Y	1,1-Dichloroethane	0.034384	0.275074	0.151	4.2	6.5%	No
75-35-4	Y	Y	Y	1,1-Dichloroethene (Vinylidene Chloride) (1,1-Dichloroethylene)	0.001406	0.011247	0.006	1.7	0.7%	No
107-06-2	**Y**	**Y**	**Y**	**1,2-Dichloroethane (Ethylene Dichloride)**	**0.001387**	**0.011095**	**0.006**	**0.0032**	**346.7%**	**Yes**
78-87-5	**Y**	**Y**	**Y**	**1,2-Dichloropropane (Propylene Dichloride)**	**0.003007**	**0.024054**	**0.013**	**0.0042**	**572.7%**	**Yes**
67-64-1	N	N	Y	Acetone	0.060191	0.481529	0.264	26.1	1.8%	No
107-13-1	**Y**	**Y**	**Y**	**Acrylonitrile**	**0.003467**	**0.027738**	**0.015**	**0.0012**	**2311.5%**	**Yes**
106-93-4	Y	Y	Y	1,2-Dibromoethane (Ethylene dibromide)	0.000028	0.000222	0.000	0.00037	60.1%	No
106-46-7	Y	Y	N	1,4-Dichlorobenzene (p-dichlorobenzene)	0.004564	0.036510	0.020	--	--	No
108-10-1	Y	Y	Y	4-Methyl-2-Pentanone (Methyl isobutyl ketone)	0.027690	0.221521	0.121	249	0.1%	No
71-43-2	**Y**	**Y**	**Y**	**Benzene**	**0.011663**	**0.093305**	**0.051**	**0.011**	**848.2%**	**Yes**
75-27-4	**Y**	**N**	**Y**	**Bromodichloromethane**	**0.075810**	**0.606479**	**0.332**	**0.0046**	**13184.3%**	**Yes**
75-15-0	Y	Y	Y	Carbon disulfide	0.006528	0.052223	0.029	54.5	0.1%	No
56-23-5	Y	Y	Y	Carbon tetrachloride	0.000091	0.000728	0.000	0.0055	13.2%	No
463-58-1	Y	Y	N	Carbonyl sulfide	0.004352	0.034812	0.019	--	--	No
108-90-7	Y	Y	Y	Chlorobenzene	0.001388	0.011103	0.006	0.2	5.6%	No
75-00-3	Y	Y	N	Chloroethane (Ethyl Chloride)	0.011923	0.095386	0.052	--	--	No
67-66-3	**Y**	**Y**	**Y**	**Chloroform**	**0.000530**	**0.004236**	**0.002**	**0.0036**	**117.7%**	**Yes**
75-71-8	N	N	Y	Dichlorodifluoromethane	0.280640	2.245123	1.229	16.6	13.5%	No
75-09-2	**N**	**Y**	**Y**	**Dichloromethane (Methylene Chloride)**	**0.482205**	**3.857640**	**2.112**	**0.17**	**2269.2%**	**Yes**
75-08-1	**Y**	**N**	**Y**	**Ethyl mercaptan (Ethanethiol)**	**0.020942**	**0.167538**	**0.092**	**0.099**	**169.2%**	**Yes**
100-41-4	Y	Y	Y	Ethylbenzene	0.020089	0.160712	0.088	8.3	1.9%	No
50-00-0	**Y**	**Y**	**Y**	**Formaldehyde**	**4.015106**	**32.120849**	**17.586**	**0.0065**	**494166.9%**	**Yes**
110-54-3	Y	Y	Y	Hexane	0.083707	0.669653	0.367	581	0.1%	No
7783-06-4	**N**	**N**	**Y**	**Hydrogen sulfide**	**1.551810**	**12.414479**	**6.797**	**0.08**	**15518.1%**	**Yes**
7439-97-6	N	Y	Y	Mercury	0.000054	0.000434	0.000	0.02	2.2%	No
78-93-3	Y	N	Y	Methyl ethyl ketone	0.075584	0.604672	0.331	415	0.1%	No
108-88-3	Y	Y	Y	Toluene	0.170273	1.362186	0.746	24.9	5.5%	No
79-01-6	**Y**	**Y**	**Y**	**Trichloroethylene (Trichloroethene)**	**0.009868**	**0.078947**	**0.043**	**0.04**	**197.4%**	**Yes**
75-01-4	**Y**	**Y**	**Y**	**Vinyl chloride**	**0.003474**	**0.027794**	**0.015**	**0.0091**	**305.4%**	**Yes**
108-38-3 / 106-42-3 / 95-47-6	Y	Y	Y	Xylenes	0.044259	0.354069	0.194	8.3	4.3%	No
				Total Quantified NMOCs	3.03	24.24	**13.27**			
				Total Quantified VOCs	4.66	37.29	**20.42**			
				Total Quantified HAPs	4.98	39.84	**21.81**			
				Total Quantified HACs	7.02	56.20	**30.77**			

As LFG contains a variety of NMOCs which may or may not have been quantified or identified in previous sampling efforts, it is possible that other NMOCs may be present which exceed their respective AL. However, the LFG collection and control requirement that has been implemented for the identified HACs would be expected to be equally effective for any unidentified HACs contained in the LFG.

The Agency has determined that HMSER for all compounds present as NMOCs in LFG shall continue to be the requirement to achieve the minimum 98% destruction efficiency of the NMOCs in the LFG as required by the prior HMSER and the federal regulations or alternatively demonstrate that the outlet concentrations of NMOCs from the control devices are less than 20 ppmvd measured as hexane. In addition, the Facility must also comply with various requirements for the collection of LFG to ensure as much gas is collected as is technically feasible and for monitoring of the gas collection and control system operations.

Formaldehyde emissions from internal combustion engines are typically minimized by following the manufacturer's recommendations for operating and maintaining the engines so that they operate at design combustion efficiency.

Although the formaldehyde emissions from the CAT 3520C engines at the Facility exceed the AL, the location and the emission characteristics of these engines are such that the dispersion of formaldehyde emissions from the stacks likely will result in emissions that are less than the Hazardous Ambient Air Standard (HAAS) for receptors that are near the Facility. Factors considered in this review include the following.

- The nearest receptors to the Facility are approximately 1 km from the Facility.
- The proposed stack height of 34 feet, exhaust temperatures of approximately 800 degrees Fahrenheit, and an exit velocity for the engine exhaust of approximately 150 feet per second all contribute to enhancing dispersion of formaldehyde.
- Formaldehyde is a ubiquitous compound that is also found in the emissions from virgin fuel fired internal combustion engines.

The EPA has determined that carbon monoxide (CO) can be used as an appropriate surrogate for formaldehyde, as is generally described in 40 CFR Part 63, Subpart ZZZZ. Accordingly, the Agency has determined that HMSER for formaldehyde emissions from the CAT 3520C LE engines will be the same as the MSER for CO, which incorporates the effects of siloxane combustion and deposition within the combustion chambers of the engines. The HMSER for formaldehyde for the CAT 3520C LE engines will be as follows:

- 3.5 g/bhp-hr and 17.3 lb/hr (each) applies at all times
- 3.1 g/bhp-hr and 15.3 lb/hr (each) must be demonstrated annually. The permit may not require each engine to be tested each year in which case the results of those being tested will be considered representative of those not tested that year.
- 2.75 g/bhp-hr and 13.5 lbs/hour (each) must be demonstrated every 6 years

Emissions of SiO_2 from LFG combustion may be controlled by removing the siloxanes from the LFG before combustion. However, as previously noted, the SRS uses a flare to control offgas from the treatment process, so the SRS likely will not provide any reduction

in SIO2 emissions. In addition, there is some uncertainty regarding what form of SiO2 is emitted from the combustion devices at the Facility. Accordingly, based on these considerations, the HMSER for SiO_2 from all combustion devices at the Facility will be a restriction on PM emissions from the Facility, limiting PM emissions to less than 19.8 tons per year.

8.0 PERMIT CONDITION DISCUSSION

Condition (24) of #AOP-14-034 / Condition (16) of #AOP-15-032

These Conditions were developed to provide an enforceable restriction on SO_2 emissions, such that these emissions are less than the 40 ton/year SO_2 emission limit proposed by the Permittee. This Condition requires monthly measurement of H_2S in the LFG collected from the Landfill and collection of information regarding total LFG volumes delivered in that month to the combustion devices.

The formula in this Condition is based on the assumption that H_2S concentrations will reflect the amount of sulfur contained in LFG, and that 100 percent of the H_2S is converted to SO_2 during combustion. The conversion factor for converting H_2S concentrations and LFG flow to mass of SO_2 was derived as follows:

lb SO_2/ ppmv H_2S -scf LFG = [ppmv H_2S]*[1 mole H_2S /ppmv H2s * 106 lbmol LFG]
* [lbmol SO_2/lbmol H_2S]*[64.07 lb SO_2/lbmol]
* [1 lbmol LFG/378.25 scf LFG]

lb SO_2/ ppmv H_2S -scf LFG = 1.694E-7 lb SO_2/ppmv H_2S -scf LFG

The SO_2 emissions generated by the combustion of LFG will be calculated each month, and the monthly emissions will be summed with the total of the emissions from the previous 11 months to insure that the rolling 12-month total of SO_2 emissions does not equal or exceed 40 tons per rolling twelve-month period.

Condition (25) of #AOP-14-034 / Condition (17) of #AOP-15-032

These Conditions were developed to provide an enforceable restriction for PM emissions from the Facility. The MSER for PM emissions included a limitation that Facility PM emissions not increase from the previous allowable PM emissions of 9.8 tons by the significance threshold for $PM_{2.5}$ of 10 tons, which results in an MSER limit for PM emissions from the Facility of not to exceed 19.8 tons per rolling 12-month period. The same 19.8 tons per rolling 12-month period emission limitation was also established as HMSER for SiO_2 emissions.

The formulae in this condition are based on the following assumptions:

- PM emissions from the SRS will of the sum of the PM emissions estimated using the AP-42 PM emission factor for landfill flares, and the emissions of SIO_2 based on siloxane combustion.
- PM emission from the CAT 3520C engines will consist of the sum of the PM emissions estimated using a site-specific PM emission factor for these engines, the hours of operation for the engines, and the capacity factor for electrical generation at the Facility.

- PM emissions from the landfill flare(s) will of the sum of the PM emissions estimated using the AP-42 PM emission factor for landfill flares, and the emissions of SIO_2 based on siloxane combustion.

The total amount of VOCs emitted from the Facility will be calculated each month, and the monthly emissions will be summed with the total emissions from the previous 11 months to insure that the rolling 12-month total of VOC emissions does not equal or exceed 50 tons per rolling twelve-month period.

Monthly PM emissions shall be calculated in accordance with the following formulae:

Equation 1: $PM_{total} = PM_{siloxane\ removal\ system} + PM_{LFG\ flares} + PM_{engine\ combustion}$

Equation 2: $PM_{siloxane\ removal\ system} = [Si\ Concentration_{srs\ inlet} - Si\ Concentration_{srs\ outlet}]*[1\ cubic\ meter/35.31cubic\ feet]*[1\ lb/453{,}592\ mg]*[LFG_{treated}]*[Molecular\ weight\ of\ SiO_2 / Molecular\ weight\ of\ Si]*[1\ ton/2{,}000\ lb] + ([LFG_{srs}]*[LFG\ Heat\ Value]*[Flare\ Emission\ Factor]*[1\ ton/2{,}000\ lb])$

Where:
$LFG_{treated}$= Total collected LFG flow in scf treated by the SRS at the Facility in that month
$Si\ Concentration_{srs\ inlet}$ = Si concentration in LFG before treatment by the SRS in mg Si / cubic meter
$Si\ Concentration_{srs\ outlet}$ = Si concentration in LFG after treatment in SRS in mg Si / cubic meter
LFG_{srs} = Total LFG flow in scf used to fire the SRS flare in that month
LFG Heat Value = Heat Value of LFG in MMBtu/scf. A default value of 5.0E-4 MMBtu/scf may be used or a site specific value approved by the Agency.
Flare Emission Factor = 1. 7E-2 lb/MMBtu

Equation 3: $PM_{LFG\ flares} = ([LFG_{month\ flare}]*[LFG\ Heat\ Value]*[Flare\ Emission\ Factor])*[1\ ton/2{,}000\ lb]) + (([LFG_{month\ flares}]*[Si\ Concentration_{flares}]*[1\ cubic\ meter/35.31cubic\ feet]*[1\ lb/453{,}592\ mg]*[Molecular\ weight\ of\ SiO_2 / Molecular\ weight\ of\ Si]*[1\ ton/2{,}000\ lb]$

Where:
$LFG_{month\ flares}$ = Total collected LFG flow in scf delivered to the flare(s) at the Facility in that month
LFG Heat Value = Heat Value of LFG in MMBtu/scf. A default value of 5.0E-4 MMBtu/scf may be used or a site specific value approved by the Agency.
Flare Emission Factor = 1.7E-2 lb/MMBtu
$Si\ Concentration_{flares}$ = Si concentration in LFG to flare(s) in mg Si / cubic meter
Molecular weight of Si = 28.09
Molecular weight of SiO_2 = 60.08

Equation 4: $PM_{engine\ combustion} = [Engine\ Emission\ Factor] *[1\ lb/453.592\ g]*[Hours\ of\ operation\ for\ 3520C\ engines]*[3520C\ engine\ rating]* [Capacity\ Factor] * [1\ ton/2{,}000\ lb])$

Where:
Engine Emission Factor = 0.153 g/bhp-hr OR emission factor in g/bhp-hr obtained from

stack testing required by Condition (27) of #AOP-15-032 at the Agency's discretion.
Hours of operation for 3520C engines = Total number of hours of operation for all 3520C engines in that month.
3520C engine rating = 2,221 bhp or a site specific value approved by the Agency.
Capacity Factor = Measured electrical output in MW of all 3520C engines at the Facility in that month / Electrical Output $_{theoretical}$
Electrical Output $_{theoretical}$ = Electrical output in MW of all 3520C engines at the Facility in that month assuming they are operated at 100 percent output for the hours operated..

Compliance with this limit shall be documented through measuring and recording:

- Monthly LFG flow treated by the SRS in standard cubic feet (scf).
- Monthly LFG flow to the CAT 3520C engines in standard cubic feet (scf)
- Monthly LFG flow to each of the flare(s) in standard cubic feet (scf)
- Silicon (Si) concentrations in untreated LFG in units of milligrams of Si per cubic meter of LFG measured every six (6) months.
- Silicon (Si) concentrations of LFG after treatment in the SRS in units of milligrams of Si per cubic meter of LFG.
- Monthly hours of operation for the five (5) 3520C engines at the Facility recorded to the nearest tenth (0.1) hour.

Concentrations of Si shall be measured before and after treatment in the siloxane removal system, and shall be measured every six (6) months using sample collection and chemical analytical methods approved by the Agency

Condition (26) of #AOP-14-034 / Condition (18) of #AOP-15-032

These Conditions were developed to provide an enforceable restriction for the 50 ton per year VOC emission limit established for the Facility. VOCs are emitted by several sources at the Facility, including fugitive emissions from the Landfill, VOCs contained in collected LFG that are not destroyed by the flares and/or engines, and VOCs created as a result of incomplete combustion in the engines.

The Permittee has assumed that the cover and gas collection system at the Landfill has an 85 percent capture efficiency. Thus, the total amount of captured LFG divided by 0.85 will equal the estimated total LFG generation from the Landfill, and 15 percent of the total LFG generation will be emitted as fugitive LFG. Previous sampling and analysis of LFG indicated that VOC concentrations in LFG were 219 ppmv as hexane (39% of the measured NMOC 561ppm), or 4.99E-05 lb VOC/scf LFG. Accordingly, fugitive VOC emissions will be based on this VOC concentration, and the measured volume of collected LFG multiplied by (0.15/0.85)

Combustion of LFG in the flares at the Facility is assumed to result in 98 percent destruction of any VOC compounds contained in the LFG. Accordingly, emissions of VOCs from the flare will be based on the assumption that 2 percent of the 4.99E-05 lb VOC/scf LFG is emitted from LFG combustion in the flares.

Combustion of LFG in the CAT 3520C LE engines at the Facility is more complex, in that VOCs contained in LFG are destroyed by combustion, but VOCs (notably formaldehyde) are also

created from incomplete combustion of methane in the LFG. To estimate total VOC emissions from the engines, the Agency has determined that combustion emissions of VOCs from the engines, exclusive of formaldehyde will be 39 percent of the most recent measured value for NMOC emissions from stack testing of the CAT 3520C LE engines at the Facility. To account for formaldehyde emissions, the formaldehyde emission factor of 5.28E-02 lb/MMBtu of heat input was obtained from AP-42, *Chapter 3: Stationary Internal Combustion Sources, Section 3.2, Natural Gas-fired Reciprocating Engines, Table 3.2-2 Uncontrolled Emission Factors for 4-Stroke Lean-Burn Engines, (Supplement F, August 2000).* Assuming a fuel heat value of 500 Btu/scf, and an LFG supply rate to each engine of 507.5 scf of LFG results in an estimated emission factor for formaldehyde of 0.164 g/bhp-hr.

Stack testing will be required to assess if this estimate of formaldehyde emissions is appropriate. The emissions factor for compliance will be adjusted, at the discretion of the Agency, to either the factor estimated as described above, or to the stack test result obtained from emissions testing required as part of #AOP-15-032.

Total Facility emissions of VOCs will be the sum of fugitive VOC emissions, VOC emission from the flares, and VOC emissions from the CAT 3520C engines. The equations used to calculate total VOC emissions are as follows:

The quantity of VOC emissions from the Facility shall be determined on a monthly basis in accordance with the following formulae:

Equation 1: $VOC_{total} = VOC_{fugitive} + VOC_{flares} + VOC_{engine\ combustion}$

Equation 2: $LFG_{fugitive} = [LFG_{month} / \text{Percent Capture Efficiency}]*[1 - \text{Percent Capture Efficiency}]$

Equation 3: $VOC_{fugitive} = [LFG_{fugitive}]*[4.99E\text{-}5 \text{ lb VOC/scf LFG}]*[1 \text{ ton}/2{,}000 \text{ pounds}]$

Where:

LFG_{month} = The total collected LFG flow in scf delivered to all combustion devices at the Facility in that month

$LFG_{fugitive}$ = The total fugitive LFG emitted from the Facility in that month

Percent Capture Efficiency = 0.85

Percent Fugitive Emissions = [1 - Percent Capture Efficiency]

Percent capture efficiency is expressed as a decimal equivalent (i.e. 85% = 0.85)

Equation 4: $VOC_{flares} = [\text{LFG flow in scf delivered to flares}]*[4.99E\text{-}5 \text{ lb VOC/scf LFG}]*[1\text{-Destruction Efficiency}]*[1 \text{ ton}/2{,}000 \text{ pounds}]$

Where:

Destruction Efficiency = 0.98

Percent destruction efficiency is expressed as a decimal equivalent (i.e. 98% = 0.98)

Equation 5: $VOC_{engine\ combustion} = [\text{Total Engine Operating Hours}*\text{Engine Horsepower}] * [\text{Capacity Factor}] * [\text{VOC Emission Factor}] * [1 \text{ lb}/453.59 \text{ g}] *[1 \text{ ton}/2{,}000 \text{ pounds}]$

Where:

Total Engine Operating Hours = The total operating hours for all 3520C engines at the Facility in that month.
Engine Horsepower = Rated output of a 3520C engine, or 2,221 bhp
Capacity Factor = Measured electrical output in MW of all 3520C engines at the Facility in that month / Electrical Output $_{theoretical}$
Electrical Output $_{theoretical}$ = Electrical output in MW of all 3520C engines at the Facility in that month assuming they are operated at 100 percent output for the hours operated..

VOC Emission Factor = 39 percent of the measured NMOC emission factor from the most recent yearly engine emissions testing in accordance with Condition (25) of #AOP-15-032 in grams per brake horsepower-hour plus the AP-42 formaldehyde emission factor for natural-gas fired engines of 0.164 grams per bhp-hr.

OR, at the Agency's discretion,

VOC Emission Factor = Measured emission factor obtained from stack testing performed under Condition (26) of #AOP-15-032.

The total amount of VOCs emitted from the Facility will be calculated each month, and the monthly emissions will be summed with the total emissions from the previous 11 months to insure that the rolling 12-month total of VOC emissions does not equal or exceed 50 tons per rolling twelve-month period.

Condition (25) of #AOP-15-032

This Condition was developed to verify that emissions from the CAT 3520C engines do not exceed the limits for CO, NOx and NMOCs identified in Condition (14) of AOP-15-032. Engine No. 5 is the only engine at the Facility that is required to perform periodic emissions testing under 40 CFR, Part 60. Subpart JJJJ. Engines No. 1 -3 are regulated under 40 CFR, Part 63. Subpart ZZZZ, but this regulation does not require periodic testing of these engines. Engine No. 4 is not regulated under either Subpart JJJJ or Subpart ZZZZ. The combustion of siloxanes contained in LFG has a cumulative, detrimental effect of the emissions performance of these engines. Accordingly, the Agency has determined that testing of Engines No. 1-No. 4 every two years is appropriate to monitor compliance with the requirements of Condition (14) of AOP-15-032.

Condition (26) of #AOP-15-032

This Condition was developed to obtain a site-specific value for the VOC emissions from the CAT 3520C LE engines. There is little available information describing VOC emission factors for internal combustion engines fired with LFG, and given the potential quantity of VOCs generated by these engines, the Agency has determined that establishing a site-specific emission factor for formaldehyde was necessary to accurately estimate Facility VOC emissions. Note that the permit assumes an emission factor in the equation but this is not a formaldehyde emission limit. Rather the VOC emission limit is 50 tons per rolling twelve month period.

Condition (27) of #AOP-15-032

This Condition was developed to obtain a site-specific value for PM emissions from the CAT 3520C LE engines after the installation of the SRS. Previous emissions testing for PM from these engines included PM from siloxane combustion. The PM formation from siloxane combustion after the installation of the SRS is anticipated to be minor component of overall PM emission from the engines. The PM emission factor for the engines that is used for establishing compliance may be adjusted pending the results of this testing.