TREATMENT SYSTEM OPERATING PLAN
PREVENTATIVE MAINTENANCE PLAN

Peoples Compressor Station/Peoples Generating Station
Saginaw County, Michigan

1. Purpose

North American Natural Resources (NANR) has prepared this Treatment System Operating Plan (TSOP) and Preventive Maintenance Plan (PMP) to ensure proper monitoring and operation of the facility and gas treatment system and to comply with the requirements to maintain a site-specific treatment system monitoring plan as specified in 40 CFR Part 62, Subpart OOO and 40 CFR Part 63, Subpart AAAA

2. Responsible Personnel

The personnel responsible for overseeing the inspection, maintenance, and repair of the equipment and process identified in this Plan are:

Eric Parker
Environmental Manager
People's Generating Facility
1001 Louisiana St., Ste. 1000
Houston, Texas 77002
Telephone:
Cell: (432) 230-0956

Justin Boone
Operations Coordinator
People's Generating Facility
4516 Rathbun Road
Birch Run, Michigan 48415
Telephone:
Cell: (269) 921-2200

3. Equipment Identification

The NANR renewable energy facility primarily consists of:

- Gas treatment equipment
- Six (6) CAT G3516 lean-burn engine-generator sets

NANR maintains a stock of long-lead time or hard to obtain replacement parts for the electric generating units and for the treated landfill gas (LFG) fueled engines. The part list is balanced against the requirement given NANR's long-term engine maintenance program following practices in the industry.

Michigan Caterpillar also stocks a list of parts as required by the various LFG-to-energy power producers in the state of Michigan. Additionally, NANR works in concert at the operator level to network with other likely situated companies to exchange parts when required.

4. Gas Treatment System Operation

The gas received from the Waste Management – People's Landfill (People's Landfill) is initially de-watered in knockout tanks that are located upstream of the NANR gas treatment system where a portion of the condensate in the LFG is removed.

After the initial knockout de-watering, the LFG is treated in equipment and processes operated by NANR that consist of:

1. A scrubber / filtration vessel that contains a wire-mesh filter which is designed to remove particles in the gas stream that are 10 microns or larger. Condensate collected by the scrubber collects in the bottom of vessel where it is transferred by gravity sump back to the landfill's condensate management system.

2. Gas compressors that increase the pressure (and temperature) of the gas.

3. An air-to-gas heat exchanger that uses ambient air to cool the compressed gas from approximately 200°F to 120°F. This cooling produces additional condensate

4. An oil-water separator that uses a coalescing filter to remove condensate formed in the air-to-gas heat exchanger and also removes any compressor oil from the gas stream.

5. Treatment System Monitoring and Operating Ranges

Based on the design of the People's LFG treatment system, the following equipment and processes are monitored daily during normally scheduled workdays and records are maintained weekly. Table 1 at the end of this Plan summarizes the treatment system process monitoring and required parameter ranges.

The Scrubber Vessel is monitored with a liquid level sight tube and a differential pressure gauge. The liquid level should be maintained at less than 50% on the sight tube and is controlled by manually draining condensate from the vessel. The differential pressure from the inlet to outlet of the vessel should be maintained at 0.5 pounds per square inch (psid) or less. A high differential pressure indicates filter plugging. If this occurs, the vessel must be isolated from the gas stream and the filters blown out or changed.

The Compressor has a normal discharge pressure between 3 and 7 pounds per square inch gauge (psig). The temperature of the gas after compression is typically approximately 200°F. Temperature readings above 250°F indicate a problem requiring shutdown of the compressor for investigation. The

compressor oil level should be maintained at 2 gallons or more and operate with no visible leaks.

The Air-to-Gas Cooler cools the compressed gas to 120°F or lower. Outlet gas temperatures above 120°F indicate an unusually high inlet temperature (check compressed gas temperature) or poor heat transfer most likely caused build up within the cooler. If this occurs, the unit must be isolated and cleaned.

The Oil Water Separator has an automatic drain to maintain an appropriate liquid level within the vessel. An abnormal liquid may require manual draining or indicates a problem with the automatic drain system that must be investigated.

6. Generator Set Monitoring

At any time, if one of the generating units shuts down, the plant operator is paged immediately by the automatic notification system. This operator is on call twenty-four (24) hours a day, seven (7) days a week and returns to the plant to investigate the nature of the shutdown. A rotation system is in place with operators from near-by locations covering for each other. Whenever a shutdown occurs, the flare immediately picks up the extra gas. As such, the flare is a backup to the renewable energy plant.

In general, investigation and corrective actions follow these procedures:

(i) Evaluate the problem.
(ii) If the issue can be safely and easily corrected, perform the corrective and action and restart the equipment.
(iii) If corrective action requires replacement of parts that are in on-site inventory, isolate the equipment, replace the parts, and restart equipment.
(iv) If the repair or corrective action cannot be performed in a timely manner, verify that the flare is running and make arrangements for repairs (outside service technician, procuring new parts, etc.).

7. Recordkeeping

NANR's personnel keep Daily Logs recording the status of operations for each of the generating units and gas treatment system. Shutdowns of the generating units or entire gas treatment system (whether automatic or manual) are logged with the likely cause of the shutdown, downtime period, and time that operations were restarted.

An example of the Daily Log and Startup/Shutdown/Malfunction Report forms are included at the end of this Plan as attachments.

8. Regulatory Requirements

This Plan was prepared to ensure proper monitoring and operation of the facility and gas treatment system and to comply with the requirements to maintain a site-specific treatment system monitoring plan as specified in 40 CFR Part 62, Subpart OOO and 40 CFR Part 63, Subpart AAAA. These requirements are summarized in this section. The regulatory language in Subpart OOO and NESHAP AAAA are similar but not identical. Where applicable, similar citations are grouped together.

This site-specific treatment system monitoring plan is required because the associated landfill is or will be subject to control requirements under 40 CFR 62, Subpart OOO and 40 CFR 63, Subpart AAAA. As part of the landfill gas collection and control system (GCCS) on-site, all or a portion of the landfill gas is "treated" as part of its overall management prior to sale or beneficial use. Per §62.16730/§63.1990, a treatment system is one that filters, de-waters, and compresses landfill gas for sale or beneficial use.

A treatment system is one of the acceptable "control systems" under the NSPS/NESHAP rule as set forth in §62.16714(c)(3)/§63.1959(b)(2)(iii)(C), which specify that the owner may:

Route the collected gas to a treatment system that processes the collected gas for subsequent sale or beneficial use such as fuel for combustion, production of vehicle fuel, production of high-Btu gas for pipeline injection, or use as a raw material in a chemical manufacturing process. Venting of treated landfill gas to the ambient air is not allowed. If the treated landfill gas cannot be routed for subsequent sale or beneficial use, then the treated landfill gas must be controlled according to §62.16714 *(c)(1) or (c)(2)/* §63.1959(b)(2)(iii)(A) or (B).

NANR and/or the landfill operator operates the treatment system as a control system for the landfill gas subject to NSPS/NESHAP control, the monitoring requirements, specifically §62.16722(g)/ §63.1961(g) require that:

The treatment system must maintain and operate all monitoring systems associated with the treatment system in accordance with the site-specific

treatment system monitoring plan required in §62.16726(b)(5)(ii)/§63.1983(b)(5)(ii).

This site-specific treatment system monitoring plan satisfies the requirements of §62.16726(b)(5)(ii)/§63.1983(b)(5)(ii). Each element of the monitoring plan is listed here followed by the site-specific information related to this specific treatment system.

§62.16726(b)(5)(ii)(A)/§63.1983(b)(5)(ii)(A) *Monitoring records of parameters that are identified in the treatment system monitoring plan and that ensure the treatment system is operating properly for each intended end use of the treated landfill gas. At a minimum, records should include records of filtration, de-watering, and compression parameters that ensure the treatment system is operating properly for each intended end use of the treated landfill gas.*

Per §62.16722(g)(1)/§63.1961(g)(1), flow must be continuously (at least once every 15 minutes) monitored into the treatment system. The flow measurement device will be maintained and calibrated per manufacturer's recommendations. Also, per §62.16722(g)(2)/§63.1961(g)(2), if there is a bypass line, from the treatment system, it must be secured in the closed position and inspected at least monthly to verify that gas is not being diverted to the bypass line and circumventing appropriate NSPS control.

Per §62.16726/§63.1983 all records must be 5 years up-to-date, readily accessible, on-site. Off-site records may be maintained if they are retrievable within 4 hours. Either paper copy or electronic formats are acceptable. The person(s) performing the inspection as per the frequency listed in Table 1, will record the observed value and determine if the value is within the range of operation. If the recorded value is out of the range of operation, they will immediately take corrective action, including contacting all relevant staff, as necessary. Furthermore, collected data and a description of the actions taken will be placed into the plant file.

§62.16726 (b)(5)(ii)(B)/§63.1983(b)(5)(ii)(B) *Monitoring methods, frequencies, and operating ranges for each monitored operating parameter based on manufacturer's recommendations or engineering analysis for each intended end use of the treated landfill gas.*

Table 1 outlines monitoring methods, frequencies, and operating ranges for each monitored treatment operating parameter.

§62.16726 (b)(5)(ii)(C)/ §63.1983(b)(5)(ii)(C) *Documentation of the monitoring methods and ranges, along with justification for their use.*

The justification for the monitoring methods and ranges for each monitored treatment operating parameter is based on operational experience and/or

manufacturer recommendation. This section is required since the ranges of these treatment parameters are not prescribed by the NSPS rules, rather, they are to be set on a site-specific basis (since different beneficial uses and gas sales require different levels of treatment).

§62.16726 (b)(5)(ii)(D)/§63.1983(b)(5)(ii)(D) *Identify who is responsible (by job title) for data collection.*

Personnel responsible for data collection are identified in Section 2 of this Plan. These individuals may assign responsibility to another facility operator.

§62.16726 (b)(5)(ii)(E)/§63.1983(b)(5)(ii)(E) *Processes and methods used to collect the necessary data.*

Table 1 specifies how each type of treatment parameter (filtration, de-watering, and compression) will be monitored.

§62.16726 (b)(5)(ii)(F)/§63.1983(b)(5)(ii)(F) *Description of the procedures and methods that are used for quality assurance, maintenance, and repair of all continuous monitoring systems.*

The data and equipment are reviewed regularly during the month to verify accuracy and to evaluate for trends that may be characteristic of diminishing performance. Additionally, staff will perform visual inspections of the equipment and note issues as they arise. Repairs will be made as necessary. At a minimum, filters will be cleaned and or replaced as needed to maintain the listed differential pressures.

9. Gas Sulfur Monitoring / SO_2 Emissions

Sulfur monitoring is performed according to the Sulfur Monitoring Plan developed by NANR as prescribed by the facility's air permit (Renewable Operating Permit).

Table 1 - Landfill Gas Treatment System Monitoring Plan

Equipment	Parameter	Inspection Frequency[1]	Monitoring Device	Range of Operation[2]	Basis[3]
Scrubber / Filter	Differential Pressure	Weekly	Diff. Pressure Monitoring Device	0 – 0.5 psid	Operational Experience
	Liquid Level	Weekly	Sight Glass	< 50% Level	Operational Experience
Compressor	Discharge Pressure	Weekly	Pressure Gauge	3 to 7 psig	Operational Experience
	Discharge Temperature	Weekly	Temperature Monitor	< 250°F	Operational Experience
Air-Gas Cooler	Outlet Temperature	Weekly	Temperature Monitor	< 130°F	Operational Experience
Oil / Water Separator	Liquid Level (Auto Operation)	Weekly	Sight Glass	Level as marked on sight glass	Operational Experience

1. Proper operation is checked daily during normally scheduled workdays, records of individual components taken weekly.
2. Refer to Section 5 of this Plan for possible corrective actions if the monitored value is outside of the range(s) specified in the table.
3. NANR has operated gas-to-energy facilities for greater than 20 years and established these ranges based on experience with designing and operating these facilities.

ATTACHMENT 1
DAILY LOG RECORDING SHEET

PEOPLES GENERATING

GAS PANEL

PEOPLES GAS EAST

Fuel Flow	VAC	Gas PSIG	Gas Temp	Total Flow	Total BTU	CH4	O2
777	-41	6.2	87.5	5429820	2777525	51.7	-

BTU	Comp Temp	Comp Press	Gas Temp	Comp HRS	Blower hz
394	30	-	100	28541	83.7

Comp 2

Temp	Pres	Gas Temp	Hrs
134	4.7	71	30385

BLOWER - PEOPLES WEST

HZ	Flow	BTU	PSI	Total Flow	Total BTU
-21.9	237	120	6.0	1717601	891028

Peoples Compressor 19s

Gas Inlet temp	Gas Inlet Vac	Strainer	Scrubber	Coal Filter
40	-48	✓	✓	✓

Motor Temp	19s Temp	19s Tank	19s oil feed	Case Temp	Discharge PSI
100	150	22	✓	110	7.0

Pressure after oil: 6.0

Tay-Ban (11s)

Gas Inlet Temp	Gas Inlet Vac	Strainer	Scrubber	Coal Filter
62	-70	✓	✓	✓

Motor Temp	11s Temp	11s Tank	11s oil feed	Case Temp	Discharge PSI
120	160	23	✓	135	8.0

Pressure after oil: 6.5

ATTACHMENT 2
STARTUP/SHUTDOWN/MALFUNCTION REPORT FORM

Startup/Shutdown/Malfunction Report Form

Section 1 - All Events

Type of Event	Military Time Date/Time Start	Date/Time End	Duration (hours)	Event Code (see back of form)	SOP* Followed? Yes	No**
☐ Startup						
☐ Shutdown						
☐ Malfunction					Complete Section 2 Below	

Date Form Filled Out: _____ Signature: _____

* Standard Operating Procedure (SOP) for Flare Startups (Manual & Autom atic) and Shutdowns are provided in SSM Plan

**If SOP in SSM Plan was not followed, notify personnel on "Contact List".

Section 2 - Malfunction Events Only

Step	Corrective Action Procedures for All Malfunctions	☑ Check one of the following for each step: Procedure completed	Procedure Not Applicable
1.	Determine if landfill gas is being released to the air (can you smell landfill gas, or measure/detect gas flow?).	☐	
2.	If landfill gas is being released to the air, notify personnel on "Contact List".	☐	☐
3.	Determine if the malfunction is causing an unsafe operating condition (air entering landfill or piping, smoking, vibration, or other problem), which may harm people, the environment or the landfill gas control equipment.	☐	
4.	If unsafe operating condition exists, or landfill gas is being released to the air, stop (if possible) landfill gas flow.	☐	☐
5.	If Control device or other system component is shutdown, follow Shutdown SOP and Complete Section 1 - "Shutdown".	☐	☐
6.	Determine if other personnel/resource (qualified technician, electrician, consultant or other) are needed for malfunction diagnosis.	☐	
7.	If additional personnel needed, notify qualified personnel: a. Record contact name, date and time:_____ b. Contact site representative with information recorded in #7.a.	☐	☐
8.	Start malfunction diagnosis.	☐	
9.	Determine if other resources are needed to fix the malfunction (qualified technician, electrician, contractor. on-site resources. manufacturer's representative. or other).	☐	
10.	If additional resources needed, contact qualified resource: a. Record contact name, date and time:_____ b. Contact site representative with information recorded in #10.a.	☐	☐
11.	Fix the malfunction.	☐	
12.	Once the malfunction is fixed, re-start the system per SOP if it had been shut down, and record start-up times and dates in boxes in Section 1 of this form.	☐	☐
13.	Record date that malfunction occurred, date that malfunction was repaired, and total time that system was out of service in boxes in Section 1 of this form.	☐	
14.	Sign this form and place it in the Start-up, Shutdown, Malfunction file.	☐	
15.	If the procedures listed above were not followed, notify personnel on "Contact List".	☐	☐

ATTACHMENT 4

- PTE Calculations

Summary of Air Pollutant and GHG Emission Rates
Landfill Gas Fueled RICE: EUICE#1

1-CAT® G3516 LE IC Engine Specifications

Net Power Output	1,148	bhp
Typical Min. LFG LHV	455	Btu/scf
Heat Input Rate	9.07	MMBtu/hr (LHV)
	10.1	MMBtu/hr (HHV)
Max Fuel Consumption	19,947	scf/hr
	332	scfm
	0.479	MMscf/day

Regulated Pollutant	Emission Basis	Emission Factors			Emission Rates	
		(g/bhp-hr)	(lb/MMscf)	(lb/MMBtu)	(lb/hr)	(TpY)
NAAQS						
Nitrogen Oxides	(Existing permit limit)	1.5	--	0.42	3.80	16.6
Carbon Monoxide	(Existing permit limit)	2.7	--	0.75	6.83	29.9
Particulate Matter	(AP42: 5th Ed., Nov. 1998, Tables 2.4.1, 2.4.2, 2.4.3)	0.25	--	0.07	0.63	2.77
Sulfur Dioxide	(based on 308.4 ppm TRS)	--	51.3	0.11	1.02	4.48
Total VOC	(Existing permit limit)	0.84	--	0.23	2.13	9.31
Hazardous Air Pollutants						
Formaldehyde	(Similar permit limit)	0.28	--	--	0.71	3.10
Hydrogen Chloride	(AP42: 42 ppm Cl in LFG)	--	3.98	--	0.08	0.35
LFG Constituents	(AP42: see attached table)	--	3.04	--	0.06	0.27
Total HAPs					**0.85**	**3.72**
Greenhouse Gases						
GHG-CO_2	(based on 52.07 kg/MMBtu)	--	--	115	1,153	5,049
GHG-CH_4	(based on 3.2E-3 kg/MMBtu)	--	--	0.007	0.07	0.31
GHG-N_2O	(based on 6.3E-4 kg/MMBtu)	--	--	0.001	0.01	0.06
GHG-CO_2e		**--**	**--**	**--**		**5,075**

Summary of Air Pollutant and GHG Emission Rates
Landfill Gas Fueled RICE: EUICE#2

1-CAT® G3516 LE IC Engine Specifications

Net Power Output	1,148	bhp
Typical Min. LFG LHV	455	Btu/scf
Heat Input Rate	9.07	MMBtu/hr (LHV)
	10.1	MMBtu/hr (HHV)
Max Fuel Consumption	19,947	scf/hr
	332	scfm
	0.479	MMscf/day

Regulated Pollutant	Emission Basis	Emission Factors			Emission Rates	
		(g/bhp-hr)	(lb/MMscf)	(lb/MMBtu)	(lb/hr)	(TpY)
NAAQS						
Nitrogen Oxides	(Existing permit limit)	1.5	--	0.42	3.80	16.6
Carbon Monoxide	(Existing permit limit)	2.7	--	0.75	6.83	29.9
Particulate Matter	(AP42: 5th Ed., Nov. 1998, Tables 2.4.1, 2.4.2, 2.4.3)	0.25	--	0.07	0.63	2.77
Sulfur Dioxide	(based on 308.4 ppm TRS)	--	51.3	0.11	1.02	4.48
Total VOC	(Existing permit limit)	0.84	--	0.23	2.13	9.31
Hazardous Air Pollutants						
Formaldehyde	(Similar permit limit)	0.28	--	--	0.71	3.10
Hydrogen Chloride	(AP42: 42 ppm Cl in LFG)	--	3.98	--	0.08	0.35
LFG Constituents	(AP42: see attached table)	--	3.04	--	0.06	0.27
Total HAPs					**0.85**	**3.72**
Greenhouse Gases						
GHG-CO_2	(based on 52.07 kg/MMBtu)	--	--	115	1,153	5,049
GHG-CH_4	(based on 3.2E-3 kg/MMBtu)	--	--	0.007	0.07	0.31
GHG-N_2O	(based on 6.3E-4 kg/MMBtu)	--	--	0.001	0.01	0.06
GHG-CO_2e		**--**	**--**	**--**		**5,075**

Summary of Air Pollutant and GHG Emission Rates
Landfill Gas Fueled RICE: EUICE#3

1-CAT® G3516 LE IC Engine Specifications

Net Power Output	1,148	bhp
Typical Min. LFG LHV	455	Btu/scf
Heat Input Rate	9.07	MMBtu/hr (LHV)
	10.1	MMBtu/hr (HHV)
Max Fuel Consumption	19,947	scf/hr
	332	scfm
	0.479	MMscf/day

Regulated Pollutant	Emission Basis	Emission Factors			Emission Rates	
		(g/bhp-hr)	(lb/MMscf)	(lb/MMBtu)	(lb/hr)	(TpY)
NAAQS						
Nitrogen Oxides	(Existing permit limit)	1.5	--	0.42	3.80	16.6
Carbon Monoxide	(Existing permit limit)	2.7	--	0.75	6.83	29.9
Particulate Matter	(AP42: 5th Ed., Nov. 1998, Tables 2.4.1, 2.4.2, 2.4.3)	0.25	--	0.07	0.63	2.77
Sulfur Dioxide	(based on 308.4 ppm TRS)	--	51.3	0.11	1.02	4.48
Total VOC	(Existing permit limit)	0.84	--	0.23	2.13	9.31
Hazardous Air Pollutants						
Formaldehyde	(Similar permit limit)	0.28	--	--	0.71	3.10
Hydrogen Chloride	(AP42: 42 ppm Cl in LFG)	--	3.98	--	0.08	0.35
LFG Constituents	(AP42: see attached table)	--	3.04	--	0.06	0.27
Total HAPs					**0.85**	**3.72**
Greenhouse Gases						
GHG-CO_2	(based on 52.07 kg/MMBtu)	--	--	115	1,153	5,049
GHG-CH_4	(based on 3.2E-3 kg/MMBtu)	--	--	0.007	0.07	0.31
GHG-N_2O	(based on 6.3E-4 kg/MMBtu)	--	--	0.001	0.01	0.06
GHG-CO_2e		**--**	**--**	**--**		**5,075**

Summary of Air Pollutant and GHG Emission Rates
Landfill Gas Fueled RICE: EUICE#4

1-CAT® G3516 LE IC Engine Specifications

Net Power Output	1,148	bhp
Typical Min. LFG LHV	455	Btu/scf
Heat Input Rate	9.07	MMBtu/hr (LHV)
	10.1	MMBtu/hr (HHV)
Max Fuel Consumption	19,947	scf/hr
	332	scfm
	0.479	MMscf/day

Regulated Pollutant	Emission Basis	Emission Factors			Emission Rates	
		(g/bhp-hr)	(lb/MMscf)	(lb/MMBtu)	(lb/hr)	(TpY)
NAAQS						
Nitrogen Oxides	(Existing permit limit)	1.5	--	0.42	3.80	16.6
Carbon Monoxide	(Existing permit limit)	2.7	--	0.75	6.83	29.9
Particulate Matter	(AP42: 5th Ed., Nov. 1998, Tables 2.4.1, 2.4.2, 2.4.3)	0.25	--	0.07	0.63	2.77
Sulfur Dioxide	(based on 308.4 ppm TRS)	--	51.3	0.11	1.02	4.48
Total VOC	(Existing permit limit)	0.84	--	0.23	2.13	9.31
Hazardous Air Pollutants						
Formaldehyde	(Similar permit limit)	0.28	--	--	0.71	3.10
Hydrogen Chloride	(AP42: 42 ppm Cl in LFG)	--	3.98	--	0.08	0.35
LFG Constituents	(AP42: see attached table)	--	3.04	--	0.06	0.27
Total HAPs					**0.85**	**3.72**
Greenhouse Gases						
GHG-CO_2	(based on 52.07 kg/MMBtu)	--	--	115	1,153	5,049
GHG-CH_4	(based on 3.2E-3 kg/MMBtu)	--	--	0.007	0.07	0.31
GHG-N_2O	(based on 6.3E-4 kg/MMBtu)	--	--	0.001	0.01	0.06
GHG-CO_2e		**--**	**--**	**--**		**5,075**

Summary of Air Pollutant and GHG Emission Rates
Landfill Gas Fueled RICE: EUICE#5

1-CAT® G3516 LE IC Engine Specifications

Net Power Output	1,148	bhp
Typical Min. LFG LHV	455	Btu/scf
Heat Input Rate	9.07	MMBtu/hr (LHV)
	10.1	MMBtu/hr (HHV)
Max Fuel Consumption	19,947	scf/hr
	332	scfm
	0.479	MMscf/day

Regulated Pollutant	Emission Basis	Emission Factors			Emission Rates	
		(g/bhp-hr)	(lb/MMscf)	(lb/MMBtu)	(lb/hr)	(TpY)
NAAQS						
Nitrogen Oxides	(Caterpillar Gas Engine Technical Data Sheet)	1.5	--	0.42	3.80	16.6
Carbon Monoxide	(Caterpillar Gas Engine Technical Data Sheet)	2.7	--	0.75	6.83	29.9
Particulate Matter	(AP42: 5th Ed., Nov. 1998, Tables 2.4.1, 2.4.2, 2.4.3)	0.25	--	0.07	0.63	2.77
Sulfur Dioxide	(based on 308.4 ppm TRS)	--	51.3	0.11	1.02	4.48
Total VOC	(Caterpillar Gas Engine Technical Data Sheet)	0.84	--	0.23	2.13	9.31
Hazardous Air Pollutants						
Formaldehyde	(Similar permit limit)	0.28	--	--	0.71	3.10
Hydrogen Chloride	(AP42: 42 ppm Cl in LFG)	--	3.98	--	0.08	0.35
LFG Constituents	(AP42: see attached table)	--	3.04	--	0.06	0.27
Total HAPs					**0.85**	**3.72**
Greenhouse Gases						
GHG-CO_2	(based on 52.07 kg/MMBtu)	--	--	115	1,153	5,049
GHG-CH_4	(based on 3.2E-3 kg/MMBtu)	--	--	0.007	0.07	0.31
GHG-N_2O	(based on 6.3E-4 kg/MMBtu)	--	--	0.001	0.01	0.06
GHG-CO_2e		**--**	**--**	**--**		**5,075**

Summary of Air Pollutant and GHG Emission Rates
Landfill Gas Fueled RICE: EUICE#6

1-CAT® G3516 LE IC Engine Specifications

Net Power Output	1,148	bhp
Typical Min. LFG LHV	455	Btu/scf
Heat Input Rate	9.07	MMBtu/hr (LHV)
	10.1	MMBtu/hr (HHV)
Max Fuel Consumption	19,947	scf/hr
	332	scfm
	0.479	MMscf/day

Regulated Pollutant	Emission Basis	Emission Factors			Emission Rates	
		(g/bhp-hr)	(lb/MMscf)	(lb/MMBtu)	(lb/hr)	(TpY)
NAAQS						
Nitrogen Oxides	(Existing permit limit)	1.5	--	0.42	3.80	16.6
Carbon Monoxide	(Existing permit limit)	2.7	--	0.75	6.83	29.9
Particulate Matter	(AP42: 5th Ed., Nov. 1998, Tables 2.4.1, 2.4.2, 2.4.3)	0.25	--	0.07	0.63	2.77
Sulfur Dioxide	(based on 308.4 ppm TRS)	--	51.3	0.11	1.02	4.48
Total VOC	(Existing permit limit)	0.84	--	0.23	2.13	9.31
Hazardous Air Pollutants						
Formaldehyde	(Existing permit limit)	0.28	--	--	0.71	3.10
Hydrogen Chloride	(AP42: 42 ppm Cl in LFG)	--	3.98	--	0.08	0.35
LFG Constituents	(AP42: see attached table)	--	3.04	--	0.06	0.27
Total HAPs					**0.85**	**3.72**
Greenhouse Gases						
GHG-CO_2	(based on 52.07 kg/MMBtu)	--	--	115	1,153	5,049
GHG-CH_4	(based on 3.2E-3 kg/MMBtu)	--	--	0.007	0.07	0.31
GHG-N_2O	(based on 6.3E-4 kg/MMBtu)	--	--	0.001	0.01	0.06
GHG-CO_2e		**--**	**--**	**--**		**5,075**

LFG sulfur content (based on site specific analysis): 308.4 ppm H_2S*

Sulfur Dioxide Emission Factor

Calculation of SO_2 emission factor from sulfur content, as H_2S:

(308.4 scf H_2S/MMcf LFG) (1 scf SO_2/scf H_2S) (64.06 lb.SO_2/mol) / (385 ft^3/mol)

= 51.3 lb SO_2/MMcf LFG

* Based of laboratory sampling conducted May 10, 2022 and November 09, 2022, plus a 20% safety factor.

** Based on 99% conversion efficiency

HCl Emission Factor		
LFG chloride content (C_{Cl})	42	ppmv
*Default for municipal solid waste landfills in AP-42 section 2.4.		
HCl molecular wt. (MW)	36.46	lb/lb-mol
HCl emission factor C_{Cl} * MW / (385 scf/mol)	3.98	lb/MMcf LFG

LFG RICE Combustion Hazardous Air Pollutant Emission Factor

HAPs[1]	Landfill Gas Concentration[2]		Molecular Weight	Destruction Effeciency[3]	HAP Emission Factor	
	(ppm)	(mg/m^3)	lb/lb-mol	(%)	(lb/MMcf)	
1,1,1-trichloroethane	0.48	2.66	133.42	93.0%	0.012	A
1,1,2,2-tetrachloroethane	1.11	7.75	167.85	93.0%	0.034	
1,1-dichloroethane	2.35	9.67	98.95	93.0%	0.042	
1,1-dichloroethene	0.2	0.81	96.94	93.0%	0.004	
1,2-dichloroethane	0.41	1.69	98.96	93.0%	0.007	
1,2-dichloropropane	0.18	0.85	112.98	93.0%	0.004	
Acrylonitrile	6.33	13.97	53.06	86.1%	0.121	
Benzene	1.91	6.20	78.10	86.1%	0.054	
Carbon disulfide	0.58	1.84	76.13	86.1%	0.016	
Carbon tetrachloride	0.004	0.03	153.84	93.0%	0.000	
Carbonyl sulfide	0.49	1.22	60.07	86.1%	0.011	
Chlorobenzene	0.25	1.17	112.56	93.0%	0.005	
Chloroethane	1.25	3.35	64.52	93.0%	0.015	
Chloroform	0.03	0.15	119.39	93.0%	0.001	
Chloromethane	1.21	2.54	50.49	93.0%	0.011	
Dichloromethane	14.3	50.50	84.94	93.0%	0.221	
Ethyl Benzene	4.61	20.35	106.16	86.1%	0.177	
Ethylene dibromide	0.001	0.01	187.88	86.1%	0.000	
Hexane	6.57	23.54	86.17	86.1%	0.204	
Mercury (total)	2.92E-04	0.00	200.61	0.0%	0.000	
Methyl isobutyl ketone	1.87	7.79	100.16	86.1%	0.068	
Perchloroethylene	3.73	25.72	165.83	93.0%	0.112	
Toluene	39.3	150.55	92.13	86.1%	1.307	
Trichloroethylene	2.82	15.41	131.40	93.0%	0.067	
Vinyl chloride	7.34	19.07	62.50	93.0%	0.083	
Xylene	12.1	53.41	106.16	86.1%	0.464	
			Total HAP Emission Factor (lb/MMcf) =		**3.04**	

Notes:

1. 1990 CAA Amendments Section 112(b) HAP
2. AP-42 default concentrations.
3. AP-42 default control efficiency values for IC engines, Table 2.4-3.

A. Sample calculation, 1,1,1 trichloroethane (TCE) emissions

(0.48 ft^3 TCE/MMcf LFG) (133.42 lb. TCE/mol) (1-0.93) / (385 ft^3 TCE/mol)

=0.012 lb. TCE/MMcf LFG

Regulated Pollutant	(TpY)
NAAQS	
Nitrogen Oxides	83.1
Carbon Monoxide	149.7
Particulate Matter	13.9
Sulfur Dioxide	22.4
Total VOC	46.6
Hazardous Air Pollutants	
Formaldehyde	15.5
Hydrogen Chloride	1.7
LFG Constituents	1.3
Total HAPs	18.6
Greenhouse Gases	
GHG-CO_2	25242.8
GHG-CH_4	1.6
GHG-N_2O	0.3
GHG-CO_2e	15223.6