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ENGINEERING EVALUATION / FACT SHEET

BACKGROUND INFORMATION

Application No.:	R13-2592B
Plant ID No.:	107-00121
Applicant:	Northwestern Landfill, Inc.
Facility Name:	Northwestern Landfill
Location:	Parkersburg
SIC Code:	4953
Application Type:	Modification
Received Date:	April 27, 2010
Engineer Assigned:	Edward S. Andrews, P.E.
Fee Amount:	$1000.00
Date Received:	April 27, 2010
Completeness Date:	June 1, 2010
Due Date:	August 30, 2010
Newspaper:	*The Parkersburg Sentinel*
Applicant Ad Date:	May 18, 2010
UTMs:	Easting: 457.5 km Northing: 4,344.4 km Zone: 17
Description:	Construction of a Landfill Gas (LFG) flare to replace the existing individual refuse gas incinerator (tiki torches).

DESCRIPTION OF PROCESS

Northwestern Landfill, Inc. permitted to operate a municipal solid waste landfill. The active gas collection and control system described below will be installed in advance of any regulatory requirements and is voluntary. This project consists of one (1) skid-mounted open flare (Emission Unit ID LFG-1) that will be connected to an active gas collection system. The flare is designed to improve odor control at the facility.

Northwestern has proposed to install a Parnel Biogass elevated flare. This skid-mounted, elevated flare consist of two gas blowers rated at 1,500 scfm each, flare arrestor, knock-out pot, and associated values. This actual flare is made out of A-53 SCH 40 pipe with 14” x 5” 304 Stainless Steel tip. A 36” diameter windshield made of 316 stainless steel, which is connected above the flare tip. This windshield is designed to help retain the flame at the tip and provide retention time for efficient combustion.

The gas blowers will be used to pull suction on the collection system that will draw the landfill gas out of the landfill. This collection system will route the gas to the flare to be destroyed. A knockout pot will be located just before the blowers, which will to collect any moisture (water) entrained in the gas.

Lighting the flare in the automatic mode, the pilot gas solenoid valve is opened to allow propane gas to the pilot assembly and the igniter is pulsed to light the pilot tip. Once the pilot is detected, a signal is sent to the programmable logic controller (PLC) to initiate the main flame light off sequence. Upon receiving the signal from the pilot light, the landfill gas fail close valve is opened and the landfill gas blower is started. Once the PLC receives that main flame is detected, the pilot light is shut down to limit propane usage. Upon main flame loss, both the waste gas valves would be closed and the blowers would be turned off. Automatic re-ignition will attempt to resume normal flare operation. If pilot or main flame re-ignition does not occur within a specified period of time, the flare would shut down and a signal to a autodialer or alarm beacon to notify the operator of the shutdown.

SITE INSPECTION

The facility was last visited on November 14, 2007, by Mr. Andy Grimm, an compliance inspector for Compliance and Enforcement Section. Mr. Grimm’s visit was targeted inspection of the entire facility. As result of this inspection, Mr. Grimm found the facility to be operating in compliance with all applicable rules, regulations, and permits. Thus, a site inspection was determined to be unnecessary for this particular permitting action.

ESTIMATE OF EMISSIONS BY REVIEWING ENGINEER

The emission estimates in the application were just based on the maximum flow rate that the flare is designed to handle. This approach would be acceptable if it was determined that the landfill was generating more landfill gas than the flare to psychical handle. Thus, this writer used the data contained in the facility's Tier 2 Sampling, Analysis, and Landfill NMOC Emission Estimate Report dated August 10, 2004, and U.S. EPA's LandGEM Landfill Gas Emission Model Version 3.02 to predict the amount of landfill gas could possibly be generated by the new area of the landfill. This model predicted that the landfill could generate 1,435 MMCF in 2010 in the new area alone. The flare is designed to handle volumetric flow rate of 3,000 scfm, which equates to 1,577 MMCF per year. This flare capacity is based on the assumption that the collection system can continuously extract 3,000 scfm of landfill gas.

When one looks closer at the LandGEN predicted results, the generation rate of landfill gas exceeds the flare capacity in 2011. Therefore, the applicant's approach to use the design capacity of flare is acceptable.

Secondary emissions from the flare were determine using equations and emission factors from Sections 2.4. "Municipal Solid Waste Landfills" and 13.5 "Industrial Flare" of AP-42. Emission factors for particulate matter are a function of methane in the LFG. An estimated emission of sulfur dioxide, hydrochloric acid, and VOCs requires the concentration of, sulfide compounds, chlorides, and NMOC. The applicant used the default concentrations as listed in Chapter 2.4. for these pollutants.

To use any of these equations or emission factors require that the methane flow rate or heat of combustion (heat value) of the gas to be defined. The applicant used the assumption that 50% of the landfill gas contains methane. EPA's required all landfills to use this same assumption when calculating the landfill gas emissions unless a site specific methane concentration rate has been established. Using the higher heat value of methane, the applicant predicted that the flare at its maximum flow rate could be releasing 91 MMBTU of heat energy per hour. This 50% methane content assumption is actually a regulatory default to be used when calculating NMOC emissions. The facility has not determined a site-specific methane concentration rate for this particular landfill. Thus, one must use the 50% methane concentration assumption.

A copy of the calculations used in these estimates is attached to the end of this evaluation. Presented in the following table are potential secondary emissions from the flare.

Table #1 - Emissions from the Flare		
Pollutant	Emission Rates	
	lb/hr	TPY
PM/ PM_{10}/ $PM_{2.5}$	1.53	6.7
SO_2	1.49	6.5
NO_x	6.20	27.2
CO	33.73	147.8
VOCs	0.48	2.1
HCL	1.26	5.5

<u>REGULATORY APPLICABILITY</u>

45CSR6 - To Prevent and Control Air Pollution From Combustion of Refuse

The purpose of this rule is to prevent and control air pollution from combustion of refuse. The permittee has proposed to install addition LFG-fired flare. This rule defines incineration as the destruction of combustible refuse by burning in a furnace designed for that purpose. The purpose of this flare is to destroy LFG through incineration. Thus, it meets this definition.

Per section 4.1, this flare must meet the particulate matter limit by weight. The flare will have an allowable particulate matter emission rate of 35.11 pounds per hour (based on predicted generation rate of 12,933 lb/hr for 2010). The predicted particulate matter rate from the flare has been estimated to be 1.53 pounds per hour, which is significantly less than the allowable under this rule.

The flare is also subject to the 20% opacity limitation in section 4.3 of this rule. Typically, the incineration of most the components contained in the landfill gas usually produces little to no visible emissions when flared. Thus, it is expect that this flare should be operated in the same manner.

45CSR10 To Prevent and Control Air Pollutant From the Emission of Sulfur Oxides

The purpose of this rule is to prevent and control air pollution from the emissions of sulfur oxides. The proposed flare will emit sulfur oxide emissions, therefore is subject to this rule as combustion of a process gas stream.

This flare will be subject to the 50 grains per 100 cubic feet of carrier gas limit from 45CSR§10-5.1. Using the tabulated total reduced sulfur rate and the LFG flow rate, this writer calculated the maximum hydrogen sulfide concentration to be 3.0 grains per 100 cubic feet of LFG. Thus, this flare is capable of meeting this limit.

45CSR13 - Permits for Construction, Modification, Relocation and Operation of Stationary sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, and Procedures for Evaluation

The potential-to-emit from the proposed flare exceeds beyond the 6 pounds per hour and 10 tons per year for carbon monoxide, which is the trigger level of a source as defined in 45CSR§13-2.24. In addition, Rule 6 requires all incinerators be required to obtain a construction or modification permit regardless of size. Northwestern Landfill, Inc. has proposed to install a flare, which is subject to Rule 6. Therefore, the facility is required to obtain a permit as required in 45CSR6-6.1.

The facility has met the applicable requirements of this rule by publishing a Class I Legal Advertisement in *The Parkersburg Sentinel* on May 18, 2010, paid the $1000.00 application fee, and submitted a complete permit application.

45CSR23 To Prevent and Control Emissions From Municipal Solid Waste Landfills

This rule establishes standards of performance for municipal solid waste landfills pursuant to Section 111 of the federal Clean Air Act as amended in 1990. The purpose of this is to satisfy the State's requirement to develop a rule as mandated in 40 CFR Part 60, Subpart Cc. Overall, landfills constructed or modified before May 1991 with a design capacity of or greater than 2.5 million Megagrams (Mg) are subject to this rule. The landfill operations began in 1975, and the combined total capacity of the landfill just exceed 5 MM Mg of waste in place.

In 2009, the Northwestern Landfill conducted Tier II testing to determine a new site specific NMOC concentration value to determine the actual amount of NMOC being generated by the waste in place. This test/sampling was reviewed and determined to be invalid by agency. To was determined that failed sample would have not change the outcome of the analysis, which was the NMOC emission rate would still been less than 50 Mg/yr. Therefore, the agency determined that next Tier 2 report would be due as required by this rule, which is in December 2014.

45CSR30 Requirements for Operating Permits

This rule provides for the establishment of a comprehensive air quality permitting system consistent with the requirements of Title V of the Clean Air Act, and provides for a transition period prior to the implementation of the permitting system. Upon submittal of this application, Meadowfill include a request to significant modification application to their existing Title V operating permit, which would be required as result of this permitting action.

<u>TOXICITY OF NON-CRITERIA REGULATED POLLUTANTS</u>

The facility potential of hazardous air pollutants (HAPs) with controls is about 20.43 tons per year. With the 98% destruction efficiency of the flare, this potential is reduced down 10.1 tons per year. Of this potential, 5.5 tons is hydrochloric acid.

Hydrochloric Acid

Hydrochloric acid is irritating and corrosive to any tissue it contacts. Brief exposure to low levels cause throat irritation. Exposure to higher levels can result in rapid breathing, narrowing of the bronchioles, blue coloring of skin, and accumulation of fluid in the lungs.

AIR QUALITY IMPACTS ANALYSIS

This writer deemed that an air dispersion modeling study or analysis was not necessary, because the proposed modification does not meet the definition as a major modification as defined in 45CSR14.

MONITORING OF OPERATIONS

Monitoring for the gas collection system and flare should be limited to monitoring gas flow, monitor the flare flame, and conducting visual emission checks. As required by 45CSR23/Subpart WWW, the facility is required to submit annual NMOC reports and conduct Tier 2 testing once every five years, which will aid in determining the compliance status of the facility.

Per the flare manufacturer and verified by this writer, this proposed flare is capable of achieve of at least a 98% destruction efficiency (DRE). During the review, it was determined that the flare should be able to achieve 98% DRE at the flare maximum flow rate of 3,000 scfm, which is based on the method outline in U.S. EPA's Handbook – Control Technologies for Hazardous Air Pollutants.

CHANGES TO PERMIT R13-2592A

Northwestern requested that all of the passive gas flares and tub grinder be removed or omitted from the permit, which was the only permitted equipment cover by Permit R13-2592A. Permit R13-2592B will only cover the new active gas collection flare.

RECOMMENDATION TO DIRECTOR

The information provided in the permit application indicates the proposed flare will meet all the requirements of the application rules and regulations when operated in accordance to the permit application. Therefore, this writer recommends granting Northwestern Landfill, Inc. a Rule 13 construction/modification permit for the Northwestern Landfill.

Edward S. Andrews, P.E.
Engineer

Date: July 6, 2010

This worksheet is for the flare proposed in application R13-2592B for the Northwestern Landfill. The formulas used are from Appendix C-5 of U.S. EPA Handbook: Control Technologies for Hazardous Air Pollutants. EPA/625/6-91/014.

The flare under review is a Parnel Biogas Inc. flare, which is non-assisted elevated flare.
Provided Data:

$Q_e := 3000$ Flow rate of the total LFG going to the flare, in units of scfm.

$T_e := 57$ Emission Stream Temperature, degrees F.

$h_e := 507$ Heat Content of the LFG stream, Btu/scf.

$D_{tip} := 14$ Flare tip diameter, inches.

$T_{flg} := T_e$ Temperature of the flare gas, degrees F.

$T_{flg} := 530$ Temperature of flare gas in Rankine

Supplementary Fuel Requirements

Since the heat content of the stream going to the flare is greater than 200 Btu/scf, then no supplementary fuel is required.

$h_e = 507$ Heat Content of the waste gas stream, Btu/scf.

Thus, no supplement fuel is required; or

$Q_f := 0$ Flow rate of natural gas add to the waste gas stream, scfm

Flare Gas Flow and Heat Content

The flare gas flow rate is determined from the flow rates of the emission stream and natural gas using the following equation:

$Q_{flg} := Q_e + Q_f$ Equation 4.4-2 on page 4-22 of the handbook, scfm.

$Q_{flg} = 3*10^3$ Maximum Flow rate of waste gas and natural gas going to the flare, scfm.

Flare Gas Exit Velocity and Destruction Efficiency

U.S. EPA's handbook offer several methods in order to calculated the maximum velocity based on a destruction efficiency of 98%. However, these methods are for non-assisted flares.
The information available on flare destruction efficiency as a function of exit velocity does not allow for a precise determination of this value. All that can be ascertained is whether the destruction efficiency is greater than or less than 98 percent, depending the exit velocity.

$$U_{flg} := \frac{\left(5.766 \cdot 10^{-3}\right) \cdot Q_{flg} \cdot \left(T_{flg} + 460\right)}{D_{tip}^{2}}$$ Equation 4.4-3, on page 4-23 of the handbook.

$U_{flg} = 87.$ Exit velocity of the flare gas, ft/sec.

Calculating the Supplementary Fuel Requirements
Equation (4.4-1) on page 4-22, Calculating the needed flow rate of supplementary fuel .

$$Q_f := \frac{\left(300 - h_e\right) \cdot Q_e}{582}$$

$Q_f = -1.$

Supplementary fuel flow rate in scfm

Calculating Maximum Exit Velocity

Using the appropriate equation listed in Table 4.4-1. to determine the maximum exit velocity that would support a 98% destruction efficiency for this particular flare.

$$U_{max} := 3.28 \cdot 10^{0.00118 \cdot h_e + 0.908}$$ Equation from Table 4.4-1, page 4-22

$U_{max} = 105$ Maximum Exit Velocity, ft/sec.

Since Uflg is less than maximum Umax, then 98% destruction level can be achieved.

Determining Emissions from the LFG Flare

Chapter 2.4 of AP-42 based the emission prediction on a function of the methane produce from the landfill. Thus, the flow rate of methane to the flow must be determined first.

$Q_{flare} := 3000 \cdot \frac{ft^3}{min}$ This is the maximum gas flow rate for the flare.

$C_{CH4} := 0.5$ Assumed that the gas vented to the flare has a methane content of 50%.

$Q_{CH4} := Q_{flare} \cdot C_{CH4}$

$Q_{CH4} = 1.5 \cdot 10$ Methane rate going to the flare.

$HV_{CH4} := 1013 \cdot \frac{BTU}{ft^3}$ Heating Value of Methane

$H_{flare} := Q_{CH4} \cdot HV_{CH4}$

$H_{flare} = 9.117 \cdot 1$ Hourly Heat Input from the flare

Carbon Monoxide

$EF_{CO} := \frac{0.37 \cdot lb}{10^6 \cdot BTU}$ Emission factor for CO from AP-42, 13.5. "Industrial Flares".

$CO := EF_{CO} \cdot H_{flare}$

$CO = 33.73$ Maximum hourly CO rate.

$CO = 147.84$ Maximum annual CO rate

Oxides of Nitrogen

$EF_{NOx} := \frac{0.068 \cdot lb}{10^6 \cdot BTU}$

Emission factor for CO from AP-42, 13.5. "Industrial Flares".

$NO_x := EF_{NOx} \cdot H_{flare}$

$$NO_x = 6.2 \cdot \frac{lb}{hr}$$

Maximum hourly NOx rate

$NO_x = 27.17 \cdot \frac{ton}{yr}$ Maximum annual NOx rate

Sulfur Dioxide

Sulfur Dioxide Emission were estimated using method outlined in Chapter 2.4 of AP-42.

$C_s := 47$ Cs is the default concentration listed in Charter 2.4 of AP-42 of the total reduced sulfur compounds (expressed in terms of ppmv),

$Q_S := \frac{Q_{CH4} \cdot C_s}{C_{CH4} \cdot 10^6}$ Equation 3 of Chapter 2.4

$T := (21 + 273) \cdot K$ Temperate of the landfill gas, Converted in Kelvin

$Q_S = 7.416 \cdot 10^4 \cdot \frac{ft^3}{yr}$ Volumetric flow of Total Reduced Sulfur.

$$UM_S := \frac{Q_S \cdot 34 \cdot 1 \cdot atm}{\left(8.205 \cdot 10^{-5} \cdot m^3 \cdot \frac{atm}{mole \cdot K}\right) \cdot \left(1000 \frac{mole}{kg}\right) \cdot T}$$

Equation 4 from Charter 2.4, AP-42.

Calculating Uncontrolled mass emission rate of Total Reduce Sulfur on a mass basis.

$UM_S = 3.263 \cdot \frac{ton}{yr}$ Mass rate of Total Reduce sulfur.

$CM_{SO2} := UM_S \cdot 1 \cdot 2.0$ Equation 7 from Chapter 2.4 of AP-42. Calculating the controlled amass emission rate of sulfur dioxide from the flare. Assumed all of the total reduced sulfur is converted into sulfur dioxide. 2 = Ratio of the molecular weight of sulfur dioxide to the molecular weight of sulfur.

$CM_{SO2} = 1.489 \cdot \frac{lb}{hr}$ Hourly rate of Sulfur dioxide from the flare.

$CM_{SO2} = 6.525 \cdot \frac{ton}{yr}$ Annual rate of Sulfur dioxide from the flare. Assumed that the flow is maintained at the flare's maximum and operated continuously.

Particulate Matter

$EF_{PM} := \frac{17 \cdot lb}{10^6 \cdot ft^3}$ Emission factor from AP-42, Table 2.4-5, 11/98, in terms of MMCF of methane.

$PM := Q_{CH4} \cdot EF_{PM}$ Calculating the potential PM rate using the AP-42 factor and the maximum predicted generation rate of methane.

$PM = 1.53 \cdot \frac{lb}{hr}$ Maximum hourly PM rate.

$PM = 6.71 \cdot \frac{ton}{yr}$ Maximum annual PM rate

Volatile Organic Compounds (VOCs)

Since the flare is capable of achieving a destruction efficiency of at least 98%, then it is assumed that the potential VOC emissions from the flare would be the remain 2% of the NMOC. Carbon dioxide and methane are not classified as VOCs. Therefore, this two compounds were not include.

$DRE_{flare} := .98$ Minimum Destruction efficiency (DRE) of the flare.

The following calculations are outlined in AP-42 Chapter 2.4., which are to predict VOC emissions from the flare.

$C_{NMOC} := 593$

Default Concentration of NMOC listed in Chapter 2.4. (expressed in ppmv)

$MW_{NMOC} := 86.18$

Molecular Weight of NMOC, as hexane.

$$Q_{NMOC} := \frac{Q_{CH4} \cdot C_{NMOC}}{C_{CH4} \cdot 10^6}$$

Equation 3 of Chapter 2.4

Equation 4 from Charter 2.4, AP-42. Calculating Uncontrolled mass emission rate of NMOC on a mass basis.

$$UM_{NMOC} := \frac{Q_{NMOC} \cdot MW_{NMOC} \cdot 1 \cdot atm}{\left(8.205 \cdot 10^{-5} \cdot m^3 \cdot \frac{atm}{mole \cdot K}\right) \cdot \left(1000 \cdot \frac{mole}{kg}\right) \cdot T}$$

$$CM_{NMOC} := UM_{NMOC} \cdot \left(1 - DRE_{flare}\right)$$

Calculating the control emission rate of NMOC from the flare.

$CM_{NMOC} = 0.476 \cdot \frac{lb}{hr}$ Maximum hourly NMOC (VOCs) rate.

$CM_{NMOC} = 2.087 \cdot \frac{ton}{yr}$ Maximum annual NMOC (VOCs) rate.

Hydrochloric Acid

The following calculations are outlined in AP-42 Chapter 2.4., which are to predict HCL emissions from the flare.

$C_{CL} := 74$ Concentration of Chloride listed in AP-42, Chapter 2.4 (expressed as CL in ppmv)

$MW_{CL} := 35.453$ Molecular Weight of NMOC, as hexane.

$$Q_{CL} := \frac{Q_{CH4} \cdot C_{CL}}{C_{CH4} \cdot 10^{6}}$$

$$UM_{CL} := \frac{Q_{CL} \cdot MW_{CL} \cdot 1 \cdot atm}{\left(8.205 \cdot 10^{-5} \cdot m^{3} \cdot \frac{atm}{mole \cdot K}\right) \cdot \left(1000 \cdot \frac{mole}{kg}\right) \cdot T}$$

Equation 4 from Chapter 2.4, AP-42.

Calculating Uncontrolled mass emission rate of total chlorides on a mass basis.

$CM_{HCL} := UM_{CL} \cdot 1.03$ Equation No. 10 from AP-42, Chapter 2.4. 1.03 is the ratio of the molecular weight of HCL to the molecular weight of chloride.

$CM_{HCL} = 1.259 \cdot \frac{lb}{hr}$ Maximum hourly HCL rate from the flare.

$CM_{HCL} = 5.517 \cdot \frac{ton}{yr}$ Maximum annual HCL rate from the flare.

Hydrogen Sulfide Loading in the LFG

45CSR10 establishes a maximum hydrogen sulfide grain loading in any waste gas stream being burned. Therefore, the following calculations will determine the H2S loading in the landfill gas stream going to the flare.

$grain := \frac{1}{7000} \cdot lb$ This equation creates grains as a mass unit.

$UM_{H2S} := UM_{S} \cdot 1.0625$ Assuming all of the total reduced sulfur in the landfill gas is hydrogen sulfide. Thus, mass balance is used to determine the mass rate of hydrogen sulfide in the landfill gas. 1.0626 is the ratio of the molecular weight of hydrogen sulfide to the molecular weight of sulfur.

$$CON_{H2S} := \frac{UM_{H2S}}{3000 \cdot \frac{ft^{3}}{min}}$$

Converting this mass rate into a volume basis by using the maximum flow rating of the flare.

$CON_{H2S} = 3.076 \cdot \frac{grain}{100 \cdot ft^{3}}$ Hydrogen sulfide loading, expressed in terms of grains per 100 cubic feet of carrier gas. Standard from 45CSR10-5.1 is 50 grains of H2S per 100 cubic feet of gas. Thus, this landfill gas complies with 45CSR10-5.1.

M E M O R A N D U M
To: File
From: Richard Fenton
Date: May 21, 2010
Subject: Northwestern Landfill, Parkersburg, 107-00121

Response to Notice of Deficiency for Teir 2 test of December 17, 2009
On April 19, 2010, an email from Mr. Adam Finley contained a response to the DAQ's Notice of Deficiency. This memo provides a summary of the actions that prompted the response and a review of the information presented in the response.

Background

On December 17, 2009, testing for Non-methane organic carbon (NMOC) was conducted at the Northwestern Landfill. A report of the event was provided to this agency on February 17, 2010. Review of the report noted a number of problems with quality assurance and quality control documentation (QA/QC) and that some samples did not meet the standard for validity. The deficiencies were described in a February 22, 2010, memo. The facility was informed of the findings of the review in a March 18, 2010, Notice of Deficiency (NOD).

Review of April 19 response

The problems with the February 17 report can be grouped into two categories, (1) lack of QA/QC documentation and (2) samples which did not meet the minimum criteria for consideration as a valid sample.

The April 19 response was composed of two documents. One that specifically addressed the deficiencies noted in the NOD and the second provided background information on landfill gas generation and worst case NMOC assumptions.

The response contained all the QA/QC information that was missing from the original report. And the QA/QC information showed that the testing and analysis was conducted appropriately. The response addressed the invalid samples by describing the worst case NMOC generation which would trigger the next regulatory step for landfills that emit NMOC. And the response also provided information on NMOC generation in landfills over time. While the samples in question may have exceeded the criteria for a valid sample, they may give an indication of probable NMOC emissions. The response showed that the "trigger level" for the next step in landfill regulatory action was far greater than the NMOC measured. So it can be reasonably assumed that the failed samples would not have contained enough NMOC to change the conclusion of the initial report, which was that the facility can retest on the five year time frame, as provided in the rule.

Conclusion

The conclusions reached as a result of the Tier 2 sampling event of December 17, 2009, should be considered as valid. The next test should be conducted on or about December 2014.