ENVIRONMENTAL INTEGRITY PROJECT

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Via e-mail
Eddie DuRant
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Maryland Department of the Environment
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RE: Public Stakeholder Process for Setting New Air Quality Regulations for the Control of Methane Emissions from Municipal Solid Waste Landfills

Dear Mr. DuRant:

The Environmental Integrity Project ("EIP") submits the following comments as part of the public stakeholder process on the Maryland Department of the Environment's ("MDE's") development of new air quality regulations for the control of methane emissions from municipal solid waste landfills. We appreciate the opportunity to comment on this matter. EIP is submitting these comments today in order to provide MDE with our technical recommendations and analysis as soon as possible. We are aware that many organizations and individuals in Maryland support our request that MDE set the strongest set of landfill methane regulations in the U.S. Over the next several weeks, we expect that many other organizations and individuals will submit written requests to MDE that echo our call for the most stringent landfill methane requirements in the country.

In summary, EIP requests that MDE model its landfill methane regulations on a rule issued in 2010 by the California Air Resources Board, which is presently the most protective landfill methane rule in the United States. We believe that there is strong technical support for using California's approach to applicability thresholds but setting even lower thresholds than those that apply in California, which will have the effect of requiring controls at a significant number of additional landfills in Maryland. In addition, California's rule establishes stronger operational standards than EPA's regulations in several ways, which are discussed in more detail below, and we have also made preliminary recommendations regarding record-keeping and reporting requirements. Finally, EIP and many other organizations and individuals in Maryland consider this rulemaking a very important opportunity for MDE to create incentives or requirements for organics diversion, which has been acknowledged by EPA as a highly effective method of reducing landfill methane emissions. We have set forth initial recommendations relating to organics diversion below and look forward to continuing to discuss this matter with MDE and other stakeholders.

BACKGROUND

Landfill Methane

Methane is a greenhouse gas ("GHG") that is 86 times more effective at causing the climate to warm than carbon dioxide (CO_2) over a 20-year life span and 34 times more potent over 100 years.[1] A recent report by the International Panel on Climate Change ("IPCC") found that, in order to avoid the catastrophic effects associated with 1.5°C in warming, substantial GHG emissions reductions should be achieved by 2030.[2] Given the urgency of achieving large, near-term GHG reductions, it is important that Maryland and other states establish requirements wherever possible to substantially reduce emission of short-lived climate pollutants, like methane, that have an outsized warming effect over a relatively short period of time.

Municipal solid waste ("MSW") landfills are a particularly substantial source of methane emissions both nationally and in Maryland. In 2018, MSW landfills were the third largest source of anthropogenic (caused by human activities) methane in the United States, emitting 17% of the country's methane.[3] In Maryland, landfills were responsible for 18% of methane emission in the state in 2017.[4] According to the 2018 Maryland Emissions Inventory, of the ten highest methane-emitting facilities in the state, nine were MSW landfills as shown below in Table 1. In addition, although not shown, when broadening the scope of inquiry, 16 of the top 20 methane-emitting facilities in Maryland in 2018 were MSW landfills.

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[1] International Panel on Climate Change, Climate Change 2013, the Physical Science Basis: Anthropogenic and Natural Radiative Forcing, p. 714, http://www.climatechange2013.org/images/report/WG1AR5_Chapter08_FINAL.pdf (the global warming potential of 86 accounts for climate-carbon feedback, i.e. the effect of methane on multiple aspects of the carbon cycle).

[2] IPCC, 2018: Global Warming of 1.5°C.An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty, p. 12 ("In model pathways with no or limited overshoot of 1.5°C, global net anthropogenic CO2 emissions decline by about 45% from 2010 levels by 2030 (40–60% interquartile range), reaching net zero around 2050 (2045–2055 interquartile range).") Available at https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf.

[3] EPA, Overview of Greenhouse Gases: Methane Emissions, Greenhouse Gas Emission, at https://www.epa.gov/ghgemissions/overview-greenhouse-gases#CH4-reference.

[4] MDE PowerPoint presentation, Updating Maryland's Municipal Solid Waste (MSW) Landfill Regulations (Sept. 21, 2020) p. 22, at https://mde.maryland.gov/programs/Regulations/air/Documents/MSWLandfillsPresentation092120.pdf (hereinafter "MDE 9/21/20 PowerPoint").

Table 1: Ten Largest Methane Sources in Maryland (2018)				
Rank in State	**Facility Name**	**Facility Type**	**2018 Methane emissions (tons)**	**Equivalent GHGs[5]**
1	Brown Station Road Sanitary Landfill	MSW landfill	8,280.01	712,080.86
2	Forty West Municipal Landfill	MSW landfill	6,556.86	563,889.96
3	Quarantine Road Municipal Landfill	MSW landfill	5,705.64	490,684.95
4	Eastern Sanitary Landfill Solid Waste Management Facility	MSW landfill	3,101.19	266,702.36
5	Worcester County Central Municipal Landfill	MSW landfill	2,099.32	180,541.26
6	Texas Eastern Transmission	Gas compressor station	1,969.09	169,341.85
7	Midshore II Regional Solid Waste Facility Municipal Landfill	MSW landfill	1,807.85	155,474.67
8	Charles County Municipal Landfill	MSW landfill	1,788.70	153,828.20
9	Newland Park Municipal Landfill	MSW landfill	1,651.31	142,013.09
10	Cecil County Central Landfill	MSW landfill	1,611.50	138,588.98

In addition to contributing to the catastrophic effects of climate change, MSW landfills emit smog-forming compounds and several toxic air pollutants including xylene, toluene, and the known carcinogen benzene.[6] For the last few years, MDE's annual emissions inventories have also shown MSW landfills to be the largest sources – by far – in the state of hazardous air pollutants ("HAP"). EIP believes that this is a mistake caused by the erroneous inclusion of methane as a HAP starting in 2017.[7] While EIP strongly believes that this is an error, it is also indisputable that MSW landfills do emit HAPs. Additional controls and stronger regulations will likely have the co-benefit of reducing these health-harming pollutants as well.

Control of Landfill Methane in Maryland

Maryland is home to 38 MSW landfills that currently produce gas.[8] According to MDE's 2014 and 2017 GHG Inventories, it appears that 14 are equipped with collection and control systems that are presently in use.[9] These 14 landfills reported collection efficiencies ranging from 5% (Northern Landfill in Carroll County) to 95% (Sandy Hill Landfill in Prince George's County). Of these 14 landfills, only 4 landfills operate collection and control systems that are

[5] Using global warming potential sof 86.

[6] *See, e.g.*, 2018 Emissions Certification Report for Quarantine Road Landfill in Baltimore City.

[7] The EPA does not list methane as a HAP for purposes of the federal Clean Air Act. In addition, EIP does not believe that methane is appropriately classified as a toxic air pollutant ("TAP") for purposes of Maryland state laws. *See* COMAR 26.11.15.01(B)(21)(definition of TAP). EIP requests that MDE revise the emissions inventories to address this error, which makes it difficult to assess what the largest sources of HAP in the state actually are.

[8] For an explanation of how we arrived at this number, please see Attachment A hereto.

[9] 14 landfills reported reductions in their total emissions based on some level of collection and/or control at the facilities. While the 2017 GHG Inventory shows that 12 landfills have collection and control systems, it omitted the Gude and Oaks landfills in Montgomery County. The 2014 GHG Inventory includes these 2 landfills and shows that they are both equipped with collection and control systems.

required under EPA's regulations promulgated under the federal Clean Air Act and, therefore, subject to the operational standards and other requirements of those regulations. Along with a dearth of standards, these systems may collect gas from only a portion of the landfill, which is the case at the Quarantine Road Landfill in Baltimore City. The federal regulations require systems to collect gas from the entire landfill and to expand the system as waste is deposited over time, if necessary to meet the requirements of the regulations.

The 4 Maryland landfills that do have federally regulated collection systems and their reported collection efficiencies in 2017 are: (1) Eastern Landfill in Baltimore County, which reported a 64% collection efficiency; (2) Millersville Landfill in Anne Arundel County, which reported a 77% collection efficiency; (3) Brown Station Road Landfill in Prince George's County, (67% reported collection efficiency); and (4) the closed Sandy Hill Landfill in Prince George's County (95% reported collection efficiency).[10] The other 10 landfills that have collection systems but are not subject to EPA regulations reported the collection efficiencies shown in Table 2 below in 2017.

Table 2: Collection Efficiencies of Unregulated Systems in Maryland (2017)

County	Facility Name	Collection Efficiency (%)
Allegany	Mountainview Municipal Landfill	62%
Baltimore City	Quarantine Road Municipal Landfill	38%
Carroll	Northern Municipal Landfill	5%
Cecil	Cecil County Central Landfill - Hog Hill	64%
Frederick	Reich's Ford A & B Municipal Landfill	60%
Howard	Alpha Ridge Landfill	41%
Montgomery	Gude Landfill (closed)	88%
	Oaks Landfill (closed)	95%
Wicomico	Newland Park Municipal LF - Wicomico County LF	55%
Worcester	Central Municipal LF- Worcester County Sanitary LF	80%

All 14 landfills that reported a collection efficiency value also reported using a flare for control, with flare destruction efficiencies ranging from 97% to 100%. Some landfills operate a flare in conjunction with other methods of control, like landfill-gas-to-energy projects.

[10] Collection efficiencies in the 2017 GHG Inventory are based on self-reported data taken from annual emissions certification reports (ECRs) submitted by landfill operators.

EPA Regulations for Landfill Methane

On August 29, 2016, the U.S. EPA issued updated New Source Performance Standards[11] ("NSPS) and Emission Guidelines ("EGs") [12] for MSW landfills. For purposes of these comments, the substantive requirements of the two sets of regulations are essentially identical, and the primary difference is that the NSPS apply to more recently constructed or modified landfills while the EGs apply to older landfills. States must implement the EGs through state regulations that must be approved by the EPA[13] while the NSPS are effective when issued by the EPA.[14] EPA's 2016 standards for MSW landfills update of the previous set of regulations issued by the EPA in 1996. The EPA regulations function as a regulatory floor and states are fully authorized to set more stringent standards in order to more effectively limit pollution.

The general approach that EPA has taken to regulating MSW landfills under the federal Clean Air Act is to require landfills that exceed certain size and emission rate thresholds to install a gas collection and control system ("GCCS"), for which operating and monitoring requirements are prescribed in the regulations. If a landfill does not meet the size and emissions rate threshold that trigger these requirements, it is not subject to any substantive emission control requirements under the federal Clean Air Act.

Only four landfills in Maryland meet or exceed the thresholds in EPA's 1996 regulations. In addition, although EPA's 2016 regulations establish a slightly lower emissions rate threshold, no additional landfills will be required to install a GCCS under the 2016 EG. As explained above in the section on control system efficiencies, the 4 Maryland landfills that are required to install and operate a GCCS under the 1996 and 2016 EPA regulations are Eastern Landfill in Baltimore County, Millersville Landfill in Anne Arundel County, Brown Station Road Landfill in Prince George's County, and the closed Sandy Hill Landfill in Prince George's County.

California's Regulations for Landfill Methane

In 2010, the California Environmental Protection Agency Air Resources Board ("CARB") finalized a set of regulations for limiting methane emissions from MSW landfills, which are set forth set forth in the California Code of Regulations, title 17, subchapter 10, article 4, subarticle 6, sections 95460 to 95476 (hereinafter "CA Methane Rule"). At the time, CARB described the benefits of the rule in terms of emissions reductions as follows:

> There are about 367 landfills currently in [C]ARB's landfill emissions inventory that have the potential to generate methane emissions. Of these, 218 landfills (14 of which are uncontrolled) may be subject to the proposed regulation. The remaining landfills are likely to qualify for an exemption. Based on [C]ARB staff's 2020 forecast of landfill emissions, if all 14 of the uncontrolled landfills were to

[11] Standards of Performance for Municipal Solid Waste Landfills, 81 Fed. Reg. 59,332 (Aug. 29, 2016) (codified at 40 C.F.R. pt. 60, subpt. XXX).
[12] Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills, 81 Fed. Reg. 59,276 (Aug. 29, 2016) (codified at 40 C.F.R. pt. 60, subpt. Cf).
[13] 42 USC § 7411(d)(1).
[14] 42 USC § 7411(b)(1)(B).

install gas collection and control systems for methane, there would be a reduction of about 0.4 million metric tons of carbon dioxide equivalents (MMTCO2E). The implementation and enforcement of this proposed regulation for the remaining estimated 204 affected MSW landfills (including those with gas collections systems already installed) is expected to result in an additional estimated emission reduction of 1.1 MMTCO2E. Overall, the proposed regulation will result in reductions of about 1.5 MMTCO2E in 2020. [15]

RECOMMENDATIONS

I. Development of MSW Landfill Regulations

As stated above, if MDE were to implement the EPA's 2016 EGs as written, without requiring additional measures, no additional landfills in Maryland would be required to install a GCCS. EIP considers this unacceptable and we believe that MDE must go above and beyond the EPA requirements in order to adopt the most effective possible set of regulations for limiting landfill methane. Further, we believe that Maryland should be a national leader in the regulation of this under-addressed category of GHG sources. Our recommendations for how MDE can set the most effective landfill methane regulations in the country are set forth below.

A. Regulatory Approach

EIP believes that any effective approach to air quality regulation must include clear, specific, and enforceable requirements for limiting air pollution that must be linked to monitoring and reporting provisions that allow the regulatory agency (and members of the public) to assess, with relative ease, compliance with each condition. We have recommended a set of requirements in these comments, based on our review of the U.S. EPA's Clean Air Act regulations and air quality regulations issued in individual states. We have recommended this approach because it is the strongest set of requirements that we believe will most effectively limit methane based on any current model in use in the U.S. If MDE or any other commenter identifies an alternative regulatory structure that will achieve even more methane reductions and can be feasibly implemented and enforced, EIP looks forward to discussing that option. We also see value in other approaches, such voluntary measures or incentives, that could supplement a strong set of enforceable requirements. However, we believe that the minimum elements of Maryland's air quality regulations must be mandatory, not voluntary, and must include monitoring and reporting requirements that assure compliance with the air quality standards.[16]

Our review of the 2016 EG and the laws of other states has revealed that the CA Methane Rule is the strongest existing rule for landfill methane that has been issued by any state or the EPA. CARB stated in 2016 that its regulation differs from federal requirements "in that the focus is generally on methane and not [NMOCs], it applies to smaller landfills (in addition to larger

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[15] CARB, Staff Report: Initial Statement of Reasons for the Proposed Regulations to Reduce Methane Emissions from Municipal Solid Waste Landfills (May 2009) (hereinafter "CARB ISOR") at ES-3 https://ww3.arb.ca.gov/regact/2009/landfills09/isor.pdf.

[16] We also urge MDE to submit its strongest landfill methane regulations to the EPA for approval once they are finalized as CARB has done.

landfills); and has more stringent requirements for methane collection and control, and component leak testing and surface emissions monitoring."[17]

For this reason, we urge MDE to use the CA Methane Rule as the model for Maryland's forthcoming landfill methane regulations. However, we have identified a few aspects of the CA Methane Rule, particularly with regard to applicability thresholds, where there is strong technical support for setting more protective requirements. Below, we address in more detail the issue of applicability thresholds as well as certain key aspects of the CA Methane Rule that are superior to EPA's 2016 EG and should be adopted or improved upon by MDE. We also identify one area (wellhead standards) in which EPA's 2016 EG sets stronger requirements, which must be included in Maryland's regulations.

B. Applicability Thresholds

The regulatory framework used by EPA and CARB requires the installation of a GCCS only if certain thresholds pertaining to size and other metrics are met or exceeded at an individual landfill. EIP strongly recommends that MDE use California's approach rather than EPA's. EIP has analyzed how four sets of applicability thresholds would apply to Maryland's MSW landfills, and a summary of our analysis is below. Notably, we were not able to incorporate into our analysis the provisions of EPA and CARB's rules that allow a landfill operator to avoid installing a GCCS based on surface methane measurements below certain levels (500 ppm for EPA and 200 ppm for CARB) even if the other thresholds are met or exceeded.[18] EIP was unable to include this in our analysis because we do not have access to surface methane data for Maryland landfills.

As shown below in Table 2, EPA's 1996 regulations require installation of a GCCS at only four landfills in Maryland as do EPA's 2016 regulations. However, the CA Methane Rule, which establishes applicability thresholds based on operation of a flare without supplemental use of fuel, would require installation of a system at an additional 21 landfills (25 in total) in Maryland. Finally, EIP has performed an updated analysis of the minimum heat input necessary to operate a flare in order to meet the regulatory requirements recommended in these comments. Our conclusion is that landfill operators could meet these requirements at much lower thresholds than those established in 201s0 by CARB, and we strongly recommend that MDE establish lower thresholds, as described in more detail below. If MDE were to adopt our recommended thresholds, shown as Option 4 (Beyond California Thresholds) in Table 3 below, a total of 35 landfills in Maryland (10 more than using the California thresholds) would be required to install a GCCS.

[17] CARB, Implementation Guidance Document for the Regulation to Reduce Methane Emissions from Municipal Solid Waste Landfills (June 2016) (hereinafter "CARB Implementation Guidance"), p.I-2, available at https://ww2.arb.ca.gov/sites/default/files/2020-07/LMR_ImplementationGuidance.pdf.

[18] We also exclude the effects of closure status and dates of construction, reconstruction, and modification from our analysis in order to focus on the effect of the size and emissions rate thresholds.

Table 3:[19] Number of Maryland Exceeding Landfills Exceeding Applicability Thresholds Out of 38 Total	
Option 1: 1996 EPA Thresholds 2.5 million megagrams and 2.5 million cubic meters + 50 megagrams per year NMOC	**Total # landfills: 4**
	Active: 3 Closed: 1
Option 2: 2016 EPA Thresholds 2.5 million megagrams and 2.5 million cubic meters + 34 megagrams per year NMOC	**Total # landfills: 4**
	Active: 3 Closed: 1
Option 3: California Thresholds 450,000 tons waste in place + 3.0 MMBtu/hr heat input	**Total # landfills: 25**
	Active: 16 Closed: 9
Option 4: Beyond California Thresholds 150,000 waste in place + 1.0 MMBtu/hr heat input	**Total # landfills: 35**
	Active: 17 Closed: 18

i. EPA Thresholds

EPA's applicability thresholds are based on the design capacity of the landfill and the emissions rate of the landfill. Under the 1996 NSPS and EGs, landfills must install a GCCS if the landfill has both of the following:

(1) a design capacity greater than or equal to 2.5 million megagrams[20] and 2.5 million cubic meters; and
(2) a nonmethane organic compound ("NMOC") emission rate of 50 megagrams per year or more.[21]

The 2016 EGs represent only a slight improvement on the 1996 standards. Under the 2016 EGs, the thresholds are the same as the 1996 standards for design capacity, but the NMOC rate is 34 megagrams per year instead of 50 (for active landfills). In addition, the 2016 EGs allow landfill operators measuring a surface methane concentration of below 500 ppm to avoid the obligation to install a GCCS even if the landfill meets or exceeds the other thresholds.[22]

As discussed above, only four landfills in Maryland are required to install a GCCS under the 1996 standards or the 2016 standards. Although there are other ways in which the CA

[19] Methodology involved in EIP's development of Table 3, including establishing the number of landfills, calculation of heat input rates, and treatment of certain individual landfills is described in Attachment A hereto (Table 3 Methodology).
[20] A megagram is approximately one metric ton.
[21] 40 C.F.R. § 60.33c; 40 C.F.R. § 60.752(b).
[22] 40 C.F.R. §§ 60.33f(e)(2), 60.35f(a)(6).

Methane Rule is superior to EPA's regulatory approach, this fact alone renders EPA's 2016 EG insufficient for the control of methane in Maryland. MDE must adopt more protective applicability thresholds.

ii. California's Thresholds

CARB, in its CA Methane Rule, established a much more useful approach to setting applicability thresholds for the control of landfill methane. CARB utilizes thresholds that are based on the amount of waste that is already in place at a landfill ("waste in place") and the heat input that the landfill gas generates. These metrics are more directly associated with whether a GCCS will be able to effectively capture and control landfill gas than those used by the EPA. In particular, California has set its "waste in place" threshold at 450,000 tons and its heat input threshold at 3.0 million British thermal units per hour ("MMBtus/hr") based on the smallest quantity of waste expected to generate sufficient gas to operate a flare, and the minimum heat input necessary to operate a flare without supplemental fuel.[23] In addition, even if a landfill exceeds these thresholds, CARB allows an operator to avoid the obligation to install a GCCS by demonstrating that surface methane concentrations at the landfill are below 200 ppm.[24] CARB has stated that the purpose of this surface methane exemption is to provide "an option that can be used by landfill owners and operators of uncontrolled landfills to show that their landfills are not expected to generate sufficient amounts of landfill gas to support a control device operating on a continuous basis without the use of supplemental fuel."[25]

Based on the waste-in-place and heat input thresholds (excluding surface methane), EIP analyzed the number of landfills in Maryland that would have to meet the CA Methane Rule's thresholds. It appears that, if California's thresholds of 450 tons of waste-in-place and 3.0 MMBtu/hr were used in Maryland, 25 landfills in total (21 more than if EPA's thresholds are used) would be required to install a GCCS.

iii. Beyond California's Thresholds

Lastly, EIP calculated our own thresholds for installation of a GCCS using an updated model of CARB's approach. CARB developed the thresholds in its 2010 rule based on the minimum quantity of gas and heat input necessary to operate a flare.[26] However, control technology often advances over time. EIP's Staff Engineer, Benjamin Kunstman, conducted a survey of modern flare technology options available for methane control at MSW landfills. Mr. Kunstman's report and findings based on this survey is attached hereto as Attachment B. In summary, Mr. Kunstman identified at least three vendors that supply flares that would meet the requirements of the regulations recommended in these comments - enclosed flares that can combust landfill gas and achieve a 99% destruction efficiency rate for methane - and can operate at lower heat input threshold than the CARB threshold without the use of supplemental fuel. In fact, Mr. Kunstman identified one option for flare control that could meet these requirements at a

[23] CARB ISOR at ES-5, V-1,V-2.
[24] 17 C.C.R. § 95463(b)(2)(B).
[25] CARB Implementation Guidance at II-4.
[26] CARB ISOR at V-1 to V-2.s

minimum thermal capacity of 0.283 MMBtu/hr without supplemental fuel and a second that can operate at a minimum heat input of 0.84 MMBtu/hr without supplemental fuel.

Based on Mr. Kunstman's findings, EIP believes that landfill operators can likely meet the requirements of the CARB regulations at even lower applicability thresholds than those established in the CA Methane Rule. To be somewhat conservative, EIP is recommending that MDE establish applicability thresholds that are 1/3 of the heat input and waste-in-place thresholds established by CARB in 2010, even though it appears that MDE would have technical support to set even lower thresholds. Thus, we recommend that MDE set applicability thresholds of 1.0 MMBtu/hr heat input and 150,000 tons of waste in place for the installation of a GCCS.[27]

EIP's analysis shows that, if MDE were to use these thresholds, 35 landfills in Maryland would be required to install a GCCS, which is 10 more landfills (40% more) than if MDE were to adopt waste-in-place and heat input thresholds directly from the CA Methane Rule.

C. Operational Standards and Limits

In addition to the applicability thresholds, the CA Methane Rule also includes operational standards that are superior to those in EPA's 2016 EGs. As described in more detail below, CARB's requirements are better than EPA's for type of collection system, leak detection and repair, surface methane monitoring, and flare control technology. EPA's 2016 EGs include better wellhead operational standards and monitoring requirements, which are also discussed below.

i. Requirement of Active Gas Collection System

There are two types of gas collection systems that can be installed at an MSW landfill, active and passive.

> Passive systems rely on the natural pressure gradient between the waste mass and the atmosphere to move gas to collection systems. Most passive systems intercept LFG migration and the collected gas is vented to the atmosphere. Active systems use mechanical blowers or compressors to create a vacuum that optimizes LFG collection.[28]

EPA's 2016 EG allows use of an active collection system or a passive system. A passive system is permitted only if liners that meet design requirements established under the Resource Conservation and Recovery Act ("RCRA") are installed "on the bottom and all sides in all areas in which gas is to be collected.[29] Howesver, when considering its 2010 landfill methane rule, CARB found that passive gas collection systems failed to sufficiently limit methane from escaping

[27] EIP does not have a position on whether a surface methane concentration component should be included in this threshold as it is in the 2016 EG and the CA Methane Rule. We look forward to discussing this issue during the stakeholder process.

[28] EPA, Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Municipal Solid Waste Landfills, (June 2011) (hereinafter "EPA Tech Paper"), p.10, at https://19january2017snapshot.epa.gov/sites/production/files/2015-12/documents/landfills.pdf,.

[29] 40 C.F.R. § 60.33f(b)(3).

into the atmosphere.[30] In addition, it is EIP's understanding that liners, even those that meet RCRA requirements, are often ineffective and fail in places, in part due to being punctured by waste. CARB, in the CA Methane Rule, requires use of active collection systems and does not allow operators to comply with its rule by using passive collection systems.[31] We recommend that MDE also require the use of active collection systems.

ii. Leak Detection Requirements

CARB, in the CA Methane Rule, establishes requirements to reduce equipment leaks that apply to the entire GCCS installed at a landfill. Conversely, EPA's 2016 EGs include no leak detection or control requirements at all. Leak detection and repair (or LDAR) has been increasingly recognized by EPA and state environmental agencies as an effective practice for controlling fugitive gas leaks from equipment used in the petrochemical sector. For example, in 2007, EPA stated that implementation of leak detection and repair programs could reduce emissions from equipment leaks by 63% at petroleum refineries and could reduce VOC emissions from chemical facilities by 56%.[32] MDE should adopt, at minimum, the leak control requirements for MSW landfills that are set forth in the CA Methane Rule and should also consider adopting additional requirements based on regulation of the natural gas industry.

Under the CA Methane Rule, a GCCS must be operated "so that there is no landfill gas leak that exceeds 500 ppm[] [of methane]" when operating the system under positive pressure.[33] CARB also requires that GCCS components under positive pressure must be monitored quarterly for leaks and leaks must be repaired within 10 days.[34] EIP recommends that MDE include these requirements in its landfill methane rule. In addition, EIP recommends that MDE consider using Optical Gas Imaging (OGI) rather than EPA Method 21 monitoring, as identified in the CA Methane Rule, [35] for leak detection. Maryland's recently passed rules limiting methane emissions from the natural gas storage and transmission sector, allow use of Method 21 or OGI for leak detection.[36] However, OGI may be a more effective leak detection technology for use at MSW landfills, where many of the components are located beneath the ground and fewer components are exposed. Use of OGI to scan the surface of the landfill could potentially identify problem areas where there may be leaks beneath the soil in addition to identifying leaks from exposed components.

[30] Specifically, CARB stated that "Passive systems rely on natural pressure or concentration gradients as a driving force for gas flow and thus have much lower collection efficiencies than active systems. Since these systems do not actively collect, process, or treat landfill gas, but allow methane to be freely vented into the atmosphere, they are not considered to be appropriate gas collection systems for the purpose of the proposed regulation." CARB ISOR at III-5.

[31] 17 C.C.R. § 95464(b)(1)(C).

[32] EPA, Leak Detection and Repair, A Best Practices Guide, (Oct. 2007) p. 7, at https://www.epa.gov/sites/production/files/2014-02/documents/ldarguide.pdf.

[33] 17 C.C.R. § 95464(b)(1)(B).

[34] 17 C.C.R. § 95469(b)(3).

[35] 17 C.C.R. § 95471(a)(d).

[36] *See, e.g.,* 47:16 Md. R. 759 (July 31, 2020); Proposed COMAR 26.11.41. 01(B)(13; COMAR 26.11.41.03(A)(1).

iii. Wellhead Standards and Monitoring Requirements

One way in which GCCS performance can be monitored and improved is by setting performance requirements that must be met at the system wellheads. EPA's 2016 EGs set pressure and temperature standards for wellheads and EPA's 1996 NSPS also established oxygen and nitrogen standards for wellheads. Conversely, the CA Methane Rule establishes only a pressure standard (failing to meet the regulatory floor, which requires incorporation of the temperature limit from EPA's 2016 EG).[37] MDE should include pressure, temperature, and oxygen standards and monitoring requirements for wellheads in its regulation. In addition, MDE should require more frequent monitoring of these parameters than the monthly sampling required by EPA.

The CA Methane Rule requires that, except during temporary situations like repairs and well raising,[38] wellheads must be operated under negative pressure unless the well has been decommissioned or a geomembrane or synthetic cover is being used, in which case "the owner or operator must develop acceptable pressure limits for the wellheads."[39] Similarly, EPA's 2016 EG requires that negative pressure be maintained at wellheads, with a slightly different set of exceptions than those established by CARB.[40] In addition, EPA's 2016 EG requires that "each interior wellhead in the collection system [must be operated] with a landfill gas temperature less than 55 degrees Celsius (131 degrees Fahrenheit)," although higher operating temperature values may be approved by EPA if "supporting data demonstrate[es] that the elevated parameter neither causes fires nor significantly inhibits anaerobic decomposition by killing methanogens."[41] Lastly, although pressure and temperature are the only two operational parameters established for wellheads in EPA's 2016 EG, EPA also set nitrogen and oxygen requirements for wellheads in its 1996 regulations that were not carried forward in the 2016 updates to those standards. Specifically, EPA's 1996 NSPS required that interior wellheads be operated "with either a nitrogen level less than 20 percent or an oxygen level less than 5 percent."[42] This requirement was also subject to the allowance that the owner or operator could establish higher parameters if based on "supporting data [showing] that the elevated parameter does not cause fires or significantly inhibit anaerobic decomposition by killing methanogens."[43]

It is EIP's understanding that pressure, temperature, and oxygen parameters at wellheads can all help to ensure that the control system is functioning properly, prevent landfill fires, and aid in the early detection of fires. It is also our understanding that maintaining an oxygen limit is more effective at preventing fires at landfills than a nitrogen limit, in large part because oxygen

[37] EPA partially disapproved California's state plan for this reason as well as the CA Methane Rule's failure to include monitoring and recordkeeping requirements for oxygen and nitrogen. 85 Fed. Reg. 1121.
[38] *See* 17 CCR § 95475(31) (definition of 'well raising.")
[39] 17 C.C.R. § 95464(c).
[40] 40 C.F.R. § 60.34f(b)(there is an additional exception in the case of a fire or increased well temperature and express exceptions for repairs and well raising are not built into the wellhead stansdards section of the regulation, though they could be incorporated in a different way).
[41] 40 C.F.R. § 60.34f(c).
[42] 40 C.F.R. § 60.753(c).
[43] *Id*.

is actually involved in a combustion reaction while nitrogen is just a proxy for air infiltration.[44] For these reasons, we recommend that MDE's rule include the negative pressure requirements from EPA's and CARB's rules, the temperature limit from EPA's 2016 EG (as required), and the 5% oxygen standard from EPA's 1996 NSPS.

In addition to setting inadequate wellhead operational standards, CARB's wellhead monitoring requirements, consisting only of monthly monitoring for pressure, also fall short of EPA requirements.[45] EPA's 2016 EG requires monthly monitoring of pressure, temperature, oxygen, and nitrogen at wellheads.[46] MDE must, at minimum, incorporate EPA's wellhead monitoring requirements and should consider requiring more frequent monitoring of these parameters at intervals of every 10 or 14 days to more consistently ensure optimal system performance.

iv. Surface Methane Monitoring Requirements

The CA Methane Rule also includes requirements for surface monitoring of landfill methane that are more protective, and better designed to identify and correct problems, than EPA's 2016 EG. EPA and CARB both require soperation of a GCCS so that surface concentrations of methane at the landfill are no higher than 500 ppm above background levels, which is to be measured based on an "instantaneous surface methane emissions method."[47] However, CARB has a second and stronger limit of 25 ppm, which is based on an "integrated surface emissions standard."[48] Instantaneous readings are essentially a single measurement taken at a single point in time whereas integrated measurement standards are based on several readings taken in a particular section of the landfill and then averaged together for a composite.[49]

In addition, the CA Methane Rule requires more monitoring that covers more of the surface of the landfill. EPA's 2016 EG requires operators to monitor the entire perimeter of the area the system collects gas from and to test along a pattern that crosses the landfill at 30 meter (about 100-foot) intervals on a quarterly basis.[50] Under the CA Methane Rule, a person must measure methane based on a walking pattern of no more than 25-foot intervals during surface emissions monitoring (for the instantaneous and integrated standards).[51] This requires that more of the landfill's surface is actually traversed and measured by the person conducting the

[44] *See* EPA, LFG Energy Project Development Handbook, Chapter 8: Best Practices for Landfill Gas Collection System Operation and Maintenance (Mar. 2020) pp. 8-2 – 8-3, 8-6 – 8-9, *available at* https://www.epa.gov/sites/production/files/2016-11/documents/pdh_full.pdf; *see also* Samain Sabrin, Development of a subsurface landfill fire risk-index (Aug. 2, 2018) pp. 3, 9-13, *available at* https://rdw.rowan.edu/cgi/viewcontent.cgi?article=3601&context=etd; Phone Conversation between Todd Thalhamer, Senior Waste Management Engineer, CalRecycle, and Ryan Maher, Attorney, Environmental Integrity Project (June 22, 2020). The Quarantine Road Landfill presents an example of a circumstance in which a high nitrogen content in the landfill gas was not accompanied by a high oxygen content.
[45] *See* 17 C.C.R. § 95469(c)
[46] 40 C.F.R. § 60.37f(a)(1)-(3).
[47] 40 C.F.R. § 60.34f(d; 17 C.C.R. § 95465(a)(1).
[48] 17 C.C.R. § 95465(a)(2).
[49] *See* 17 C.C.R. § 95471(c).
[50] §§ 60.765(c)(1), 60.36f(c)(1).
[51] 17 C.C.R. § 95471(c)(1)(B).

monitoring,[52] although California's landfill operators may elect to use a 100-foot interval if compliance is demonstrated for a certain period of time.[53] EIP believes that CARB's surface landfill measurement requirements represent important improvements over the EPA requirements and recommends that MDE follow the CARB approach.

v. Requirements for Flares

Both EPA and CARB allow a landfill operator to choose from several different approaches, including flares, for the control of landfill gas once it is routed from the collection system to the control portion of the system. However, CARB has established stronger requirements for flares that will more effectively reduce methane emissions. Specifically, CARB phases out use of open flares and, for enclosed flares, establishes a stronger destruction efficiency standard based on methane destruction rather than NMOC reduction.

EPA's 2016 EG allows use of enclosed flares or use of "non-enclosed" (open) flares if the open flares meet certain operational parameters.[54] However, CARB determined that open flares, while less expensive and complex, are not as effective as enclosed flares for several reasons. Specifically, CARB stated that open flares, "since they are essentially an exposed flame[,]s . . . cannot be easily be sampled for compliance testing. It is not feasible to source test or measure the percent reduction of methane concentration for open flares."[55] Conversely, CARB found that combustion efficiency can be more easily controlled at enclosed flares and that enclosed flares "can be easily source tested to measure flare destruction and treatment efficiency."[56] CARB also found that open flares emit more "luminosity, noise, and heat radiation compared to enclosed flares."[57] For these reasons, the CA Methane Rule requires that use of open flares must be phased out by January 1, 2018 unless an operator "can demonstrate . . . that the landfill gas heat input capacity is less than 3.0 MMBtu/hr . . . and is insufficient to support the continuous operation of an enclosed flare or other gas control device."[58]

CARB has also sets stronger standards for enclosed flares than EPA has. The 2016 EPA EG requires that enclosed flares must achieve a 98% reduction of NMOC or reduce the outlet NMOC concentration to less than 20 ppm.[59] The CA Methane Rule, on the other hand, requires that enclosed flares must achieve a 99% destruction rate of *methane*, the gas that MDE seeks to limit in this rulemaking.[60]

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[52] In the context of OGI, there is evidence indicating that closer transect distances (closer to 10m or 32.8 ft) result in better detection and quantification. Ravikumar, Arvind, et. al. Are Optical Gas Imaging Technologies Effective For Methane Leak Detection?, *Environ. Sci. Technol.* 2017, 51, 1, 718–724 available at https://pubs.acs.org/doi/full/10.1021/acs.est.6b03906. This further supports CARB's approach by suggesting that a closer transect interval results in better surface monitoring coverage.
[53] 17 C.C.R. § 95471(c)(1)(B).
[54] 40 CFR § 60.33f(c)(1).
[55] CARB ISOR at III-9
[56] *Id*.
[57] *Id*.
[58] 17 C.C.R. §95464 (b)(2)(B)(1)-(2)
[59] 40 C.F.R. § 60.33f(c)(2) (dry basis as hexane at 3% oxygen).
[60] 17 C.C.R. § 95464(b)(2)(A)(1),(b)(3)(A)(1).

We believe that it is particularly important that MDE (1) require the use of enclosed flares rather than open flares; and (2) require enclosed flares to achieve 99% destruction efficiency of methane rather than the using the NMOC control standards set forth in EPA's rule.

D. Reporting and Record-keeping

Proper reporting and record-keeping requirements are an essential component of any effective set of regulations. It is particularly important, in the present situation in which only four landfill operators have been previously subject to any substantive requirements, that MDE require reporting that allows MDE to assure compliance with prescribed standards. Given that EIP is recommending that MDE use the CA Methane Rule, rather than EPA's 2016 EG, as its model, we expect that the necessary reporting and record-keeping requirements will be a matter for additional discussion once substantive requirements have been established.

In general, we consider the following to be particularly important records that should be reported to MDE (not kept on site) at least semi-annually if not quarterly: (1) records of the results of wellhead monitoring; (2) records of the results of surface methane monitoring; (3) records of leak detection monitoring activities (3) records relating to flare operation and efficiency; and (5) records of all repairs and /or corrective actions. In addition, MDE should require submission of an annual report modeled on the annual report required under the CA Methane Rule, which must include the following:

- MSW landfill name, owner and operator, address, and solid waste information system (SWIS) identification number.
- Total volume of landfill gas collected (reported in standard cubic feet).
- Average composition of the landfill gas collected over the reporting period (reported in percent methane and percent carbon dioxide by volume).
- Gas control device type, year of installation, rating, fuel type, and total amount of landfill gas combusted in each control device.
- The date that the gas collection and control system was installed and in full operation.
- The landfill gas collection efficiency and percent methane destruction efficiency of each gas control device(s).
- Type and amount of supplemental fuels burned with the landfill gas in each device.
- Total volume of landfill gas shipped off-site, the composition of the landfill gas collected (reported in percent methane and percent carbon dioxide by volume), and the recipient of the gas.
- Most recent topographic map of the site showing the areas with final cover and a geomembrane and the areas with final cover without a geomembrane with corresponding percentages over the landfill surface.
- The information required by [several other paragraphs of CARB's record-keeping and reporting regulations].[61]

[61] 17 C.C.R. § 95470(b)(3).

E. Additional Control Measures

In materials presented at its September 21, 2020 stakeholder, MDE also mentioned the following potential control measures: landfill coverings, optimizing landfill practices, biocovers, and installing and operating aerobic reactors. EIP recognizes the control value of all of these practices and notes, in particular, that EPA has estimated that biocovers can reduce landfill methane emissions by an additional 32% and that anaerobic digestion is also effective, as discussed in section II below.[62] We not addressed these control measures specifically in these comments because we did not identify them as components of CARB's 2010 CA Methane Rule. We are attempting to provide as specific a set of recommendations to MDE as possible based on improvements on regulatory approaches that are already in use elsewhere. However, if MDE or other commenters believe that these approaches can be incorporated into a workable and enforceable set of regulations, EIP is very interested in learning about and discussing those potential approaches.

II. Organics Diversion

EIP strongly urges MDE to establish a program that incentivizes or requires organics diversion, which must be defined to exclude incineration, as a method of reducing landfill methane. Organics diversion is a practice that avoids generation of methane in the first place by using alternative waste disposal practices for organic materials (typically food waste and yard scraps) that produces methane when decomposing. EPA has recognized organics diversion as a method of reducing landfill methane, stating that "[m]ethane generation at landfills is reduced proportionally to the amount of organic waste diverted."[63] In fact, in 2013, the EPA estimated that composting and anaerobic diversion practices each achieve a 95% methane reduction efficiency when compared to landfilling organic waste.[64]

CARB has taken at least one step, as described in more detail below, to incentivize organics diversion under the CA Methane Rule. EIP recommends that MDE consider additional options for incentivizing and/or requiring organics diversion under COMAR Title 26, Subtitle 11 (Maryland's air quality regulations). EIP also notes that it is likely that the Maryland legislature will mandate organics diversion on some scale within the near future. During the 2020 legislative session, HB589 was introduced, which required certain food waste producers in Maryland to divert organic waste from landfills and incinerators if a composting or anaerobic digestion facility was located within 30 miles.[65] A version of this bill is anticipated to be introduced again in 2021, which will likely focus son the largest commercial generators of food waste, those who

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[62] EPA Tech Paper, p. 9.
[63] EPA Tech Paper, p. 21.
[64] EPA, Global Mitigation of Non-CO2 GHGs Report: 2010-2030 (2013), Landfills, p. III-6, at https://www.epa.gov/sites/production/files/2016-06/documents/mac_report_2013-iii_waste.pdf (entire report available at https://www.epa.gov/global-mitigation-non-co2-greenhouse-gases/global-mitigation-non-co2-ghgs-report-2010-2030).
[65]HB589, Solid Waste Management - Organics Recycling and Waste Diversion, Food Residuals, at: http://mgaleg.maryland.gov/mgawebsite/Legislation/Details/hb0589. This approach also uses a California State policy as a model. In 2016, California passed a law establishing methane emissions reductions targets, which "codifie[d]" CARB's Short-Lived Climate Pollutant Reduction Strategy. See CalRecycle, Short-Lived Climate Pollutants (SLCP): Organic Waste Methane Emissions Reductions, at https://www.calrecycle.ca.gov/climate/slcp.

generate 2 tons/week and eventually 1 ton/week, and where requirements will likely be phased in starting around 2024 or 2026. HB589 had support from organizations throughout Maryland, including the 28 organizations who joined written testimony submitted by Clean Water Action in support of the bill.[66]

EIP understands that an organics diversion program under MDE's air quality regulations would have to include details relating to implementation, including time scale, phase-in, requirements for reporting or estimating the amount of organic waste diverted from a landfill, and provisions for estimating associated methane reductions. We look forward to participating in discussions regarding these matters.

A. Definition of Organics Diversion

Any organics diversion program would have to include a definition of "organics diversion" in order to identify practices and technologies that are eligible for incentives or to meet requirements. Composting and anaerobic digestion should be included as eligible practices. Under no circumstances should waste incineration by any name, including "waste-to-energy" or "refuse-derived fuel," by considered to constitute organics diversion or incentivized as a landfill methane reduction strategy. Waste incinerators produce high rates of toxic air pollution as well as criteria pollutants[67] and are highly controversial for that reason. Waste incinerators are also large emitters of GHGs themselves and are not properly part of an environmentally responsible organics diversion program.

B. Potential Approaches to Organics Diversion

There are few ways in which MDE could require or incentivize the diversion of organic waste to reduce landfill methane emissions. Any of the approaches discussed below, taken separately or together, would complement and further the goals of existing laws and regulations related to organics diversion, like the Maryland Recycling Act.[68] EIP also looks forward to discussing any ideas that MDE staff or other commenters have for the creation of a workable program to incentivize or require organics diversion as part of MDE's landfill methane reduction program.

i. Compliance Flexibilities

MDE could incentivize organics diversion from MSW landfills though by allowing flexibility relating to compliance with certain aspects of its mandatory air quality regulations for reducing landfill methane. For example, landfill operators coulds demonstrate diversion of a

[66] Clean Water Action, Testimony on HB589 for Organics Recycling and Waste Diversion, available at https://www.cleanwateraction.org/2020/02/19/testimony-hb589-organics-recycling-and-waste-diversion.
[67] EIP recently found that, in 2018, Maryland's 2 trash incinerators emitted, on average, 17 times more of the neurotoxin mercury per unit of energy than Maryland's four largest coal plants: Chalk Point, Morgantown, Brandon Shores, and Herbert A. Wagner. In addition to mercury, the incinerators emitted, on average, five times as much nitrogen oxides (NOx) and two times as much carbon monoxide per unit of energy as those coal plants. See EIP Testimony Supporting HB438 House Economic Matters Committee February 20, 2020, at https://environmentalintegrity.org/wp-content/uploads/2020/08/EIP-FINAL-Testimony-in-Support-of-HB438.pdf.
[68] Md. Code Ann., Envtl. Art. §§ 9-505, 9-1701 – 9-1730.

certain percentage of their organic wasste could be subject to less frequent monitoring requirements or somewhat less stringent operational standards due to their generation of less methane that requires control. MDE could also consider adjusting applicability thresholds for new landfills that can demonstrate diversion of a high percent (not a small portion) of organic waste. CARB's CA Methane Rule provides an exemption from the rule's requirements for landfills that contain only "non-decomposable waste,"[69]which may help incentivize landfill operators who have the option of banning organics disposal entirely at their landfills. MDE could take a somewhat similar approach by setting a higher waste-in-place applicability threshold for new landfills (that do not already contain organics in sufficient quantities, as many do) that divert a substantial amount of organic waste. This would be contingent upon MDE implementing either the California or the Updated California applicability thresholds, which are premised on waste-in-place tonnage and the minimum heat input necessary to fuel a flare. If organic material is diverted from the landfill, the landfill's gas generation rate will diminish, so more waste is required to produce gas in sufficient quantities to fuel a flare.

ii. Creation of Offsets or Credits for Organics Diversion Under RGGI or Other Programs

MDE could include composting and anaerobic digestion operations that divert organics away from landfills and reduce methane emissions as qualifying offset projects in the Regional Greenhouse Gas Initiative ("RGGI").[70] Under RGGI, fossil fuel-fired power plants in participating states must obtain allowances that permit their carbon dioxide emissions. These facilities can purchase allowances from the sponsors of offsetting projects that reduce greenhouse gas emissions.[71] Permitted composting and anaerobic digestion facilities in Maryland that divert organic waste away from landfills result in quantifiable methane emission reductions.[72] Allowing sponsors of composting and anaerobic digestion projects to generate offset credits that can be sold to facilities regulated under RGGI would incentivize these effective methods of reducing methane emissions from organic waste. RGGI already permits regulated facilities to purchase offset allowances from sponsors of projects that use anaerobic digesters to capture and destroy methane in agricultural manure management.[73] Expanding the

[69] 17 C.C.R. § 95462.
[70] Carbon dioxide emissions reductions at landfills, as well as carbon dioxide and nitrous oxide emissions from composting or anaerobic digestion operations, could also be factored in to shift the focus to total GHGs.
[71] RGGI, Offsets, *available at* https://www.rggi.org/allowance-tracking/offsets (last accessed Oct. 14, 2020). RGGI is implemented in Maryland at COMAR 26.09.01 – .04, as required by Md. Code Ann. Envir., §§ 2-1001 through -1005 (2007 & Supp. 2009).
[72] *See, e.g.*, MDE, Land and Materials Administration, Maryland Solid Waste Management and Diversion Report (CY17 Data) (2018) p. 29-30 (quantifying GHG emissions reductions from different forms of waste diversion, including composting); Eugene Mohareb, Greenhouse Gas Emissions from Waste Management—Assessment of Quantification Methods, 61 Journal of the Air and Waste Management Association 480-93 (Oct. 10, 2011) (evaluating different methods of quantifying GHG emissions from alternative waste disposal methods, including composting and anaerobic digestion).
[73] RGGI, Offset categories: Agricultural Methane, *available at* https://www.rggi.org/allowance-tracking/offsets/offset-categories/agricultural-methane (last accessed Oct. 14, 2020); *see also* COMAR 26.09.03.02A(3) (the Maryland regulation permitting this type of offsetting project).

offsetting program to include organics diversion from landfills is readily comparable to this method of reducing methane emissions.[74]

MDE could also consider developing its own program to allow composting or anaerobic digestion facilities to develop credits or offsets for avoided methane emissions due to their activities. For example, such a program could introduce a cap on statewide or county-specific methane emissions from the MSW landfills in Maryland that still produce gas.[75] This cap could decrease on an annual basis, like the RGGI cap on carbon dioxide emissions, which decreases by 2.5% each year.[76] This approach could build on the Maryland Greenhouse Gas Reduction Act, by requiring a certain percentage reduction below the landfill methane emissions in a prior year by some future year. However, given the unique nature of methane emissions from landfills—which accept additional waste each year, resulting in increased methane production over time—the cap could slightly increase by an amount designed to increase organics diversion year over year (as well as increased GCCS efficiency) while accommodating increasing gas generation rates. Trend data on landfill methane emissions over time would be needed to inform how the cap should fluctuate. MDE could then consider what kind of flexible mechanisms, potentially including trading, could be used to meet the cap.

Thank you for considering our comments.

Respectfully submitted,

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[74] EIP recognizes that Maryland cannot unilaterally add a category of offset projects without the agreement of the other states that are part of RGGI. MDE should initiate the process to add this category of offset projects. *See* RGGI, Memorandum of Understanding, Section F(1)(c) ("Additional Offset Types. The Signatory States agree to continue to cooperate on the development of additional offset categories and types, including other types of forestry projects, and grassland re-vegetation projects. Additional offset types will be added to the [RGGI] Program upon approval of the Signatory States.").

[75] Carbon dioxide and nitrous oxide could be included to make this a cap on GHG emissions from the landfill sector.

[76] *See* RGGI, Memorandum of Understanding, Section D.

Cc: *via email*

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Attachment A

Table 3 Methodology

Table 3 Methodology

In total, this analysis considered 38 municipal solid waste landfills in Maryland. This number is the sum of the 35 landfills included in the 2017 Maryland Greenhouse Gas ("GHG") Inventory with three landfills that were not in the 2017 Inventory but were included in the 2014 Inventory. It is not clear why these three landfills—the Gude and Oaks landfills in Montgomery County, and the Midshore II Regional Municipal Landfill in Talbot County—were omitted from the 2017 Inventory. The Maryland Department of the Environment's 2018 Annual Emission Inventory shows that these landfills emitted significant amounts of gas that year.

The total count of 38 landfills also aggregates the emissions from separate parts of the same landfill, treating them as one landfill, as is done for purposes of Title V reporting. For example, the 2017 GHG Inventory has two separate entries for sections A and B of the Brown Station Road landfill. For purposes of this analysis, these were treated as one landfill and their methane generation rates, presented separately in the Inventory, were summed.

Heat input capacity was calculated using the equations in Appendix I of the California landfill methane regulation. Methane generation rates came from the 2017 GHG Inventory data, except for the three landfills mentioned above, for which the most recent information available is from the 2014 Inventory.

For active and recently closed landfills, waste-in-place information came from MDE's annual Solid Waste Management and Diversion Reports. For older, closed landfills, waste-in-place data derived from EPA's Landfill Methane Outreach Program (LMOP) database for Maryland.

Waste-in-place data was not available for The Oaks landfill in Kent County (not to be confused with Oaks landfill in Montgomery) and the Vale Summit landfill in Allegany County. However, based on the age of the landfills, their closure year, and the amount of gas they continue to produce, it was assumed that both exceed the California waste-in-place threshold of 450,000 tons (and therefore necessarily exceed the Beyond California threshold of 150,000 tons). Because they also exceed the heat input capacity thresholds, both were added to the count of landfills that exceed the California and Beyond California thresholds. As indicated, these landfills are both closed.

Finally, the active Somerset County / Fairmount Road landfill was included in the count of landfills that exceed the California thresholds, despite the fact that the 2017 GHG Inventory shows that it has a waste-in-place tonnage below the 450,000-ton threshold. (The landfill does exceed the heat input capacity threshold in the California regulations. It also exceeds both the Beyond California waste-in-place and heat input capacity thresholds.) Somerset County's waste-in-place amount did exceed the California threshold in the 2014 GHG Inventory. It is not clear why this waste-in-place amount decreased by over 100,000 tons in the 2017 Inventory. In addition, even starting with the lower waste-in-place tonnage reported in the 2017 Inventory, Somerset County will exceed the California waste-in-place threshold by 2023 based on the average amount of waste deposited at the landfill annually for the last five years. Because this landfill was already included in the Beyond California threshold count, this only affects the California threshold count, increasing it by one.

The applicability estimates that relate to the federal regulations are based on the Title V permits for the 16 Maryland landfills that have one.

This analysis excludes three landfills that are identified in EPA's LMOP database for Maryland. These landfills may still produce gas but were not included in MDE's 2014 GHG Inventory or its 2017 GHG Inventory.

Attachment B

Report by Benjamin Kunstman, EIP Staff Engineer, On
Municipal Solid Waste Landfill Flaring Survey
And Appendices A-C

Report by Benjamin Kunstman, EIP Staff Engineer, On
Municipal Solid Waste Landfill Flaring Survey: Methods and Takeaways
October 9, 2020

I. Introduction

In preparation for Maryland Department of the Environment's (MDE) rulemaking for updating Maryland's municipal solid waste (MSW) landfill regulations, EIP reviewed other landfill regulations across the country, and identified California's 2010 "Methane Emissions from Municipal Solid Waste Landfills Regulation"[1] as an important precedent and guidepost for developing Maryland's regulations. California's Air Resources Board (CARB) established some of the most stringent controls and requirements for MSW landfills at the time, including an applicability threshold that applied to more of the state's landfills than federal regulations.

CARB establishes the applicability threshold on the basis that "the smallest commercially available flares are capable of processing approximately 133 standard cubic feet per minute of landfill gas (or 3.0 MMBtu/hr) without the use of supplemental fuel."[2] CARB cross-referenced the gas production rate against the state emissions inventory, and found that this generation rate corresponds to landfills with 450,000 tons of waste-in-place or greater and "represents a feasible lower limit for the installation of a gas collection and control system at a typical landfill."[3] However, since this regulation is over a decade old, EIP identified the applicability threshold as an opportunity to update to take into consideration improvements and advancements in modern flare technology. As EIP's Staff Engineer, I was tasked with conducting a survey of modern flare technology options available for methane control at MSW landfills.

II. Methodology

For my review of available flaring options, I identified a list of potential manufacturers using an industrial sourcing platform with options for potential suppliers.[4] From this list, I was able to further reduce the list given the inclusion of manufacturers of ancillary equipment for flares, such as pilot flares, valves, burners and monitoring equipment. I began with a primary review of available literature on each facility web page, and followed up with a secondary contact where possible, either through e-mail or by phone.

For each manufacturer, I applied the following search criteria to identify options capable of processing landfill gas without the use of supplemental fuel:

- Survey limited to enclosed flares, as the California regulation seeks to phase out the use of open flares for landfill gas by 2018.
- Identified flares must specifically be designed to be able to combust landfill gas.

During the initial review process, the only criteria was to identify flares that could meet the definition provided within the California threshold: that the enclosed flare was capable of operating without the use

[1] Regulation available at: https://ww2.arb.ca.gov/resources/documents/landfill-methane-regulation.
[2] California ARB. "Staff Report: Initial Statement of Reasons for the Proposed Regulation to Reduce Methane Emissions from Municipal Solid Waste Landfills." May 2009. (herein referenced as CARB ISOR). At V-1. Available at: https://ww3.arb.ca.gov/regact/2009/landfills09/isor.pdf
[3] Ibid at V-2.
[4] Thomas' industrial sourcing platform provided a list of 16 landfill gas flare manufacturers, available at: https://www.thomasnet.com/products/landfill-gas-flares-30292700-1.html#register.

of supplemental fuel. However, to further ensure the feasibility of a lower applicability threshold within the regulatory framework that EIP is recommending, I applied a further constraint limiting options to those capable of achieving the 99% destruction efficiency of methane at the rated capacity and throughout the turndown ratio range, matching the California regulation requirements.

III. Results

Throughout the flare survey process, I identified flaring control options below the applicability threshold of the California regulation, including options capable of operating **below 1 MMBtu/hr** for landfill gas. Each manufacturer contacted acknowledged that, in order to further refine the flare design, they require additional parameters to fully tailor the flare to the expected landfill gas composition and properties. However, the options identified below were able to provide general information and product specifications for a typical landfill gas waste stream, which was useful in our context of applying across multiple landfills in Maryland. Below are a summary of the options I identified for low-capacity treatment of landfill gas.

A. **AEREON (Cimarron)** Certified Ultra-low Emissions Burner (CEB®)

AEREON offers variable designs for the CEB units, including for different uses and specifications. One of the smaller options available for landfill application is the CEB 50, as seen in Appendix A hereto.[5] This enclosed combustor is capable of high destruction efficiencies, and can meet the required 99% destruction and removal efficiency (DRE) from the California regulations.

The rated thermal capacity for the CEB 50 is 1.7 MMBtu/hr, with a specified turndown ratio of 6:1 for typical landfill gas applications.[6] Applying this turndown ratio (the ratio between the rated capacity and the minimum operating capacity), the minimum thermal capacity for this unit would be **0.283 MMBtu/hr**. Using the same landfill gas heating value assumed in the California regulation,[7] this rate would be approximately equivalent to 12.5 scfm.

B. **AirScience** Enclosed Gas Flares (AST-EFF 300)

Airscience similarly offers multiple standard sizing options for their enclosed gas flares, which are offered for landfill gas applications. The AST-EFF 300 option is able to provide a low capacity for the maximum gas flow rate (300 Nm^3/h) at a turndown ratio of 5:1, as seen in Appendix B hereto. The minimum capacity of 60 Nm^3/h (at 0°C) equates to approximately 37.3 scfm, or **0.84 MMBtu/hr**. While the specific engineering parameters must be decided upon based on additional properties of the landfill gas, a secondary phone follow-up with AirScience confirmed that using temperature control, the AST-EFF 300 units are capable of meeting 99% DRE without the use of supplemental fuel.

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[5] AEREON product specification sheet available online at: http://www.aereon.com/sites/default/files/enclosed_combustion_systems%20-%20CEB%2050_Product%20Sheet%20FINAL.pdf.

[6] See Attachment A for product specification sheet. Though a turndown ratio of 10:1 is listed in the brochure, a phone call follow-up with an AEREON representative indicated that a turndown ratio of 6:1 is more typical for a CEB 50 operating on landfill gas.

[7] California's regulation equates 133 standard cubic feet per minute of landfill gas to 3.0 MMBtu/hr (CARB ISOR at V-2). This equivalence corresponds to a heating value of landfill gas of 375.94 Btu/scf, which has been applied to convert between volume and heat rate.

C. **Varec** 244E Enclosed Burner System

The Varec 244E series enclosed burner system is designed to burn biogas efficiently over a wide range of operating parameters. This design uses the introduction of combustion air to achieve high destruction efficiency of methane above the required 99%. Varec offers burner inlet sizes down to 3", and its design enables an "infinite turn down ratio," simply meaning that these enclosed flares can achieve landfill gas combustion without limiting the gas flow range, as seen in Appendix C hereto. As with the options above, the Varec 244E must be tailored to the specifics of the landfill gas and thus don't provide burner capacities with the manufacturer specification sheet, but the high-turn down allows for low flows of landfill gas while still being able to operate

Conclusions

By surveying commercially available enclosed flares on the market, I identified potential options for control of landfill gas down to smaller flow rates than the California regulations, and consequently smaller waste-in-place thresholds. These flares provide a reasonable basis to update the applicability threshold from the California regulation to reflect current options commercially available. Additionally, if the 99% control of methane constraint, which is a feature of California's regulations but not the U.S. EPA's, is not used, there are additional options available capable of combusting landfill gas without the use of supplemental fuel. Flare vendors also emphasized that additional parameters, such as heating value of the gas and combustion temperature, play a crucial role in the destruction efficiency and ability to combust small landfill gas volumes, and should be considered when evaluating control options on a site-by-site basis.

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Appendix A to Flare Survey Report

CEB® 50

Photos of CEB® 50 unit at landfill

Description

AEREON's Certified Ultra-low Emissions Burner (CEB®) technology is a device unlike any other in the market. The CEB® utilizes a proprietary premixed surface combustion technology to burn VOC-laden waste gases.

The primary advantages of the CEB® products versus conventional flares or open flares are ultra-low emissions and very high VOC destruction efficiencies (99.99%). This coupled with the compact footprint and no smoke, soot, or visible flame; make it a very attractive solution for vapor combustion requirements.

The compact footprint, simple installation, easy maintenance and very low life cycle/operational costs make the CEB® suitable for every type of application from continuous and discontinuous operation to emergency backup of other equipment.

Advantages

Keep the environment clean when combusting your waste gases

- No luminous flame
- No odor
- No heat radiation
- No smoke
- Low height
- Small footprint
- Heat recovery available

CEB® 50

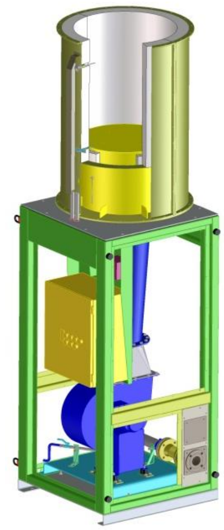
Specifications

Capacity*	38,100 SCFD or 38 MSCFD (1080 Nm3/day)
Maximum thermal capacity*	1.7 MMBTU/hr. (0.50 MWth)
Turndown ratio**	10:1
Footprint and height***	4’6” x 4’6” x 13’ (137 x 137 x 396 cm)
Approximate weight	2,100 lbs. (952 kg)
Waste gas supply pressure	10 – 80” WC (25 – 200 mbar(g))
Fan motor size	1.5 hp (1.1 kWe)
Waste gas connection	2” ANSI 150 lbs. RF
Support gas connection	1” ANSI 150 lbs. RF
Ignition System	Spark or pilot ignition
Operating temperature	1,800 to 2,200°F (982 – 1204 °C)
Ground temperature	Ambient during operation

*Capacity is based on natural gas with gross heating value of 1,069 BTU/scf (39.8 MJ/Nm3)

** Turndown ratio can be increased for specific projects with customized units

*** Stack height is based on minimum height that meets EPA’s protocol for position of the testing ports



Principal Applications

Petrochemical and chemical industries

- Vent gas flare
- Reactor, dryers and other process vents
- Tank loading
- Tank or pipeline degassing

Biogas and Synthetic Gas applications

- Pipeline Purification
- Siloxane Removal Systems
- Low caloric value biogas streams

Onshore upstream and midstream oil and gas

Design Features

Achievable emissions levels at 3% Oxygen*:

- NOx ≤ 15 ppmv; ≤ 0.018 lbs/MMBTU (31.7 Mg/Nm^3)
- CO ≤ 10 ppmv; ≤ 0.01 lbs/MMBTU (12.5 Mg/Nm^3)
- CxHy ≤ 10 ppmv; ≤ 0.005 lbs/MMBTU (7.06 Mg/Nm^3)

Combustion efficiency:

- Up to 99.99% DRE over full operating range.

*Emissions based on reference gas methane.

Appendix B to Flare Survey Report

Enclosed Flame Gas Flare

Process Gas Applications

AirScience
An ASL Company

Biogas Purification and Biogas Flares
That's Our Business

Enclosed Gas Flares for Continuous or Emergency Conditions

Landfill gas applications

For landfill gas applications enclosed flame flare have been required for years for the destruction of landfill gas. As more and more landfill gas is valorized through the production of electricity or the production of renewable natural gas (RNG), enclosed flame flares are used for emergency conditions and for excess gas situation.

Anaerobic Digester (AD) biogas applications

For AD biogas applications enclosed flame flares are used to burn excess biogas from the process as well as to burn the full biogas production while the downstream biogas valorization system is stopped for maintenance or emergency conditions.

Process gas applications

Several processes produce combustible gases which for some reason need to be flared from time to time. This could be the case with off-spec gas during process start-up especially in the case of batch type processes. In these applications enclosed flame flares shall be used as they permit the analysis of the gas of combustion to confirm the respect of the air emission regulations.

Simple Process, High Efficiency

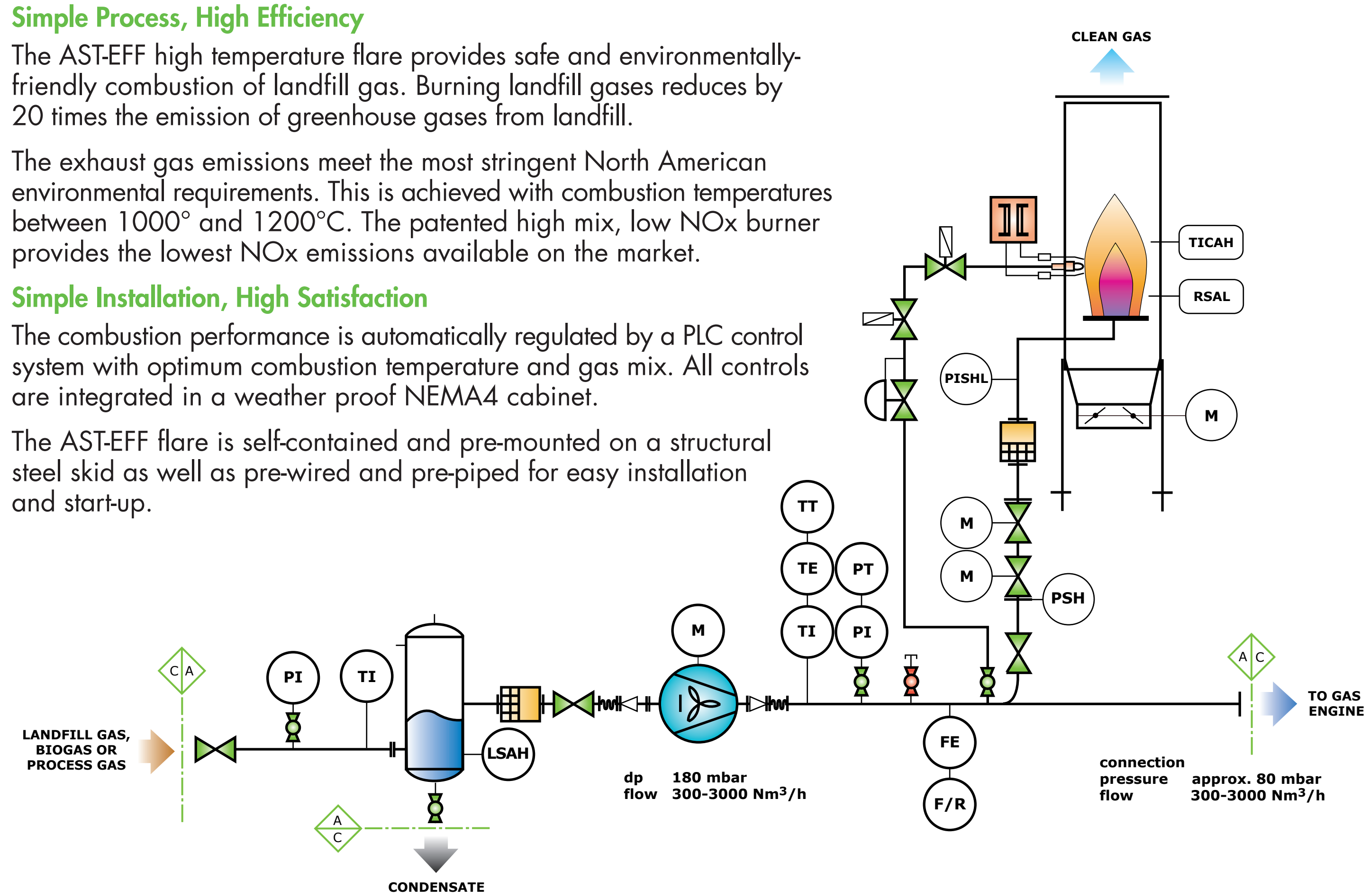
The AST-EFF high temperature flare provides safe and environmentally-friendly combustion of landfill gas. Burning landfill gases reduces by 20 times the emission of greenhouse gases from landfill.

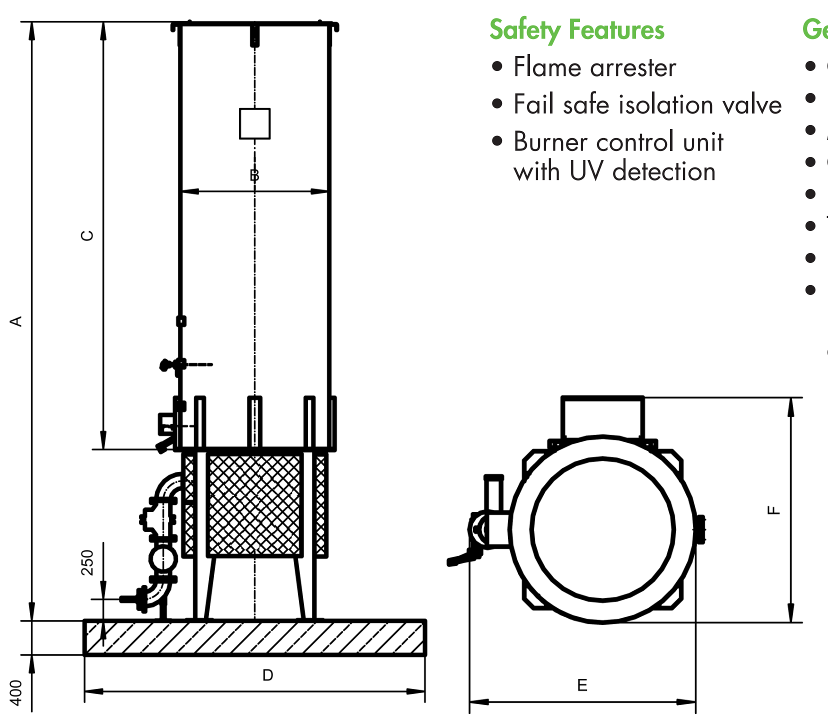
The exhaust gas emissions meet the most stringent North American environmental requirements. This is achieved with combustion temperatures between 1000° and 1200°C. The patented high mix, low NOx burner provides the lowest NOx emissions available on the market.

Simple Installation, High Satisfaction

The combustion performance is automatically regulated by a PLC control system with optimum combustion temperature and gas mix. All controls are integrated in a weather proof NEMA4 cabinet.

The AST-EFF flare is self-contained and pre-mounted on a structural steel skid as well as pre-wired and pre-piped for easy installation and start-up.





Safety Features

- Flame arrester
- Fail safe isolation valve
- Burner control unit with UV detection

General Specifications

- Gas flow rate : 300 - 3,000 Nm³/h
- Burner capacity up to : 15,000 kW
- Methane concentration : 30 - 50 vol. %
- Combustion temperature : 1000 - 1200 °C
- Residence time : > 0.3 s
- Turn down ratio : 1 : 5
- Initial gas pressure : 80 - 100 mbar
- Expected sound pressure level at full load (at 15m distance and 2m height) : < 69 dB(A)

Options

- Frost protection
- Extended turn down ratio up to 1 : 10

More options are available on request

Specifications for Standard Units

	Gas Flow Rate (maximum)	Burner Capacity (maximum)	Flange Connection	Initial Gas Pressure at Full Load (minimum)	Dimension A	Dimension B	Dimension C	Dimension D	Dimension E	Dimension F	Weight (approximate)
AST-EFF 300	300	1,500	80	80	6,500	Ø 960	4,500	3,000	1,350	1,420	1,050
AST-EFF 600	600	3,000	100	80	6,500	Ø 1,280	4,500	3,000	1,690	1,700	1,460
AST-EFF 800	800	4,000	125	80	6,500	Ø 1,440	4,500	4,000	1,900	1,810	1,600
AST-EFF 1000	1,000	5,000	150	80	7,000	Ø 1,590	5,000	4,000	2,170	2,130	1,800
AST-EFF 1500	1,500	7,500	150	100	7,000	Ø 1,760	5,000	4,000	2,290	2,300	2,300
AST-EFF 2000	2,000	10,000	200	100	7,700	Ø 1,920	5,500	4,000	3,210	2,440	2,500
AST-EFF 2500	2,500	12,500	200	100	8,200	Ø 2,070	6,000	4,000	3,330	2,600	2,900
AST-EFF 3000	3,000	15,000	200	100	8,200	Ø 2,240	6,000	4,000	3,470	2,770	3,850

Lifetime Service Contract

AirScience is one of the few North American companies providing its customers with a lifetime service contract. For a low nominal fee, we will inspect your AST-EFF system at pre-established regular intervals. Our experienced field specialists will control the key operating parameters of your AST-EFF system and will optimize its performance by making the necessary adjustments.

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Biogas Purification and Biogas Flares
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Appendix C to Flare Survey Report

Varec BIOGAS™

An Ovivo Company

VAREC BIOGAS 244E Series (US PATENT# 6,012,917 and 6,146,131)
ENCLOSED BURNER AND AUTOMATIC PILOT IGNITION SYSTEM

The Varec Biogas 244E Series Enclosed Burner Systems are designed to burn biogas with guaranteed destruction removal efficiency (>99%) over a wide range of operating parameters.

Introduction

The Varec Biogas 244E Enclosed Burner Systems are designed to burn biogas efficiently and safely over a wide range of operating parameters. With no visible flame, the 244E systems use an innovative stack design to naturally induce the proper amount of combustion air which guarantees high destruction removal efficiency.

The design of the 244E allows for complete combustion of the digester gas or landfill gas. The unique stack design takes advantage of the natural draft properties of the combustion process to draw in the correct amount of air necessary to provide complete combustion. This is all done without the need for motorized dampers and complicated control systems. Independent tests have shown Destruction Removal Efficiencies (DRE) in excess of 99% and low NOx and CO emissions.

The 244E enclosed burner system is not a time and temperature based flare. Its design is constructed to allow combustion air to be naturally inspirated and obtain the proper air-gas mixture, thus achieving the optimum operating temperature necessary for complete combustion to occur. The 244E's innovative combustion stack design eliminates the need for refractory lining and insulation to protect the chamber of high temperatures since cooling air is naturally induced in the stack section openings. This also eliminates the need for heat shields and structures.

The 244E Enclosed Burner System is cost effective and its design makes for easy and reliable operation and maintenance.

Operation

Biogas is introduced via venturi nozzle burners to the combustion chamber zones. Gas is introduced into the main burner zone, and secondary burner zones are opened when the gas flow rate and pressure increases.

Air is naturally introduced from the stack base and the gaps between each stack section. The design allows for a natural introduction of air into the combustion process. The required amount of air is induced with the increase in heat release rate resulting in higher combustion efficiency. The heat generated in the combustion process draws in air that allows natural cooling of the chamber to take effect.

Design Features

- No visible flame
- Infinite turn down ratio - The design allows biogas combustion without limiting the gas flow range
- No motorized or manual dampers required to bring in combustion air
- Destruction Removal Efficiencies (DRE) in excess of 99% for low NOx and CO emissions
- No refractory lining or insulation required.
- Smaller footprint
- Utilizes the same efficient and reliable 244W flame front technology or pilot ignition
- UL Certified NEMA 4, 4X, and 7 panel

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Specifications

The 244E utilizes the same state-of-the art, pilot ignition system as the 244W. Pilot gas and air are mixed and ignited at ground level, remote from the combustion stack assembly. This controlled method results in a stable pilot flame with an ideal gas-to-air ratio. It is not affected by changes in the biogas flow rate or BTU content.

The unit includes an electronics package that controls pilot gas supply, ignition and monitoring. During the ignition cycle, pilot gas is diverted through the dual pilot lines.

One line is referred to as the Continuous Flame line and another smaller pilot line is referred to as the flame or ignition retention line. Air is inspirated through venturi(s) installed in either one or both pilot lines. This stoichiometric air/ gas mixture is ignited remotely from the combustion stack and generates a flame front that travels to the pilot nozzle tip. The secondary pilot fuel line assists in ensuring that the flame front is not purged, and a pilot flame is established.

The pilot flame continuously burns to ensure efficient combustion of the biogas. Pilot gas only continuously flows through the continuous line when there is a demand to combust biogas. Otherwise, the controls will permit burner operation in a standby mode. No pilot gas is consumed when there is no demand to combust biogas. The ignition system provides for automatic re-ignition in case the pilot is lost. If unsuccessful, an alarm is activated signaling PILOT FLAME FAILURE.

Burner Inlet Sizes

3”, 4”, 6”, 8”, 10”, and 12”

Burner Capacity

Please consult the factory for proper sizing of the 244E. Specify maximum waste gas flow rate, gas composition, inlet gas pressure and specific gravity.

“S” Pilot Ignition System

HIGH PRESSURE PILOT GAS
Natural Gas or Propane

Min. Supply Pressure: 10 PSIG (70 kPa)
Max. Supply Pressure: 50 PSIG (450 kPa)

Recommended Pipe Length from Venturi to Continuous Flame Nozzle:
Min. Distance: 15 feet (5m)
Max. Distance: 100 feet (30m)

LOW PRESSURE PILOT GAS
When available pilot gas pressure is less than 10 PSIG (70 kPa) and greater than 10”WC (100mmWC).

Pilot Fuel Supply - ½” NPT
NOTE: Pilot gas piping supplied by others

BLOWER PACKAGE
Specify when piping layout dictates that the control panel cannot be installed 10 feet horizontal distance from the stack.

Natural Gas or Propane
Min. Supply Pressure: 8” WC (200mmWC)

General Purpose Motor: Standard

Explosion Proof Motor: Optional

Recommended Pipe Length from blower package to continuous flame nozzle:
Max. Distance: 33 feet (10m)

Control System

The control panel is provided with a programmable logic controller (PLC) as a standard. A NEMA 4/ 4X control panel comes standard with a HMI touchscreen panel. Relay logic panels are available upon request.

“L” Pilot Ignition System

BIOGAS PILOT IGNITION SYSTEM
Dry Biogas Pilot of 500 BTU/ ft^3 minimum

Biogas, Natural Gas or Propane

Supply Pressure: 10” WC (100mmWC Min.)
If supply pressure is >1 PSIG (Max 5 PSIG), specify pressure regulator

Pilot Fuel Supply - ½” NPT
NOTE: Pilot gas piping supplied by others

Recommended Pipe Length from Venturis to continuous flame nozzle:
Max. Distance: 70 feet (21m)

45° bend allowed on pilot gas piping

Combusted Gas

Biogas - Primarily methane of low BTU content.

Minimum Inlet Pressure

4” WC (100mm H_2O) at flare inlet manifold.

“G” Pilot Ignition System

BIOGAS PILOT IGNITION SYSTEM
Dry Biogas Pilot of 500 BTU/ ft^3 minimum
Biogas or Natural Gas Supply Pressure

Supply Pressure: 10” WC Minimum

Pilot Fuel Supply - 2” NPT
NOTE: Pilot gas piping supplied by others

Recommended Pipe Length from Venturis to Waste Gas Burner (Biogas Pilot Ignition System):

Max. Distance: 10 feet (3m) horizontal distance to the stack

Only one 90° bend allowed on pilot gas piping, Max.

Materials

COMBUSTION STACK ASSEMBLY
304 SS

STACK BURNER BASE & PEDESTAL AND INLET MANIFOLD
Carbon Steel with a 3 - 4mil P-Series TGIC Polyester topcoat powder coating for corrosion resistance

All 304 or 316 SS (Option)

The stack base, pedestal and venturi burner manifold can be provided with insulation blanket (Optional)

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Materials (Cont'd)

COMBUSTION STACK PILOT GAS PIPING
The pilot gas piping provided with the combustion stack assembly is supplied in 316 SS.

PILOT GAS NOZZLES
Continuous Pilot Flame Nozzle: 316 SS
Flame Retention (S & L Ignition System): 316 SS
Ignition (G Ignition System): 316 SS

VENTURI NOZZLE BURNERS
347 SS

UV FLAME VERIFICATION
A UV Scanner can be added as back up to the thermocouple to signal a presence of a pilot

THERMOCOUPLE ASSEMBLY
Type K with inconel sheath and inconel thermowell

A secondary thermocouple can be installed at the combustion stack assembly and temperature recorder exit to monitor stack exit temperature (Optional)

STACK PILOT GAS CONNECTION
"S" and "L" Ignition System
Continuous Pilot Nozzle - 2" NPT
Flame Retention Nozzle - ½" NPT

"G" Pilot Ignition System
Continuous Pilot Nozzle - 2" NPT
Ignition Line - 1" NPT

CONNECTIONS COMBUSTION STACK ASSEMBLY
The combustion stack assembly mounts on the burner base and is self supporting. Lugs are provided on the stack for attachment of guy wires where necessary for additional support.

Waste biogas standard connection is an ANSI 150 RF Flange. ANSI 150# FF or DIN Flanges available upon request.
The assembly Includes:
Main combustion stack, Burner manifold, Continuous pilot nozzle, thermocouple, and flame or ignition retention nozzle.

Available Options

REMOTE START/STOP SIGNAL INPUT
Option provided when remote automatic pilot ignition is required.
Contact connections are provided for available plant signal.
N.O. Dry Contact Closure (Standard)
120 VAC or 240 VAC input signal (Optional)

REMOTE START TIME DELAY RELAY
Included when remote start option is supplied.

Factory Set: Setting Mode D, Unit Mins

Range: 0-30, factory set 4 minutes

Function: Prevents system from frequent "ON"/"OFF" cycles (nuisance switching) during pressure fluctuations at remote pressure switch.

REMOTE START PRESSURE SWITCH
Option provided when remote automatic pilot ignition is specified and a method of starting and shut- ting the burner is required through main gas line pressure.

Range: 4" - 30" (100mm - 750mm) WC

Pressure Connection: 1/4" NPT

Switch Rating: 15 amps @125VAC

Enclosure: NEMA 7, Explosion proof,
Class1, Div. 1, Groups C & D

Deadband: 1.1" (28 mm) W.C.

Conduit Connection: 3/4" NPT

Temperature Range: -80° to +180°F
(-62°C to +82°C)

Approvals: UL Recognized, CSA Certified

CONTROL PANEL ENCLOSURE HEATER
This is recommended for outdoor panel installations that have cold weather conditions.

Rating: 125 watts, 120VAC or 240VAC

REMOTE SPARK GENERATOR
The hi-tension lead wire supplied with the unit is a maximum 10 feet (3m) in length. In cases where the control panel that houses the transformer cannot be located within 10 feet (3m) of the spark plug location, a remote generator can be specified. The transformer is supplied in either a NEMA 4, 4X or 4 & 7 enclosure and located within 10 feet (3m) of the spark plug. This allows an operator to have the control panel installed further away from the burner for improved burner monitoring.

Electrical

ENCLOSURE
NEMA 4, Weatherproof (Standard)
NEMA 4X, Corrosion Resistant
316 Stainless Steel (Optional)
NEMA 7, Explosion Proof, Aluminum (Optional)

POWER CONSUMPTION
10 amps @ 120VAC or
5 amps @ 240VAC (50/60 Hz)

AMBIENT TEMPERATURE RATING
-40°F to +131°F (-40°C to +55°C)

OPERATING MODES
"MANUAL", "AUTOMATIC", "STAND-BY"

FLAME MONITORING
Thermocouple with individual set point adjustments, pilot lights and alarm relay.

REMOTE ALARM CONTACTS
One set SPDT dry contacts for pilot on/off status
One set SPDT dry contacts for pilot flame failure

Contact rating: Max 2 amps @ 120VAC OR 240VAC (50/60Hz)

PILOT ON/OFF ALARM RESPONSE
Immediate upon cooling of thermocouple below set point.

FLASHBACK PROTECTION
It is recommended that suitable flame flashback protection be installed in fuel gas lines supplying any of the 244E Burner systems. Please refer to 5200 Series Product data sheet for information.

ZONE CONTROL
The flare is provided with zones that open based on increased gas flow rate. Motorized ball valves can be provided to allow control of the burner zones either by the Plant DCS, SCADA, or via the local burner control panel.

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Ordering Information

Model — **Description**
244E — Waste Gas Burner & Ignition System, Enclosed with No Visible Flame

Code	Configuration (Select One)
S	Standard
G	Low Pressure Pilot Ignition System (Minimum 10" WC Supply Pressure) [1]
L	Low Pressure Pilot Ignition System (Minimum 10" WC Supply Pressure) [1]

Code	Size (Based on Maximum Flow Capacities)
	SCFH / **m³/hr**
B	PLEASE CONSULT FACTORY FOR SIZING
C	
D	
E	
F	
G	

Code	Power Requirements (Must Select One)
1	115/ 120 VAC, 60 Hz (Standard)
2	220/ 240 VAC, 60 Hz
3	220/ 240 VAC, 50 Hz

Code	Electronic Enclosure Rating (Must Select One)
4	NEMA 4, Weather-Proof (Standard)
7	NEMA 7, Explosion-Proof (Optional)
9	NEMA 4X, Stainless Steel (Optional)

Code	Remote-Start Option (Must Select One)
0	None - Local Start
1	Auto Start - Pressure Switch Included
2	Auto Start - Dry Contacts Only
3	Auto Start - NEMA 7 Pressure Transmitter Included

Code	Pilot Solenoid (Used Only with Auto-Start Option) (Must Select One)
0	No Auto Start Option Required
1	Pilot Solenoid Shall Fail Open (Not Avail. w/ Blower)
2	Pilot Solenoid Shall Fail Closed

Code	Blower Package Option (Only w/ 244WS) Indicate When Specified:
0	Standard Venturi-Driven System (Pilot Gas 10PSIG or Greater) or "G" & "L" Pilot Ignition System
1	Blower-Driven System [2]

Code	Options (May Select More Than One)
0	None required (Standard)
1	Heater and Thermostat Mounted within Electronic Enclosure Panel
2	Remote Spark Generator NEMA 4
3	Remote Spark Generator NEMA 7
4	Low Pressure Natural Gas for Pilot Gas (244WG & 244WL)
5	Propane/ LPG for Pilot Gas (244WS or 244WL Option)
7	Mounting Stand & Weatherhood (316L Weatherhood and Mounting Plate with 304L Stands) [3]
9	Auxiliary Weatherhood and Mounting Stand (316L Weatherhood and Mounting Plate with 304L Stands) [4]
R	Relay for use with Model 386/ 440 [5]
A	Anchor Bolt Calculations
C	CSA Approval (Min. Stack Height, FF Flange, CSA Inspection)
W	Left Exit Panel (Right Exit - Standard)
P	Step Down Pilot Gas Pressure Regulator Max 10 PSIG Regulated to 12" WC [6]
H	Insulating Blanket on Burner Base and Manifold with Heat Trace
S	Combustion Temperature Thermocouple
U	UV Flame Verification
X	Relay Logic Control Panel
Y	Special PLC and HMI Requirement - Must Specify Brand Required
Z	Zone Control Motorized Ball Valves

Code	Material of Construction (Combustion Chamber, Base, Pedestal & Manifold)
*	Leave Blank When Specifying Standard of 304SS Combustion Chamber, Powder-Coated Carbon Steel Bas, Pedestal & Manifold
S4	All 304 SS
S6	All 316 SS

NOTE:
1 - 1-5 PSIG supply pressure, include Code P for Pressure Regulator
2 - Comes standard with Explosion Proof Motor and Switch.
3 - Available option with the 244EG and 244EL.
4 - Option can be used for 244ES/ EG/ EL Systems.
5 - Include when specifying a 3-Way Solenoid Valve with the Model 386/ 440.
6 - Always include when specifying an "L" ignition system.

Consult factory or your authorized sales representative for ordering information.

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