HEINONLINE

Citation: 56 Fed. Reg. 24468 1991

Content downloaded/printed from
HeinOnline (http://heinonline.org)
Fri Sep 14 14:58:21 2012

-- Your use of this HeinOnline PDF indicates your acceptance
of HeinOnline's Terms and Conditions of the license
agreement available at http://heinonline.org/HOL/License

-- The search text of this PDF is generated from
uncorrected OCR text.

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 51, 52 and 60

[AD-FRL-3780-9]

RIN 2060-AC42

Standards of Performance for New Stationary Sources and Guidelines for Control of Existing Sources: Municipal Solid Waste Landfills

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule and guideline and notice of public hearing.

SUMMARY: This proposal would add subpart WWW to 40 CFR part 60 for control of new sources and would propose emission guidelines and compliance schedules for existing sources under subpart C.

Subpart WWW would limit emissions from certain new and modified municipal solid waste (MSW) landfills. The proposed standards implement section 111(b) of the Clean Air Act (CAA) and are based on the Administrator's determination that emissions from MSW landfills cause, or contribute significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare. The intent of the proposed standards is to require certain new MSW landfills to control emissions to the level achievable by applying the best demonstrated system of continuous emission reduction considering costs, nonair quality health and environmental impacts, and energy requirements.

The proposed emission guidelines implement Section 111(d) of the CAA which requires the Administrator to prescribe regulations under which the States will submit plans for the control of existing emissions of certain air pollutants for which new source performance standards (NSPS) have been established. The intent of the emission guidelines is to initiate State action to develop State regulations controlling air emissions from certain existing MSW landfills to the level achievable by applying the best demonstrated system of continuous emission reduction, considering costs, nonair quality health and environmental impacts, and energy requirements.

If requested, a public hearing will be held to provide interested parties an opportunity for oral presentations of data, views, or arguments concerning the proposed standards and emission guidelines.

DATES: *Comments.* Comments must be received on or before August 1, 1991.

Public Hearing. If anyone contacts EPA requesting to speak at a public hearing by June 21, 1991, a public hearing will be held on July 2, 1991, beginning at 10:00 a.m. Persons wishing to present oral testimony must contact Ms. Julia Stevens of EPA at (919) 541-5578 by June 21, 1991. Persons interested in attending the hearing should call Ms. Stevens at the same number to verify that a hearing will be held.

ADDRESSES: *Comments.* Comments should be submitted (in duplicate if possible) to: Air Docket (LE-131), Attention Docket No. A-88-09, Room M1500, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460.

Public Hearing. If anyone contacts EPA requesting a public hearing, it will be held at the EPA's Office of Administration Auditorium, Research Triangle Park, North Carolina. Persons interested in attending the hearing or wishing to present oral testimony should notify Ms. Julia Stevens, Standards Development Branch, Emission Standards Division (MD-13), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number (919) 541-5578.

Background Information Document. The background information document (BID), entitled "Air Emissions from Municipal Solid Waste Landfills—Background Information for Proposed Standards and Emission Guidelines," may be obtained from the U.S. EPA Library (MD-35), Research Triangle Park, North Carolina 27711, telephone number (919) 541-2777. Refer to EPA-450/3-90-011(a). The discussion of the proposed section 111(d) emission guidelines in this BID satisfies the requirements of 40 CFR 60.22(b) that information be provided to States on the implementation of the guidelines. Throughout the preamble, this document will be referred to as the BID.

A regulatory impact analysis, entitled "Regulatory Impact Analysis of Air Pollutant Emission Standards and Guidelines for Municipal Solid Waste Landfills" was prepared as required by Executive Order (E.O.) 12291, and is available for review at the EPA's Air Docket Section, 401 M St. SW., Room M1500, Washington, DC.

Docket. Docket No. A-88-09, containing supporting information used in developing the proposed standards and guidelines, is available for public inspection and copying between 8:00 a.m. and 3:30 p.m., Monday through Friday, at the EPA's Air Docket, Waterside Mall, Room M1500, 1st Floor, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: For information on the regulation of MSW landfills, contact Ms. Alice H. Chow, Standards Development Branch, Emission Standards Division (MD-13), Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number (919) 541-5626.

For technical information, contact Mr. Mark Najarian, telephone number (919) 541-5393, Chemicals and Petroleum Branch, Emission Standards Division (MD-13), at the above address.

SUPPLEMENTARY INFORMATION: The following outline is provided to aid in reading the preamble to the proposed standards and emission guidelines.

I. Introduction
- A. Summary of Action
- B. New Source Performance Standards—General Goals
- C. Emission Guidelines—General Goals
- D. Overview of This Preamble

II. Summary of the Proposed Standards and Guidelines
- A. Source Category to be Regulated
- B. Pollutant to be Regulated
- C. Best Demonstrated Technology
- D. Format for the Standards and Guidelines
- E. Proposed Standards and Guidelines
- F. Performance Testing and Monitoring
- G. Reporting and Recordkeeping Requirements
- H. Compliance Times for the Guidelines

III. Impacts of the Proposed Standards and Guidelines
- A. Air
- B. Other Environmental Impacts
- C. Control Costs and Economic Impacts

IV. Rationale for the Standards and Guidelines for Municipal Solid Waste Landfill Emissions
- A. Background
- B. Selection of the Source Category
- C. Selection of the Designated Pollutant
- D. Selection of the Affected and Designated Facilities
- E. Selection of Best Demonstrated Technology
- F. Selection of Requirements to Implement The Best Demonstrated Technology
- G. Test Methods and Procedures
- H. Reporting and Recordkeeping Requirements—New Municipal Solid Waste Landfills
- I. Reporting and Recordkeeping Guidelines—Existing Municipal Solid Waste Landfills
- J. Compliance Times
- K. Additional Considerations and Solicitation of Comments

V. Considerations for Prevention of Significant Deterioration

VI. Administrative Requirements
- A. Public Hearing
- B. Docket
- C. Clean Air Act Procedural Requirements

D. Office of Management and Budget Review

I. Introduction

A. Summary of Action

This notice proposes standards of performance for new MSW landfills under section 111(b) of the CAA and emission guidelines for existing MSW landfills under section 111(d). The standards and guidelines would require MSW landfills emitting greater than 150 megagrams per year (Mg/yr) (about 167 tons per year (tpy)) of nonmethane organic compounds (NMOC's) to design and install gas collection systems and then combust (with or without energy recovery) the captured landfill gases. This action addresses air emissions from MSW landfills which contribute to ambient ozone problems, air toxic concerns, and potential explosion hazards. The EPA has developed an overall agenda (see "The Solid Waste Dilemma: An Agenda for Action"; EPA/530-SW-89-019; February 1989) to address MSW disposal issues, and today's air emission standards and guidelines are just one component of this agenda. This rule will also have the ancillary benefit of reducing global loadings of methane, a gas under discussion by the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change convened by the United Nations.

B. New Source Performance Standards—General Goals

New source performance standards (NSPS or "standards") implement section 111(b) of the CAA, and are issued for categories of sources which cause, or contribute significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare. Today's standards would affect MSW landfills whose construction, modification, or reconstruction begins after a standard is proposed. An NSPS requires these sources to control emissions to the level achievable by "best demonstrated technology" (BDT) considering costs and any nonair quality health and environmental impacts and energy requirements. If it is not feasible to prescribe or enforce an emission limit, the CAA authorizes the Administrator to promulgate a design, equipment, or work practice or operational standard, or combination thereof.

C. Emission Guidelines—General Goals

The EPA develops emission guidelines under section 111(d) of the CAA for certain sources covered by NSPS. When an NSPS has been promulgated under section 111(b) for a category of sources, section 111(d) of the CAA requires that States submit plans which establish emission standards for existing sources and provide for implementation and enforcement of emission standards for the designated pollutant. In general, a designated pollutant is one that may cause or contribute to endangerment of public health or welfare but is not "hazardous" within the meaning of section 112 of the CAA and is not controlled under sections 108 through 110 of the CAA. For ease of discussion, existing facilities which emit designated pollutants are considered to be "designated facilities."

The EPA requires that States adopt and submit to the Administrator a plan implementing the section 111(d) guidelines within 9 months after the promulgation of the guidelines. The CAA further requires that the procedure for State submission of a plan shall be similar to the procedure for submission of State implementation plans (SIP's) under section 110 and mandates that EPA shall prescribe a plan according to procedures similar to those in section 110(c) if the State fails to submit a "satisfactory plan."

Section 111(d) requires EPA to approve State emission standards only if they reflect application of the best systems of emission reduction that are reasonably available for designated facilities. Accordingly, EPA has published a BID (Docket No. A-88-09, Item No. III-B-1) for the guidelines which describes available systems of emission control, identifies the best demonstrated systems considering costs, nonair quality health and environmental impacts, and energy requirements, and identifies the emission limitations that reflect the application of such systems. State plans will be approved if they include an emission standard equal to or more stringent than that specified in the guidelines. For health-related pollutants, as is the case for MSW landfill emissions, State emission standards must ordinarily be at least as stringent as the corresponding EPA guidelines to be approved (§ 60.24(c)).

The EPA recognizes, however, that a State may find application of today's proposed guidelines to be unreasonable in some situations and appropriate adjustments may be necessary on a case-by-case basis. The guidelines reflect the EPA's judgment of the degree of control that can be attained by various classes of sources taking into consideration the cost of achieving such emission reductions, nonair quality health and environmental impacts and energy requirements

The development of the emission guidelines are carried out in the context of a nationwide program encompassing an entire class of sources without consideration of the local air quality conditions that must be considered in nonattainment areas or in prevention of significant deterioration (PSD) in accordance with permitting activities associated with the CAA. In some cases, State standards may be more stringent than these guidelines in order to address concerns which are specific to a particular localized air quality situation. Moreover, States that believe additional control is necessary or desirable would be free to do so under Section 116 of the CAA.

D. Overview of This Preamble

This preamble will:

1. Summarize the important features of these proposed standards and guidelines by discussing the conclusions reached with respect to each of the elements in the decision summary.
2. Describe the environmental, energy, and economic impacts of the standards and guidelines.
3. Present a rationale for each of the decisions in the decision summaries for the standards and guidelines.
4. Discuss administrative requirements relevant to these actions.

II. Summary of the Proposed Standards and Guidelines

A. Source Category To Be Regulated

Today's proposed standards and guidelines would apply to certain new and existing MSW landfills. For purposes of these proposed regulations, an MSW landfill is defined as an entire disposal facility in a contiguous geographical space where household waste is placed on or in land. An MSW landfill may receive other types of waste as well.

The proposed NSPS would control air emissions from certain new MSW landfills. A new MSW landfill is defined as a landfill for which construction, modification, or reconstruction commences on or after today's date. The affected facility under the proposed NSPS is each new MSW landfill.

The proposed guidelines would require control for certain existing MSW landfills. An existing MSW landfill is defined as a landfill for which construction commenced prior to today's date. An existing MSW landfill may be active, i.e., currently accepting waste, or having additional capacity available to accept waste, or may be closed, i.e., no longer accepting waste nor having available capacity for future waste

deposition. The designated facility under the proposed guidelines is each existing MSW landfill that has accepted waste since November 8, 1987, or that has capacity available for future use.

B. Pollutant To Be Regulated

The pollutant to be regulated under the proposed standards and guidelines is "MSW landfill emissions." Municipal solid waste landfill emissions, also commonly referred to as "landfill gas," is a collection of air pollutants, including methane and NMOC's, some of which are toxic. The composite pollutant is proposed to be regulated under section 111(b), for new facilities, and is proposed to be the designated pollutant under section 111(d), for existing facilities. In order to reduce the burden and complexity of measuring and monitoring the various constituents of landfill gas, NMOC's are being specified as a surrogate for measurement purposes.

C. Best Demonstrated Technology

The proposed standards for new MSW landfills are based on the conclusion that BDT would require reducing MSW landfill emissions from new MSW landfills emitting 150 Mg/yr (167 tpy) of NMOC's or more with: (1) A well-designed and well-operated gas collection system and (2) a control device capable of reducing NMOC's in the collected gas by 98 weight-percent. The BDT does not specify collection and control systems for new landfills emitting less than 150 Mg/yr (167 tpy) of NMOC's.

The proposed guidelines for existing MSW landfills are based on the conclusion that BDT would require reducing air emissions of existing MSW landfills emitting 150 Mg/yr (167 tpy) of NMOC's or more with the same collection and control devices as required for new landfills. The BDT does not include collection and control systems for existing landfills emitting less than 150 Mg/yr (167 tpy) of NMOC's.

A well-designed and well-operated collection system would, at a minimum: (1) Be capable of handling the maximum gas generation rate, (2) have a design capable of monitoring and adjusting the operation of the system, (3) be able to collect gas effectively from all areas of the landfill that warrant control, and (4) be able to expand by the addition of further collection system components to collect gas from new areas of the landfill as they require control.

The control device included as part of BDT is an open flare capable of reducing NMOC emissions by 98 weight-percent. Open flares are applicable to all affected and designated facilities regulated by the proposed standards and emissions guidelines, respectively.

D. Format for the Standards and Guidelines

The format for the proposed standards and guidelines is a design and operational standard (or guideline) for the gas collection system, and a percent reduction requirement for the control device.

E. Proposed Standards and Guidelines

The major provisions of the proposed standards and guidelines are identical. The proposed standards and guidelines for MSW landfill emissions would require the periodic calculation of the annual NMOC emission rate at each affected or designated facility with a maximum design capacity or 100,000 Mg (111,000 tons) or more. At each facility where the calcualted emission rate is equal to or exceeds the regulatory cutoff of 150 Mg/yr (167 tpy) of NMOC's, the proposed standards and guidelines specify the installation of a well-designed gas collection system and one of several effective control devices to either recover or destroy the collected landfill emissions.

The proposed standards and guidelines are based on the use of active collection systems and open flares operated in accordance with the General Provisions for control devices (40 CFR 60.18). The EPA has also identified several other control devices which may be used to satisfy the 98-percent destruction criterion. The proposed standards and guidelines would allow the use of these control devices as well.

F. Performance Testing and Monitoring

Applicability. All affected and designated facilities would periodically calculate the NMOC emission rate in order to determine if the installation of collection and control systems would be required. The calculation is performed using default values provided in the proposed standards and guidelines. The calculation may also be performed using site-specific data. Proposed Method 25C provides instruction on site-specific sampling of the landfill gas, and is used to determine the concentration of NMOC's. Those landfills emitting less than the regulatory cutoff of 150 Mg/yr (167 tpy) of NMOC's would not need to install control equipment under the proposed standards and guidelines, and would therefore not need to perform additional testing or monitoring.

Compliance Demonstrations. For those landfills that are required to install collection and control systems, compliance with the proposed standards or guidelines for the gas collection system includes calculation of: (1) The maximum expected gas generation rate within the landfill in order to demonstrate that the system is designed to handle this flowrate and (2) the total area of influence of all the extraction wells within the landfill in order to demonstrate that this area equals the total landfill area warranting collection. Compliance also includes maintaining a negative pressure at the point where each extraction component (from the well or trench) is connected to the gas collection header. The EPA is proposing two additional test methods to use in these compliance demonstrations for the collection system. Method 3C would be used to measure nitrogen (N_2) in landfill gas, in order to determine if excessive air infiltration has occurred. Method 2E would be used to determine the landfill gas flowrate from the landfill.

Compliance demonstrations for open flares used in control of landfill emissions are specified in 40 CFR 60.18. If a control device other than an open flare conforming to § 60.18 is used, then the landfill owner or operator would demonstrate compliance with the proposed standards or guidelines by testing to demonstrate 98 percent emission reduction or an outlet NMOC concentration of 20 parts per million volume, dry (ppmvd), at 3 percent oxygen (O_2), using Method 25, to ensure continued compliance. The landfill owner or operator would provide to the Administrator or State agency information on: (1) The operation of the control device and (2) the process parameters that would indicate whether the device is properly operated and maintained. The Administrator may request additional information if warranted.

Monitoring Requirements. Monitoring requirements for the gas collection system would include monthly measurements of gauge pressure in the gas collection header. For the control or recovery system, monitoring would be required of parameters that indicate the gas stream is being continuously routed for destruction or recovery and that 98 percent emission reduction of NMOC's, or 20 ppmvd for enclosed combustors, is being continuously achieved.

G. Reporting and Recordkeeping Requirements

The proposed standards and guidelines include initial notification provisions. In addition, if the maximum design capacity of a landfill equals or exceeds 100,000 Mg (111,000 tons), the owner or operator would periodically

report the NMOC emission rate until such time that either the collection and control systems are installed, or the landfill closes permanently.

Under either the proposed standards or guidelines, there are specific reporting requirements addressing the design and installation of the collection and control systems. If a collection system is designed following the specifications in § 60.758, a notification of intent to install the system would be required within 1 year of the date when the NMOC emission rate reaches 150 Mg/yr (167 tpy). If an operator wishes to install a collection system based on the guidance provided in chapter 9 of the BID, but not conforming in all points to the specifications in § 60.758, a collection system design plan must be submitted for review within 1 year of the date when the NMOC emission rate reaches 150 Mg/yr (167 tpy).

After the installation of collection and control systems, a report of the initial performance test and semiannual reports would be required to verify proper design, operation, and monitoring of the collection and control systems. For those owners or operators installing a collection system based on the specifications provided in § 60.758, the initial performance test report would include the provisions and time table for adding wells as waste accumulates.

The proposed regulations would also require (and the proposed guidelines would specify) that the following records be maintained: The accumulated refuse in place; the periodic calculation of the NMOC emission rate; the collection system design (when applicable), including present and future well or trench locations, depths and spacing; the control device vendor specifications; the initial performance test results; and the monitoring parameters established during the initial performance test of the control device.

H. Compliance Times for the Guidelines

The proposed emission guidelines would stipulate that existing MSW landfills emitting above the regulatory cutoff of 150 Mg/yr (167 tpy) of NMOC's should achieve compliance with the guidelines for collection and control systems within 3 years from the time of promulgation of State regulations. The 3-year time period allows 90 days for the initial report; 2½ years for further site-specific testing (if elected by the owner or operator); preparation and review of a collection system design plan; installation of the collection and control system; and 90 days for a performance test. Some MSW landfills may already have collection and control systems in place, and may already be in compliance with the guidelines or may not require 3 years to bring their systems into compliance, but in most cases 3 years is expected to be required. In the case of existing MSW landfills whose NMOC emission rates reach the regulatory level of 150 Mg/yr (167 tpy) of NMOC's and whose owner or operator elected to perform site-specific testing in determining the NMOC emission rate, 2 years and 9 months would be required to achieve compliance and conduct a performance test, after the date of the first periodic report documenting emissions of 150 Mg/yr (167 tpy) or more. Some landfills could achieve compliance sooner, if the owner or operator elects to install collection and control systems without first performing all the site-specific testing available for the emission rate calculation, or if the testing, design, or installation activities were completed more quickly than expected. But in many cases, about 2½ years would be needed to conduct site-specific testing, design and install the systems, and another 90 days would be needed for a performance test.

The 3-month difference above is the result of what each time period includes. In the first case, the NMOC emission rate of the existing landfill is already greater than 150 Mg/yr (167 tpy) when the State regulations are promulgated. After promulgation, 3 months are allowed for the submittal of the first NMOC emission rate calculation, followed by 2 years and 9 months to complete the installation and testing of the system. In the second case, the NMOC emission rate has not reached 150 Mg/yr (167 tpy), and therefore the landfill would be filing NMOC emission rate reports periodically. The first report is required 3 months after the promulgation of the State regulations. Reporting would continue until the rate reaches 150 Mg/yr (167 tpy), and then 2 years and 9 months are also allowed after the report is filed to complete the installation and testing of the system. Since emissions at existing landfills will increase at varying rates, the period of time between the promulgation of the State regulations and the emission rate report that "triggers" the 2 years and 9 months will also vary from landfill to landfill.

III. Impacts of the Proposed Standards and Guidelines

Environmental, energy, and economic impacts of NSPS or guidelines are normally expressed as incremental differences between facilities complying with the standards or guidelines as proposed and those same facilities if no NSPS or guidelines were in effect. The level that assumes no NSPS or emission guidelines is in place is referred to as the baseline. At present, very few States or local air pollution control agencies have landfill regulations that address NMOC air emissions. Since few new landfills would be affected by these State or local regulations, air emissions from MSW landfills are assumed to be uncontrolled in the baseline. The environmental, energy, and economic impacts were computed relative to this baseline.

For most NSPS and emission guidelines, impacts are expressed in annual terms. In the case of the NSPS and guidelines for landfills, the proposed regulations require controls at a given landfill only after the increasing NMOC emission rate reaches the level of the regulatory cutoff. Additionally, the proposed regulations allow the collection and control devices to be shut down at each landfill after certain criteria are met. Therefore, at two different points in time, even though those points may be only a year or two apart, control may or may not be required at a given landfill. Controls would not be required over the same time period for all landfills. The impacts are a direct result of control; therefore, the annualized numbers for any impact change from year to year.

Because of the variability of impacts of the proposed standards and guidelines over time, EPA has judged that the net present value (NPV) of an impact is a more valuable tool in the decision process for landfills. The use of NPV allows for the evaluation of nationwide costs and benefits which occur over discrete time periods for individual sources. Thus, the impacts presented include both annualized estimates (and fifth year annualized impacts) and estimates expressed in terms NPV in 1992. The use of NPV is noted in the text.

A. Air

For new landfills (i.e., those projected to begin construction after today's date), the undiscounted NMOC emission reduction achievable under the proposed standards is estimated to be 4,080 Mg/yr (4,510 tpy) in 1997, which reflects reductions from baseline emissions of 9,250 Mg/yr (10,200 tpy) from refuse estimated to be in place in new landfills built between 1992 and 1997. Control of 87,800 Mg/yr (96,700 tpy) methane is also achieved from a baseline of 471,000 Mg/yr (519,000 tpy).

For existing landfills, the undiscounted NMOC emission reduction achievable under the proposed guidelines is estimated to be 404,000 Mg/yr (448,000 tpy) in 1997, a 79 percent

reduction from a baseline of 506,000 Mg/yr (557,000 tpy) with the methane reduction estimated to be 9,600,000 Mg/yr (10,500,000 tpy). Baseline methane emissions are estimated to be 18,100,000 Mg/yr (19,900,000 tpy) in 1997. As existing landfills are filled, closed, and replaced by new landfills, the emissions reductions achieved by the guidelines will decrease, while the reductions achieved by the standards will rise proportionately. These emissions reductions are summarized in Table 1.

TABLE 1.—SUMMARY OF NATIONWIDE COST ESTIMATES AND ENERGY IMPACTS FOR COLLECTION AND CONTROL OF AIR EMISSIONS FROM NEW AND EXISTING MSW LANDFILLS AT A STRINGENCY LEVEL OF 150 Mg/Yr [a]

	New landfills	Existing landfills
Potential emissions reduction:		
Net present value (10^6 Mg NMOC)	0.76	11
5th year annualized value (10^5 Mg NMOC)	30	183
Nationwide cost of collection/control (flare):		
Net present value ($10^9)	776	5,871
5th year annualized value ($10^9)	26	246
Nationwide net energy impacts:		
Energy required—flares: Net present value (10^6 Btu)	109,000	810,000
Energy Recovery—Gas Turbines: Net present value (10^6 Btu)	5.7×10^8	4.2×10^9

[a] Net present value is presented in 1992 terms. The 5th year is assumed to be 1997, if these standards are promulgated in 1992. One Mg equals 1.11 tons.

In comparison to the President's proposed initiative of planting a billion trees a year in response to climate change, based on carbon dioxide (CO_2) emissions, EPA has roughly estimated (in 1992 dollars) that 1.1 to 2.0 billion trees would need to be planted at a cost of 0.57 to 1.1 billion dollars in order to achieve an equivalent reduction in CO_2 as achieved by today's proposal. While EPA has attempted to quantify the relationship between the President's tree planting initiative and the equivalent CO_2 reduction achievable in this proposal, it should be noted that ancillary benefits associated with planting trees (such as the establishment of shade and wildlife habitat) could not be quantified.

Carbon dioxide is also an important greenhouse gas contributing to climate change. Under the proposed standard, annual CO_2 emissions would increase, proportional to the relative use of flares compared to energy recovery for control. It should be noted, however, that methane contributes considerably more to climate change on a weight basis than CO_2. Thus, the reduction of methane emissions is expected to have a positive impact on global climate change.

Many constitutents of MSW landfill emissions are carcinogenic or can cause other adverse health effects. The reduction in landfill emissions would result in a reduction of these risks from exposure to these constituents.

The use of energy recovery devices for the control of MSW landfill emissions has the potential to reduce secondary air impacts at coal-fired utility plants. This is because the air impacts of coal-fired energy generation are larger than those of landfill gas-fired energy generation. Since EPA cannot reliably predict how many owners or operators would elect to use energy recovery, the magnitude of this potential impact cannot be quantified at this time.

Certain by-product emissions, such as nitrogen oxides (NO_x), carbon monoxide (CO), NMOC's, sulfur oxides (SO_x), and particulates, may be generated by the combustion devices used to reduce air emissions from MSW landfills. The types and quantities of these by-product emissions vary depending on the control device. However, by-product emissions are very low compared to the achievable NMOC and methane emission reductions. Chapters 4 and 6 of the BID present additional information about the magnitude of potential secondary air impacts.

B. Other Environmental Impacts

Water. Landfill leachate is the primary potential source of water pollution from an uncontrolled landfill. Although there is no data on the effect of gas collection on leachate composition, the amount of water pollution present as NMOC's in the leachate may be reduced under these standards and guidelines.

When landfill gas is collected, organics and water are condensed inside the header pipes of the gas collection system. This waste also contains NMOC's and various toxic substances present in the landfill gas. The pH of this condensate is normally adjusted by adding caustic at the landfill and then routing it to a public treatment facility. This does increase the amount of these substances entering the public water supply. There is insufficient data available to quantify this effect at this time.

Solid Waste. The proposed standards and guidelines will likely have little impact on the quantity of solid waste generated nationwide. The required controls do not generate any solid waste. However, the increased cost of landfill operation resulting from the proposed control requirements may cause greater use of waste recycling and other alternatives to landfill disposal, but quantification of such an impact is not possible at this time.

Implications of the Rulemaking for Superfund. Municipal solid waste landfill sites comprise approximately 20 percent of the sites placed by EPA on the National Priorities List (NPL). Often, remedial actions selected at these sites include venting methane and volatile organic contaminants, and airborne emissions are treated if determined necessary to protect human health and the environment.

The emission standards and guidelines in this rule may affect remedial actions under Superfund for MSW landfills. Section 121(d)(2) of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) requires compliance with the substantive standards of applicable or relevant and appropriate requirements (ARAR's) of certain provisions in other environmental laws when selecting and implementing on-site remedial actions. "Applicable" requirements specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Superfund site. "Relevant and appropriate" requirements are not legally applicable, but may address problems or situations sufficiently similar to those encountered so that their use is well suited to a particular site. See 40 CFR 300.5 (55 FR 8814, 8817, March 8, 1990).

As stated in this preamble, the air emission regulations will apply to new MSW landfills, as well as to those facilities that have accepted waste since November 8, 1987, or that have capacity available for future use. For CERCLA municipal landfill remediations, these requirements would be potential ARAR's for all Records of Decision (ROD's) signed after the rules' promulgation date. The standards and guidelines in this rulemaking, once promulgated, will be applicable for those municipal landfill sites on the NPL that accepted waste on or after November 8, 1987, or that are operating and have capacity for future use. The standards may be determined relevant and appropriate for sites that accepted wastes prior to November 8, 1987. The determination of relevance and

HeinOnline -- 56 Fed. Reg. 24472 1991

appropriateness is made on a site-specific basis pursuant to 40 CFR 300.400(g) (55 FR 8841, March 8, 1990).

Energy. Regulated landfills with NMOC emission rates of 150 Mg/yr (167 tpy) or more would be required to install a gas collection system and control device. The gas collection system would require a relatively small amount of energy to run the blowers and the pumps. If a flare is used for control, auxiliary fuel should not be necessary because of the high heat content of landfill gas, commonly 1.86×10^7 Joules per standard cubic meter (J/scm) [500 British thermal units per standard cubic foot (Btu/scf)] or more. If a recovery device such as a gas turbine is used, an energy savings would result.

The EPA evaluated the overall energy impacts resulting from the use of flares or gas turbines for control of collected emissions at all affected landfills. The results of this analysis are presented below. The impacts are expressed as NPV in 1992.

If all new landfills opening between 1992 and 1997 requiring control use flares, the annualized energy requirements would be equivalent to about 543 barrels per year of No. 6 fuel oil. If all new controlled landfills are equipped with gas turbines, the energy to run the blowers and pumps would be offset by the recovery of the methane, resulting in annualized energy savings of approximately 2.8 million barrels per year of No. 6 fuel oil.

If all existing controlled landfills use flares, the annualized energy requirements would be equivalent to about 4,030 barrels per year of No. 6 fuel oil. If all existing controlled landfills are equipped with gas turbines, the annualized energy savings is approximately 21 million barrels per year of No. 6 fuel oil.

The actual energy impact for either new or existing landfills would be somewhere between the values for flares and gas turbines. Even the worst-case scenario results in a very small energy requirement, considering that domestic oil use is currently in the range of 15 to 20 million barrels per day or 5 to 7 billion barrels per year.

C. Control Costs and Economic Impacts

Nationwide annualized costs estimates for collection and control of air emissions from new MSW landfills are estimated to be $26 million. The nationwide cost of the proposed guidelines would be approximately $240 million. In comparison to other solid waste-related proposals, the nationwide costs of the recently proposed RCRA Subtitle D rule are estimated to range from $691 per year to $880 million per year and the estimated nationwide costs of the recently promulgated MWC rules are estimated to be $170 million per year for new combustors and $302 million per year for existing combustors.

Preliminary economic analysis indicates that the annual cost of waste disposal may increase by an average of less than $1 per ton for the proposed NSPS and the proposed guidelines. Costs per household would increase less than $3 to $5, when the household is served by a new or existing landfill, respectively. Additionally, less than 10 percent of the households would face annual increases of $30 or more per household as a result of the proposed NSPS and guidelines. However, EPA anticipates that many landfills will elect energy recovery systems, and costs per household for those areas would be less. The EPA has concluded that no households would incur severe economic impacts. For additional information, please refer to the regulatory impact analysis (Docket No. A-88-09, Item No. II-F-1).

IV. Rationale for the Standards and Guidelines for Municipal Solid Waste Landfill Emissions

A. Background

The regulation of MSW landfill emissions originally was considered during deliberations under a RCRA Subtitle D rulemaking. In 1987, the Administrator decided to regulate these emissions under the authority of the CAA. This decision was announced in the **Federal Register** on August 30, 1988 (53 FR 33314).

Today's action proposes standards under the regulatory authority of section 111(b), which will regulate new landfills which commence construction after today's date, and emissions guidelines under the authority of section 111(d), which will regulate existing landfills. The source of landfill emissions is essentially the same at both new and existing landfills; therefore, in general, the control of these emissions would be the same as well. Throughout this preamble, where clear distinctions arise, the rationales for the EPA actions affecting new and existing landfills are discussed separately. Otherwise, the discussion applies to the proposed standards and emission guidelines.

B. Selection of the Source Category

The EPA is proposing to list MSW landfills as a source category which causes, or contributes to, air pollution that endangers public health or welfare. This decision is based on evidence from EPA and State studies that MSW landfills release air pollutants that have adverse effects on both public health and welfare. In this section of the preamble, EPA discusses this evidence.

Municipal solid waste landfill emissions consist primarily of methane and CO_2, with trace amounts of more than 100 different NMOC's such as ethane, toluene, and benzene. These emissions, commonly called "landfill gas," are formed from the anaerobic decomposition of the refuse in MSW landfills. The landfill gas is generated by naturally occurring methanogens that decompose complex organic materials into organic compounds of lower molecular weight. The methane in the landfills acts as a stripping (or transport) gas, moving the NMOC's present in the landfills through the landfill to the atmosphere. There are several concerns for public health and welfare associated with emissions from MSW landfills. These landfill gas emissions have adverse health and welfare effects resulting from NMOC's. These NMOC's contribute to ozone formation; some are known or suspected carcinogens or cause other noncancer health effects. The NMOC's in landfill gas emissions can cause an odor nuisance and the methane has caused explosions and fires resulting from its migration to on- and off-site structures or enclosures. In addition, the proposed rule will have the ancillary benefit of reducing methane, a gas under discussion by the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change, convened by the United Nations.

Emission Estimates. Estimates taken from "The Office of Solid Waste Survey of Municipal Landfills" (Docket No. A-88-09, Item No. II-A-25), a database developed from a MSW landfill survey conducted in 1986, indicate that there were approximately 6,000 active MSW landfills nationwide in 1987. The EPA estimates that NMOC emissions from these landfills total approximately 255,000 Mg/yr (283,000 tpy). The NMOC's are primarily volatile organic compounds (VOC's) contributing to the ambient ozone problem. Roughly 1.0 percent of the NMOC emissions from stationary sources nationwide are emitted by MSW landfills. Additionally, methane emissions from MSW landfills nationwide total approximately 10.5 million Mg/yr (12 million tpy).

The EPA predicts that in the first 5 years after the NSPS goes into effect, about 940 new landfills will be built to accommodate increasing waste production and replace existing landfills that reach capacity and close. Total NMOC emissions from these new landfills would be over 52,000 Mg/yr

(58,000 tpy) when they are filled to design capacity. While it is difficult to project the actual number of new landfills, the emission estimate is mainly a function of the amount of waste generated. Therefore, uncertainty about the number of new landfills does not greatly affect the estimate of the quantity of emissions.

Health Effects. The NMOC's present several hazards to human health. The NMOC's participate in chemical reactions leading to the formation of ozone, which causes health effects. Also, certain NMOC's have cancer risks and cause noncancer health effects.

Ozone is created by sunlight acting on NO_x and NMOC's in ambient air. Ozone leads to alterations in pulmonary function, aggravation of pre-existing respiratory disease, damage to lung structure, and adverse effects on blood enzymes, the central nervous system, and endocrine systems. Ozone also warrants control due to its welfare effects, specifically, reduced plant growth, decreased crop yield, necrosis of plant tissue, and deterioration of certain synthetic materials such as rubber (Docket No. A-88-09, Item Nos. II-A-26, II-I-16, etc.).

There is also concern about cancer risks from landfill NMOC emissions. In reviewing limited emissions data from MSW landfills, EPA identified both known and suspected carcinogens such as benzene, carbon tetrachloride, chloroform, ethylene dichloride, methylene dichloride, perchloroethylene, trichloroethylene, vinyl chloride, and vinylidene chloride. However, toxics emissions data were not available from most MSW landfills. The EPA attempted to apply statistical methods to the limited data to generate the average annual increased cancer incidence and the maximum individual risk (MIR). In evaluating the results of the calculations for annual incidence and MIR, EPA could not determine reasonable estimates of either an annual incidence or the MIR. The EPA believes the uncertainties in the database are too great to calculate credible estimates of the cancer risks associated with MSW landfills.

At least 12 pollutants, such as benzene, chloroform, and ethylene dichloride, contained in MSW landfill emissions, have the potential to produce health effects other than cancer. Noncancer health effects associated with these pollutants include adverse effects on the kidneys, liver, and central nervous system. A qualitative discussion of noncancer health effects is presented in chapter 2 of the BID. However, due to limitations in the data describing the link between emissions and these effects, EPA is unable to quantify the noncancer health effects at this time.

After considering what statutory approach to use in regulating MSW landfill emissions, EPA announced the decision to regulate these emissions under section 111 of the CAA in the **Federal Register** on August 30, 1988 (53 FR 33314). When this decision was made, EPA was cognizant that section 112 of the CAA (which can be used to develop NESHAP) could have been used. However, given the uncertainty and difficulty in setting standards under section 112, EPA decided to proceed with standards development under section 111. Now that EPA is proposing standards to regulate MSW landfills, EPA has found no reason to change that initial decision to regulate these emissions under section 111 of the CAA.

Fire and Explosion. A third reason MSW landfill emissions warrant control is the well-documented danger of fires and explosions, both on- and off-site. Decomposition of the wastes in landfills produces explosive methane gas. If this methane migrates and accumulates in structures or pockets, such as basements, crawl-spaces, utility closets, or false ceilings, fires and/or explosions can result. The EPA has documented many cases of acute injury and death caused by explosions and fires related to municipal landfill gas emissions. In addition to these health effects, the associated property damage is a welfare effect. Furthermore, when the migration of methane and the ensuing hazard are identified, adjacent property values can be adversely affected (Docket No. A-88-09, Item Nos. II-I-6, II-I-7, etc.). Subtitle D of RCRA will require owners and operators of MSW landfills to monitor for methane to ensure that the concentration of methane gas does not exceed either: (1) 25 percent of the lower explosive limit in facility structures, or (2) the lower explosive level as the property border. If either level is exceeded, the owner or operator would be required to develop and implement a methane reduction plan. The control of air emissions under the CAA, which will result in reduced levels of methane, thus reducing the potential for fires and explosions, will complement the RCRA provisions. The risk of fire or explosion has not been quantified due to the difficulty in describing emission levels which can be causally linked to these effects. Chapter 2 of the BID describes these effects in greater detail (Docket No. A-88-09, Item No. III-B-1).

Odor. Another aspect of MSW landfill emissions is the offensive odor associated with landfills. While the nature of the wastes themselves contribute to the problem of odor, the gaseous decomposition products are often characteristically malodorous and unpleasant. Various welfare effects may be associated with odors, but due to the subjective nature of the impact and perception of odor, it is difficult to quantify these effects. Studies indicate that unpleasant odors can discourage capital investment and lower the socioeconomic status of an area. Odors have been shown to interfere with daily activities, discourage facility use, and lead to a decline in property values, tax revenues, and payrolls (Docket No. A-88-09, Item Nos. 11-I-6, 11-I-7, etc.).

Global Climate Change. An ancillary benefit from regulating air emissions from MSW landfills is a reduction in the contribution of MSW landfill emissions to global emissions of methane. Methane is a major greenhouse gas, and is 20 to 30 times more potent than CO_2 on a molecule-per-molecule basis. This is due to the radiative characteristics of methane and other effects methane has on atmospheric chemistry.

There is a general concern within the scientific community that the increasing emissions of greenhouse gases could lead to climate change, although the rate and magnitude of these changes are uncertain. Efforts to reduce the uncertainties regarding the science of global climate change are ongoing within EPA and within the international community. This rule produces the ancillary benefit of reducing methane emissions, a gas under discussion by the Intergovernmental Negotiating Committee for a Framework Convention on Climate Change convened by the United Nations, whether landfill owners and operators comply with the proposed standards through the use of control processes based on combustion or based on recovery.

Conclusion. In light of the level of emissions and potential public health and welfare effects described above, EPA proposes to list MSW landfills as a source category under section 111(b)(1)(A) of the CAA.

C. Selection of the Designated Pollutant

Today's notice designates air emissions from MSW landfills, hereafter referred to as "MSW landfill emissions," as the air pollutant to be controlled. The EPA views these emissions as a complex aggregate of pollutants which together pose a threat to public health and welfare based on the combined adverse effects of the various components. As previously stated, these components are methane and NMOC's, including various toxic substances. A number of factors determine the specific

HeinOnline -- 56 Fed. Reg. 24474 1991

proportion of each constituent of MSW landfill emissions, such as the composition, age, and amount of waste in the landfill, moisture content and pH of the refuse, climate, and the presence of nutrients and/or toxic substances in the landfill. Landfill management practices, such as waste segregation, may also affect the composition of the emissions generated. Given the variability of these factors, the exact composition of MSW landfill emissions can vary significantly from landfill to landfill and over time. Although the types of compounds are typically the same, the complex mixture cannot be characterized quantitatively in terms of single pollutants. The EPA thus views the complex air emission mixture from landfills to constitute a single designated pollutant.

The EPA has determined that this mixture, MSW landfill emissions, will be designated and regulated under sections 111(b) and 111(d) of the CAA. Section 111 standards can address a broad range of sources and pollutants " * * * which may reasonably be expected to endanger public health or welfare." Municipal solid waste landfill emissions are designated on the basis of both the health and welfare impacts described in the previous section. Although different effects may result from different individual constituents of the landfill gas, the constituents are emitted together and the same control technologies will control all the constituents of MSW landfill emissions. Therefore, control of these constituents can be achieved through regulation of "MSW landfill emissions." Furthermore, MSW landfill emissions may contain 100 or more individual compounds. Although it would be theoretically possible to measure all of the components, such a task would be extremely burdensome, expensive, and impractical. The standards and guidelines EPA is proposing provide a high level of control of total MSW landfill emissions, and avoid the administrative burden and expense of measuring all components of MSW landfill emissions by using NMOC concentration as a surrogate measure.

In conclusion, today's notice proposes to regulate air emissions from MSW landfills as a designated pollutant by the addition of subpart WWW to 40 CFR part 60. This action is warranted by the potential for adverse health and welfare effects posed by MSW landfill emissions as described above under section B, "Selection of the Source Category."

D. Selection of the Affected and Designated Facilities

In summary, EPA is proposing that the affected facility for regulating new sources under section 111(b) of the CAA is each MSW landfill that commences construction on or after today's date. Additionally, today's notice proposes that the designated facility for regulating existing sources under section 111(d) is each existing MSW landfill (i.e., landfill that commenced construction before today's date), if it was receiving waste at any time since November 8, 1987, or has additional capacity which may be filled in the future.

Landfills are also regulated under subtitles C and D of the Resource Conservation and Recovery Act (RCRA). Hazardous waste is regulated under subtitle C, and in general, household and nonhazardous wastes are regulated under subtitle D. The proposed NSPS, however, has been developed under the authority of the CAA. Under RCRA, a landfill means an area of land or an excavation in which wastes are placed for permanent disposal, and which is not a land application unit, surface impoundment, injection well, or waste pile. The Resource Conservation and Recovery Act further defines an MSW landfill as any landfill or landfill unit that receives household waste. This landfill may also receive other types of subtitle D wastes, such as commercial waste, nonhazardous sewage sludge from publicly owned treatment works, construction/demolition waste, and industrial solid waste.

In defining the affected facility as part of an NSPS for an industrial source category, EPA typically determines which emission point or group of points is the appropriate unit (the source) for separate emissions standards in the particular industrial context involved. Today's proposal defines the affected facility as the entire landfill rather than any subdivision of the landfill such as an individual cell. An "entire landfill" is the total landfill property designated for solid waste disposal irrespective of subdividing access roads or multiple ownership. The entire landfill is appropriately covered by the proposed standard because the emissions potential of the landfill, and the magnitude of the associated health and welfare effects, are determined by the total area in which refuse is deposited. Additionally, the controls and their costs estimated for this proposal are also associated with the entire landfill rather than with any smaller subdivision.

In establishing 111(d) guidelines for existing sources, EPA typically defines "designated facilities" (see 40 CFR 60.21(b)). For the same reasons described in selection of the affected facility, the designated facility is the entire landfill. In considering how to define the designated facility under section 111(d), EPA specifically evaluated the applicability of the guideline to inactive landfills. Unlike manufacturing facilities, which typically cease emissions once they have closed, a landfill will generate landfill gas long after closure, in some cases as long as 100 years. During the development of today's proposed standards and guidelines, EPA found that a typical landfill is likely to generate landfill gas at a maximum rate at, or soon after, closure and that the generation rate would steadily decline thereafter. At some time after closure, emissions will no longer be a concern.

Control of closed landfills would pose a number of administrative issues. Based on available information, EPA estimates that there are over 32,000 closed solid waste disposal facilities across the country (53 FR 33324, August 30, 1988). Many of these would be classified as MSW landfills because household waste was deposited in them. The histories of many of these landfills may not be documented by State regulatory programs and would be difficult to locate. An additional concern would be the difficulty in establishing accountability and financial responsibility for the installation and operation of controls at closed facilities for which ownership may be uncertain.

The retroactive application of operating requirements to closed facilities also raises policy concerns. The EPA generally does not require owners of closed sources to implement controls. These sources were presumably operating in compliance with applicable regulations prior to closure and establishing post-closure requirements may place undue burdens on these facilities.

Faced with the administrative and policy complexities of regulating closed facilities, EPA looked for an approach that was likely to lead to reasonable success in reducing emissions without establishing unreasonable requirements. The Hazardous and Solid Waste Amendments to RCRA of 1984 required States to establish a permit program or other system of prior approval to ensure that facilities that receive household hazardous waste or small quantity generator hazardous waste are in compliance with 40 CFR part 257, "Criteria for Classification of Solid

Waste Disposal Facilities and Practices." This permit program was to be established by November 8, 1987. This date was selected as the regulatory cutoff in the emission guidelines for landfills that are no longer receiving wastes because EPA judged States would be able to identify active facilities as of this date. The EPA views this permit program as a readily available resource for States to use in implementing today's guidelines and compliance schedules under section 111(d). Therefore, EPA is proposing to define a designated facility as an existing landfill that received waste on or after November 8, 1987, or has additional capacity which may be filled in the future.

The EPA is requesting comment about the ability of States to identify those landfills which may have closed after November 8, 1987, and the appropriateness of this date as a cutoff for applicability. The EPA typically does not establish operating standards through section 111(d) of the CAA for sources no longer operating. Further, since landfill emissions decline after closure, would it be more appropriate to limit the regulation to those facilities operating on the date of proposal? What additional emissions would occur if the applicability date was moved from November 8, 1987 to the date of proposal? The EPA also requests comments on the model used to estimate landfills emissions and the assumed emission profile.

E. Selection of Best Demonstrated Technology

Introduction. Under section 111(b), EPA proposes that new MSW landfills with annual emissions of NMOC's equal to or greater than 150 Mg/yr (167 tpy) would be required to be controlled through the use of gas collection systems and combustion devices (or equivalent systems). Under section 111(d), EPA would establish guidelines for existing MSW landfills that received refuse on or after November 8, 1987. The guidelines would specify that landfills with annual NMOC emissions equal to or greater than 150 Mg/yr (167 tpy) have collection and control systems. The same level of control has been selected as BDT for new and existing landfills.

Section 111(a)(1)(b) of the CAA requires that standards of performance for new sources reflect the—

> * * * degree of emission limitation and the percentage reduction achievable through application of the best technological system of continuous emission reduction which (taking into consideration the cost of achieving such emission reduction, any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated.

Similarly, section 111(a)(1)(c) requires emission guidelines for existing sources to reflect the—

> * * * degree of emission reduction achievable through the application of the best system of continuous emission reduction which (taking into consideration the cost of achieving such emission reduction, and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated for that category of sources.

These systems are referred to as BDT for new and existing sources.

This section presents the rationales for selection of BDT for new and existing sources. Subsection 1 describes the gas collection and control technologies EPA evaluated in selecting BDT. The second subsection describes the analyses of regulatory alternatives for new and existing landfills. The rationales for selection of BDT for new and existing sources are presented in subsection 3. Finally, Subsection 4 describes the selection of the format of the standards and guidelines.

1. Discussion of Demonstrated Technologies

Today's standards and guidelines are based on gas collection and add-on control devices or systems. Today's proposed standards and guidelines would require that the air emissions from MSW landfills be collected and directed through an emission control device that achieves recovery or destruction of the NMOC's by at least 98 percent by weight. In selecting BDT for new and existing sources, EPA considered various technologies associated with gas collection and the control devices used to destroy the collected gas. The technologies described below would be equally applicable to both new and existing landfills.

Gas Collection. Typical landfill practices include application of a daily 0.15 meter (m) [6-inch (in.)] earthen cover over newly received refuse and a final cover of up to 0.6 m [2 feet (ft)] in thickness. This practice alone is inadequate to prevent release of MSW landfill emissions which continue through the cover long after the landfill is closed. There is no evidence that thicker final covers do any more than retard the emissions for a short period of time, with little or no effect on the overall mass emissions. In addition, MSW landfill emissions have the potential to migrate through the sides of the landfill or from places where the cover has been eroded over time. Thus, the emissions must be collected and destroyed to prevent release to the air.

One type of gas collection system presently in use is the passive collection system. Passive systems consist primarily of gas extraction wells, each of which may or may not be connected to a flare. However, passive wells are frequently vented to the atmosphere uncontrolled. Uncontrolled passive wells serve primarily to prevent gas migration and reduce fire and explosion hazard. Other public health and welfare concerns are not reduced by uncontrolled passive collection systems. The EPA believes that because these emissions are not reduced by uncontrolled passive collection systems, these systems are an ineffective control technology, and EPA therefore did not consider uncontrolled passive systems further during the selection of BDT.

Theoretically, a passive system could be as effective as an active system if each well or trench were equipped with an effective control device, and if the well or trench spacing were adequate to effectively collect gas from all areas of the landfill. However, due to their shorter radius of influence, an effective passive well system would need many more wells in a given area. The additional wells would result in higher overall costs. The EPA considers such passive well systems as being less cost effective than active systems for compatible volumes of collected gas.

Active collection systems are presently in use at more than 100 landfills and consist of two major components, gas extraction wells and/or trenches, and gas moving components. These systems employ mechanical blowers or compressors to create a pressure gradient, thereby extracting the MSW landfill emissions. The configuration of the wells or trenches and gas moving equipment, and the pressure gradient necessary to collect the emissions effectively without air infiltration from the surface and sides of the landfill, are affected by many site-specific factors. These factors include the gas generation rate, size and depth of the landfill, and refuse and cover permeability. A gas collection header system conveys the emissions to the control device(s).

Well-designed and well-operated gas collection systems, at a minimum, include the following capabilities: (1) The ability to handle the maximum gas generation rate predicted over the life of the equipment; (2) the ability to monitor and adjust the operation of the system as gas generation varies; and (3) the ability to be expanded as needed (i.e., to

HeinOnline -- 56 Fed. Reg. 24476 1991

collect gas from all areas of the landfill in which refuse has been or will have been deposited for at least 2 years). Chapters 4 and 9 of the BID discuss the considerations necessary in designing an effective gas collection system (Docket No. A-88-09, Item No. III-B-1).

Active collection systems are capable of conveying the emissions to a control device, which destroys or removes the NMOC's and methane, thereby reducing the public health and welfare concerns. Other systems have not been demonstrated to accomplish these goals. Therefore, well-designed and operated active collection systems were considered as an essential component in selection of BDT for MSW landfill emissions. The emission reduction, cost, and other impacts of applying active collection systems, along with control systems, to new and existing landfills are estimated in Subsection 2, "Analysis of Regulatory Alternatives."

Control devices. Gas treatment or control devices are the other major part of a control system for air emissions from MSW landfills. Gas treatment can be performed either by systems that burn the collected gas or by systems that purify the emissions by the removal of the CO_2 and other contaminants to produce pipeline quality gas. Control (treatment) systems that burn the emissions can be further divided into those based on destruction, such as flares and incinerators, and those based on energy recovery, such as boilers, turbines, and internal combustion (I.C.) engines.

Gas purification techniques are used to upgrade landfill gas to pipeline quality natural gas by the removal of water, condensible NMOC's, and CO_2. Since standard natural gas pipelines may not accept gas containing halogenated compounds and sulfur derivatives, removal of these compounds can be a part of a purification process design. Compounds that are removed are often vented to the air. In such cases, the purification system would not reduce the public health and welfare impacts of landfill emissions. The landfill gas generation rate, availability of customers, and local environmental issues are important limiting factors in the decision to install purification systems at MSW landfills. These systems would not be economically feasible for all landfills. Thus, EPA has not used gas purification techniques as a candidate BDT control device. However, even though they are not applicable to all MSW landfills, today's proposed standards and guidelines allow purification processes to be used to control landfill emissions, if gaseous vent streams from purification systems at MSW landfills are routed to control devices where a 98-percent overall reduction in NMOC's is achieved.

Flares are currently being used to control air emissions from MSW landfills. Good combustion in a flare is governed by flame temperature, residence time of NMOC's in the combustion zone, turbulent mixing of the combustion zone, and the amount of oxygen (O_2) available for combustion.

There are basically two types of flares: Open flares (i.e., flame is exposed), and enclosed flares. Open flares generally have one burner tip and can be located at ground level or can be elevated. Enclosed flares are usually composed of multiple gas burner heads and are staged to operate at a wide range of flowrates. They are often located at ground level. Good mixing in enclosed flares is the result of high velocity of the fuel gas at the burner nozzles. The enclosure reduces luminosity, noise, and heat radiation. Chapter 4 of the BID provides additional information about the design, combustion efficiency, by-product emissions, and available test data for flares.

The EPA has established criteria (40 CFR 60.18) to assure (specifying when) open flares achieve at least 98 percent destruction efficiency. This efficiency can be achieved only under certain design and operating parameters, as specified in 40 CFR 60.18. The EPA reviewed data on the flaring of MSW landfill gas using enclosed flares. These data were collected through State and local regulatory agencies. The EPA concluded that properly designed and operated flares, both open and enclosed, can achieve this efficiency with landfill gas. Additionally, flares can consistently achieve a 98-percent or higher destruction efficiency at a lower cost than the other nonrecovery combustion control systems considered. (Cost impacts and economic feasibility of the application of flares are presented in the analysis of regulatory alternatives in Subsection 2.) Thus, EPA has concluded that open flares as an add-on control device are a demonstrated technology for control of landfill emissions and will be considered, along with collection systems, as a basic component in the selection of BDT.

Several other control systems that EPA has determined have the potential to meet the 98-percent destruction criterion are discussed below. While these other techniques may not be technically or economically feasible at all landfills, and are, therefore, not the basis of BDT, they have been demonstrated to reduce emissions and could be used to meet the requirements of the standards or guidelines in cases where they are feasible. At some landfills, use of these techniques rather than flares could reduce the costs of compliance.

A second control method utilizing combustion without energy recovery for control of collected emissions is incineration. Incinerators have been demonstrated to achieve 98 percent or greater reduction, the same control level as flares. Incineration may be more or less expensive than flares, depending on site-specific factors (Docket No. A-88-09, Item No. 11-A-16), but in general they are likely to be more expensive than flares and may not be economically feasible in all cases. Therefore, while EPA would allow the use of incinerators, EPA has not based the calculation of the impacts of BDT on incinerators.

Energy recovery systems have also been demonstrated to achieve 98 percent emission control at landfills where their use is feasible. Energy recovery systems currently used to combust landfill emissions include I.C. engines, gas turbines, and steam-generating boilers. Power produced by these systems may be used to generate electricity or for heating. Each of these is briefly discussed below. Chapter 4 of the BID provides additional details of the operation, by-product emissions, and applicability of each of these systems to the control of MSW landfill emissions. Energy recovery systems have the potential to offset the cost of control. However, the capital cost for these systems is higher than for flares, and a site-specific study would be needed to determine the technical and economical feasibility of installing an energy recovery system for a given landfill. The EPA cannot predict the recovery potential with confidence for all existing or future MSW landfills without performing site-specific analyses. Additionally, EPA believes that landfill operators will themselves select recovery systems when it would make sense economically to do so. Therefore, EPA concluded that it would be inappropriate to further consider these systems in the selection of BDT. The BID for today's proposed standards and guidelines provides additional information that will be useful to landfill owners and operators in making decisions concerning energy recovery. In addition, this topic is discussed in Section K below, "Additional Considerations and Solicitation of Comments."

Internal combustion engines are in use at about 40 landfills. The type of engine used to recover energy from landfills is usually a 4-cycle, spark-ignited engine similar in design to the common gasoline engine. The I.C. engine is being used for landfills because of its short construction time, ease of installation, and operational capacity over a wide range of speeds and loads. Internal combustion engines can be operated to achieve a destruction efficiency of 98 percent or better.

Gas turbines, which generally achieve a destruction efficiency of 98 percent, are in use to recover energy at 18 U.S. landfills (Docket No. A-88-09, Item No. II-B-24). A gas turbine is a heat engine that converts fuel energy into work using compressed hot gas as the working medium. Gas turbines take large amounts of air from the atmosphere, compress it, burn fuel to heat it, then expand it in the power turbine to develop shaft horsepower. Ambient air is compressed and combined with fuel in the combustor. The combustor exhaust stream flows to the power turbine which converts some of the stream's fuel energy to rotary shaft power. This shaft power drives the inlet compressor and an electrical generator. The applicability of gas turbines to a given landfill will depend on the quantity of landfill gas generated, the availability of customers, the price of electricity, and local environmental issues.

At a few landfills, energy recovery is achieved with industrial boilers, i.e., a boiler with a heat input of 2.9 to 29 megawatts (MW) (10 to 100 million Btu/hr), of the watertube design. In a watertube boiler, hot combustion gases contact the outside of heat transfer tubes, which contain hot water and steam. Heat is transferred via these tubes to collection drums, which collect and store the heated water and steam. Landfill gas-fired boilers may be utilized in two ways. On-site landfill gas may be routed to an on-site boiler to produce heat or hot water, or to produce steam, which in turn is fed to a steam turbine to generate electricity. The landfill gas may alternatively be piped and sold to an off-site boiler. Three of the five landfill gas-fired boilers presently operating are utilized as simple heat or hot water sources. There are at least two landfill gas-fired boiler-to-steam turbine facilities currently operating in the United States (Docket No. A-88-09, Item No. II-B-24).

2. Analysis of Regulatory Alternatives

Introduction. The "Discussion of Control Technologies" section indicates that there is basically one approach to reducing landfill emissions—gas collection and control. However, EPA recognizes that not all landfills warrant control, especially given the variability in the quantity of landfill emissions from a specific landfill and the cost of reducing these emissions. In addition, EPA recognizes that landfill emissions increase in quantity as more MSW is added to the landfill and that, after closure of the landfill, emissions decrease to the point that they no longer warrant control. Accordingly, EPA structured its regulatory analysis to decide *if* the installation of controls is warranted and *when* the controls are no longer warranted on a national basis and therefore could be removed. The EPA considered the results of this analysis in selecting BDT for new and existing landfills.

The Database. The EPA developed a database from which the impacts of applying the control technologies discussed above to new and existing landfills. In 1986, EPA sent municipal landfill survey questionnaires to 1,250 of the estimated 6,034 active MSW landfills in the United States. From this survey, EPA received responses for a total of 1,174 active MSW landfills (Docket No. A-88-09, Item No. II-A-25). Of the 1,174 landfills responding, the information provided on location, annual waste acceptance rate, refuse in place, age, depth, and design capacity were complete for 931 landfills. However, site-specific emission rates were not known and, therefore, were not reported to EPA. Because EPA needed emission rate information, it gathered gas generation rate and NMOC concentration information from literature, State and local air pollution control agencies, and industry test reports obtained through the authority of section 114 of the CAA.

The information from the 931 landfills was used with gas generation rate factors and NMOC concentrations to create two subsets of landfills: existing and new landfills. The existing landfills subset comprised all those landfills not closing prior to 1997. The new landfill subset was created by assuming existing landfills that will close between 1992 and 1997 are replaced by new landfills with similar characteristics. Each subset of landfills was evaluated for potential nationwide emission reduction under the regulatory alternatives discussed in the next section of this preamble. An algorithm was developed to track the landfill characteristics on an annual basis; determine annual emission rates; and determine, based on specific regulatory alternatives, if controls would be required and when they could be removed. The algorithm also estimated capital expenditures for initial placement of controls (i.e., flares) and routine equipment replacement, as well as operating and maintenance costs every year controls were in place. This tool allowed the development of regulatory alternatives and an estimation of the number of landfills affected by various regulatory alternatives, the potential emission reduction, and the cost of controlling the affected landfills. The impacts and trends presented in the remainder of this section are derived from this algorithm, and were scaled up from the 931 landfills in the database to estimate the number of landfills nationwide. Additional discussion of this algorithm is provided in Chapter 3 of the BID.

Regulatory Alternatives. Three regulatory alternatives were considered in selecting the standards for new landfills. The same alternatives were also considered in selecting the emission guidelines for existing sources. Each alternative was based on the use of estimated annual NMOC emission rates as the parameter for determining whether control would be required. Under each alternative, demonstrated gas collection and control systems would apply to landfills with annual NMOC emission rates higher than a specified level for that alternative. Annual emission rates were chosen as the cutoff parameter because, in general, it is the most practical way to select and implement the appropriate application of gas collection and control systems to MSW landfills. (See Subsection 4 below, "Selection of the Format of the Standards and Guidelines" for further discussion on this topic.)

Emission rates from a given landfill vary over time. After a landfill opens, emissions gradually increase as more waste is added. At some point in time, emissions may increase enough to warrant the use of gas collection and control devices. Emissions peak at or shortly after closure and then gradually decrease over time. Eventually, as emissions decline, emission reduction benefits of control are reduced and controls are no longer warranted. Therefore, under the regulatory alternatives, EPA would not only be determining the annual emission rate used to affect MSW landfills, but also would be implicitly determining when control systems must be installed and when they may be removed. This is also discussed in Subsection 4 below, and the following section entitled, "Selection of Requirements to Implement Best Demonstrated Technology."

HeinOnline -- 56 Fed. Reg. 24478 1991

The emission rate cutoff levels specified in Regulatory Alternatives 1, 2, and 3 are 25, 150, and 250 Mg/yr (28, 167, and 278 tpy) of NMOC's, respectively. In selecting regulatory alternatives, EPA performed a preliminary evaluation of many different emission rate cutoffs, ranging from 25 to 500 Mg/yr (28 to 555 tpy) (Docket No. A-88-09, Item No. II-B-32). As the cutoff level is lowered, the emission reduction, cost impact, and number of landfills at which controls must be installed increase. The three levels selected for further analysis (25, 150, and 250 Mg/yr [28, 167, and 278 tpy]) represent values in the high, middle, and low end of the range of impacts.

The emission and cost impacts in the tables are expressed in terms of NPV. Net present value is the value at one point in time of a flow of values across time. For this study, EPA used 1992 NPV's to allow comparison among alternatives with uneven flows of values. In the case for MSW landfills, both control costs and emission reductions vary year by year. Therefore, comparisons of alternative stringency levels include comparisons of net present values for both control costs and emission reductions.

For each regulatory alternative, the number of landfills controlled, national emission reduction, costs, and cost effectiveness were estimated. The costs are based on application of active gas collection systems and flares to those landfills above the specified emission level cutoffs. As described under "Control Devices," these control systems are demonstrated and would reduce emissions by 98 percent when applied to new or existing landfills.

Table 2 presents the number of new landfills at which control would be required and the emissions reductions EPA has predicted would result if the standard is set at 25, 150 or 250 Mg/yr (28, 167, or 278 tpy) for new landfills. The emission reductions for both NMOC's and methane are presented. Table 3 presents the national net annualized cost and cost effectiveness of each regulatory alternative for new landfills, in terms of cost per Mg (ton) of NMOC emission reduction. The incremental cost effectiveness, which compares each alternative to the next less stringent alternative, is also presented. Table 4 presents the number and distribution of new landfills, by capacity, that would be required to install controls under each alternative.

TABLE 2.—EMISSION REDUCTION ACHIEVED AT NEW MSW LANDFILLS FOR THREE REGULATORY ALTERNATIVES[a]

Regulatory alternative	Emission rate cutoff (Mg NMOC/yr)	Number of landfills affected	NMOC emission reduction[b]		CH_4[c] emission reduction[b]	
			Million Mg NMOC	Percent reduction	Million Mg CH_4	Percent reduction
1	25	247	0.99	90	51	82
2	150	87	0.76	69	36	57
3	250	41	0.63	57	27	43

[a] New landfills means those landfills constructed and opened in the first 5 years of the NSPS [between 1992 and 1997] to replace those existing landfills which will close during the same time period.
[b] All emission reductions are expressed as NPV (1992). The numbers presented have been rounded to two significant figures. The actual reduction potentials are given in the text. One Mg equals 1.11 tons.
[c] Methane.
Note: Baseline emissions for new MSW landfills are 1.1 million Mg NMOC and 63 million Mg methane. (NPV 1992.)

TABLE 3.—AVERAGE AND INCREMENTAL COST EFFECTIVENESS AT NEW MSW LANDFILLS FOR THREE REGULATORY ALTERNATIVES

Regulatory alternative	Emission rate cutoff (Mg NMOC/yr)	National annualized cost of control (million/yr)	Average cost effectiveness[a] ($/Mg NMOC)	Incremental cost effectiveness[b] ($/Mg NMOC)
1	25	45.2	1,416	[c] 2,731
2	150	26	1,020	[d] 1,588
3	250	19	897	[e] 897

[a] The average cost effectiveness for each alternative is calculated using the following formula:

$ACE = P_C/P_{ER}$

where:
ACE = average cost effectiveness
P_C = NPV of Operating + Capital Costs
P_{ER} = NPV of NMOC emission reduction

[b] The incremental cost effectiveness of going from one alternative to the next stringent alternative

$ICE = (P_O + P_C)_A - (P_O + P_C)_B / P_{ER}A - P_{ER}B$

where:
ICE = incremental cost effectiveness
P_O = NPV of operating costs
P_C = NPV of capital costs
P_{ER} = NPV of NMOC emission reduction
A = more stringent regulatory alternative
B = less stringent regulatory alternative

[c] Incremental cost effectiveness between Options 2 and 1.
[d] Incremental cost effectiveness between Options 3 and 2.
[e] Incremental cost effectiveness between Option 3 and baseline.
NPV = net present value.

TABLE 4.—DISTRIBUTION OF CONTROLLED NEW LANDFILLS FOR THREE REGULATORY ALTERNATIVES

Design capacity of affected landfills	Regulatory alternative		
	1	2	3
<1 million Mg	58	0	0
1-5 million Mg	121	32	10
5-10 million Mg	29	19	14
>10 million Mg	39	36	17
Total number of affected landfills	247	87	41

Note: One million Mg equals 1.11 million tons.

Tables 5, 6, and 7 present the same information about existing landfills.

TABLE 5.—EMISSION REDUCTION ACHIEVED AT EXISTING MSW LANDFILLS FOR THREE REGULATORY ALTERNATIVES[a]

Regulatory alternative	Emission rate cutoff (Mg NMOC/yr)	Number of landfills affected	NMOC Emission reduction[b]		CH_4[c] Emission Reduction[b]	
			Million Mg NMOC	Percent reduction	Million Mg CH_4	Percent reduction
1	25	1,884	13	92	411	81
2	150	621	10.6	79	266	52
3	250	386	9.6	71	200	39

NOTE: Baseline emissions for existing MSW landfills are 13.6 million Mg NMOC and 509.2 million Mg methane. (NPV 1992.)
[a] EPA projects that some 1,100 of the 6,000 existing active landfills, all of which were receiving wastes in 1992, will close prior to promulgation.
[b] NPV. The numbers presented have been rounded to two significant figures. See the test for the actual reductions potential. One Mg equals 1.11 tons.
[c] Methane.

TABLE 6.—AVERAGE AND INCREMENTAL COST EFFECTIVENESS AT EXISTING MSW LANDFILLS FOR THREE REGULATORY ALTERNATIVES

Regulatory alternative	Emission rate cutoff (Mg NMOC/yr)	National Annualized cost of control (million/yr)	Average cost Effectiveness[a] ($/Mg NMOC)	Incremental cost effectiveness[b] ($/Mg NMOC)
1	25	416	927	2,894[c]
2	150	240	555	2,075[d]
3	250	150	407	407[e]

[a] The average cost effectiveness for each alternative is calculated using the following formula:

$ACE = P_C/P_{ER}$

where:

ACE = avrage cost effectiveness
P_C = NPV of Operating + Capital Costs
P_{ER} = NPV of NMOC emission reduction

[b] The incremental cost effectiveness of going from one alternative to the next stringent alternative

$ICE = (P_O + P_C)_A - (P_O + P_C)_B / {}^{P}ER_A - {}^{P}ER_B$

where:

ICE = incremental cost effectiveness
P_O = NPV of operating costs
P_C = NPV of capital costs
P_{ER} = NPV of NMOC emission reduction
A = more stringent regulatory alternative
B = less stringent regulatory alternative

[c] Incremental cost effectiveness between Options 2 and 1.
[d] Incremental cost effectiveness between Options 3 and 2.
[e] Incremental cost effectiveness between Option 3 and baseline.
NPV = net present value.

TABLE 7.—DISTRIBUTION OF CONTROLLED EXISTING LANDFILLS FOR THREE REGULATORY ALTERNATIVES

Design capacity of affected landfills	Regulatory alternative		
	1	2	3
<1 million Mg	514	59	22
1-5 million Mg	837	266	181
5-10 million Mg	295	111	48
>10 million Mg	238	185	135
Total number of affected landfills	1,884	621	386

Note: One million Mg equals 1.11 million tons.

3. Selection of Best Demonstrated Technology

In the selection of BDT, EPA must weigh the emission reduction associated with application of a control system along with the costs, nonair quality health and environmental impacts and energy requirements associated with these systems. The decision is made separately in this section of the preamble for new and existing landfills, considering the impacts of the regulatory alternatives presented in the previous section and other relevant factors. The decision for new MSW landfills concerns defining BDT for landfills affected by section 111(b); the decision for existing MSW landfills concerns defining BDT for landfills affected by section 111(d). These are separate and distinct decisions.

In the analysis of regulatory alternatives presented below, EPA acknowledges that the discussion is atypical in that there is only one control technology to consider, i.e., the installation of collection systems which convey the collected gases to a control device. The discussion revolves around the question of when it is reasonable to require collection and control systems at a given landfill and when it is not.

HeinOnline -- 56 Fed. Reg. 24480 1991

However, because of the unique emission characteristics of landfills when compared to more traditional emission units, regulatory alternatives can be created by considering alternative emission levels at which to require the installation of BDT. The installation of BDT at varying NMOC emission levels results in a range of emission reductions, costs and cost-effectiveness values which may be compared and contrasted much as is done in the selection of BDT from among different control technologies.

In considering which alternative to propose as BDT, EPA decided to consider both NMOC's and methane reductions. However, these alternatives presented below are being evaluated and implemented using NMOC's as the engineering basis for the regulatory cutoff. This means that the cost-effectiveness numbers presented do not reflect a dollar value for the reduction of methane. Rather, EPA qualitatively considered the anticipated methane reduction when selecting the regulatory cutoff.

However, the EPA's Division of Global Climate is studying the problem of methane emissions, primarily in relation to the phenomenon of global climate change, and is developing strategies for reducing these emissions. This rulemaking presents considerable potential for methane reductions, resulting in benefits such as the abatement of global warming, reductions in odor nuisance, and potential energy savings resulting from the selection of energy recovery devices to meet the control requirements of the standard and guidelines. As global climate change policy develops, these benefits could lead to the direct consideration of methane reductions along with NMOC reductions in setting these standards and guidelines. In that case, the resultant incremental cost effectiveness, emission reductions and potential energy savings might indicate that a more stringent threshold emission level (using NMOC concentration as the engineering basis) is warranted. Such benefits as reduced global climate change and energy savings are not considered in the following discussion of the regulatory alternatives. Although EPA has decided to consider methane reductions only as an ancillary benefit in this proposal, EPA is soliciting comments on the pros and cons of selecting the threshold emission level based on the direct consideration of both NMOC and methane reductions.

New Landfills. As shown in Table 2, the NMOC emission reduction for new MSW landfills under Regulatory Alternative 3, the least stringent alternative, would be 0.63 million Mg (0.7 million tons), or a 57-percent reduction relative to baseline emissions, on a NPV basis. Regulatory Alternative 2 would result in an additional reduction of 0.13 million Mg (0.14 million tons), while Regulatory Alternative 1 would reduce emissions by another 0.23 million Mg (0.25 million tons) compared with Regulatory Alternative 2. These emission reduction impacts demonstrate that as expected, as the stringency increases (i.e., as the cutoff level becomes smaller) the NMOC emission reductions obtainable increases. Methane emission reductions shown in Table 2 follow the same trend. Under Regulatory Alternative 3, a methane reduction of 27 million Mg (30 million tons) would be achieved, with additional reductions of 9 and 15 million Mg (10 and 17 million tons) achieved by Regulatory Alternatives 2 and 1, respectively. With this in mind, EPA considered the number of landfills and cost and economic impacts of achieving these emission reductions in selecting among the regulatory alternatives.

The EPA first compared Regulatory Alternatives 1 and 2. The EPA found a large increase in the number of affected landfills and the incremental costs for Regulatory Alternative 1 when going from Regulatory Alternative 2 to Regulatory Alternative 1. Regulatory Alternative 1 affects nearly three times as many landfills as Regulatory Alternative 2 while obtaining proportionately smaller NMOC and methane emission reductions. For example, the average emission reduction achieved per landfill (i.e., total additional emission reduction/number of additional landfills controlled) under Regulatory Alternative 1 is approximately one half that achieved on average by the landfills controlled under Regulatory Alternative 2. Furthermore, the majority of the increase in costs is associated with landfills with design capacities <5 million Mg (<5.6 million tons), 25 percent of which have design capacities <1 million Mg (<1.11 million tons), that would only be affected under Regulatory Alternative 1. The national incremental cost effectiveness for Regulatory Alternative 1 would be about $2,731/Mg ($2,452/ton). However, this figure does not include the ancillary bvenefits of methane control, such as the abatement of global climate change, odor reductions, or energy savings resulting from the use of energy recovering control devices, which could be realized under Regulatory Alternative 1. Additionally, more than 30 percent of households served by new MSW landfills installing collection and control systems as a result of Regulatory Alternative 1 would incur annual costs in excess of $10. The EPA believes that the additional cost and the administrative burden of controlling this many additional landfills (particularly, many smaller landfills having design capacities <1 million Mg [<1.11 million tons]) may be unreasonable based on the consideration of NMOC's alone given the relatively small incremental emission reductions achieved. Although EPA has selected Regulatory Alternative 2 for proposal, EPA solicits comments on the pros and cons of Regulatory Alternative 1 in light of the additional environmental benefits that can be achieved by reducing greenhouse gases. The EPA may elect to promulgate such a standard, or a standard incorporating an intermediate alternative, should evolving global climate change policies indicate more control is warranted.

Next, EPA compared Regulatory Alternatives 2 and 3, which would require control at 87 and 41 new landfills, respectively. Regulatory Alternative 2 provides a proportional 21 percent increase in NMOC emission reduction and a proportional 33 percent increase in methane reduction in comparison to Regulatory Alternative 3. These reductions are achieved at costs per unit of NMOC emission reduction comparable to previous decisions of VOC control under Section 111 in cases where cocontrol of air toxics and other concerns are evident. Additionally, the average and incremental cost effectivenesses for NMOC's emission reduction shown in Table 3 do not consider the ancillary benefits of methane reduction, such as global warming abatement, reduction in explosion hazard, and reduction in odor nuisance. Nor do they include any consideration of the potential for energy savings, which would result in cost savings. Although these benefits have not been quantified, they support qualitatively the judgment that the incremental costs of Regulatory Alternative 2 are reasonable. As shown in Table 4, while Regulatory Alternative 2 affects about 46 more landfills than Regulatory Alternative 3, many of those additional landfills have design capacities of 1 million Mg (1.11 million tons) or more. Regulatory Alternative 3 would control about 40 landfills, but would not require control of several very large landfills which emit relatively large quantities of NMOC's (e.g., quantities greater than 150 Mg/yr [167 tpy]), which could pose significant health and welfare risks. Based on economic impact analysis, EPA believes

that neither Regulatory Alternative 2 nor Regulatory Alternative 3 should result in any households served by MSW landfills intalling collection and control systems incurring annual costs greater than $10. Based on this analysis, and considering the ancillary benefits of the significant methane reductions achieved, EPA concludes that Regulatory Alternative 2, and NMOC emission rate cutoff of 150 Mg/yr (167 tpy), results in reasonable economic impacts. Based on these considerations, EPA proposes an NMOC emission rate cutoff of 150 Mg/yr (167 tpy) as BDT (Regulatory Alternative 2) for new landfills.

In selecting Regulatory Alternative 2, EPA judged the application of well-designed gas collection systems and 98 percent efficient recovery/destruction control systems to landfills emitting more than 150 Mg/yr (167 tpy) of NMOC's to represent BDT for new landfills. The EPA finds that this is the best demonstrated technological system of continuous emission reduction for MSW landfills, taking into consideration costs and other relevant factors. Collection systems and control systems with 98 percent efficiency are demonstrated at about 25 landfills, and their application to those new landfills emitting 150 Mg/yr (167 tpy) of NMOC's or more will significantly reduce emissions without causing any unreasonable cost, environmental, or energy impacts.

The EPA believes that these controls are technologically feasible for landfills emitting less than 150 Mg/yr (167 tpy) of NMOC's. In light of growing concerns about global climate change, a more stringent regulatory option may well be reasonable in the future. For instance, if Regulatory Alternative 2 were set at 100 Mg/yr (111 tpy), an additional 6 percent reduction in NMOC's emissions could be achieved (methane emissions would decrease by an additional 9 percent). Only 17 additional new landfills, or a total of 104, would require control. The incremental cost effectiveness would increase only slightly when compared to 150 Mg/yr, from $1,588/Mg to $1,650/Mg. The EPA is still considering whether or not the additional benefits obtained under a stringency level of 100 Mg/yr are reasonable. However, for administrative and financial reasons, regulating to a more stringent level, such as Regulatory Alternative 1, 25 Mg/yr (28 tpy), may or may not be worthwhile. The EPA seeks comments on the pros and cons of a more stringent threshold level.

Existing Landfills. The NMOC emission reduction for existing landfills under Regulatory Alternative 3, the least stringent alternative, would be 9.6 million Mg (10.7 million tons), or a 71-percent reduction relative to baseline emissions. Regulatory Alternative 2 would result in an additional reduction of 1.0 million Mg (1.1 million tons), while Regulatory Alternative 1 would reduce emissions by another 2.4 million Mg (2.6 million tons) compared with Regulatory Alternative 2. As with new landfills, EPA found that these emission reduction impacts demonstrate that as the stringency increases (i.e., as the cutoff level increase) the NMOC emission reductions obtainable also increase. The methan reductions follow the same trend as the NMOC reductions, beginning with a reduction of 200 million Mg (222 million tons) under Regulatory Alternative 3, followed by cumulative reductions of 266 million Mg (295 million tons), and 411 million Mg (456 million tons) under Regulatory Alternative 2 and under Regulatory Alternative 1, respectively.

The number of landfills at which controls would be required, cost, and economic impacts of achieving these emission reductions were then considered in selecting among the three regulatory alternatives.

The EPA first compared Regulatory Alternatives 1 and 2. The EPA found a large increase in the number of affected landfills and the incremental costs for Regulatory Alternative 1 when going from Regulatory Alternative 2 to Regulatory Alternative 1. As was the case for new landfills, Regulatory Alternative 1 affects more than three times as many landfills as Regulatory Alternative 2 while obtaining proportionately smaller NMOC and methane emission reductions. Furthermore, the majority of the increase in cost is associated with landfills with design capacities <5 million Mg (<5.6 million tons) that would only be affected under Regulatory Alternative 1. Nearly nine times as many landfills with design capacities below 1 million Mg (1.11 million tons) would be required to install controls under Regulatory Alternative 1 than under Regulatory Alternative 2. The national incremental cost effectiveness for Regulatory Alternative 1 would be about $2,890/Mg NMOC's ($2,610/ton). However, this figure does not directly consider the ancillary benefits of methane control realized under Regulatory Alternative 1, such as global warming abatement, the reduction of odor nuisance, or the potential for energy savings resulting from the use of energy recovery control devices. Additionally, based on the economic impact analysis presented in BID Chapter 8, EPA believes that as many as 16 percent of the households served by MSW landfills installing collection and control systems in compliance with emission guidelines based on Regulatory Alternative 1 would incur annual costs in excess of $30. The EPA believes that the additional cost and the administrative burden of controlling this many additional landfills (particularly, many smaller landfills, having design capacities <1 million Mg [<1.11 million tons]) may be unreasonable based on the consideration of methane alone, given the relatively small incremental emission reductions achieved. Although EPA selected Regulatory Alternative 2 for proposal, EPA solicits comment on the pros and cons of this alternative, in light of the additional environmental benefits that may be achieved by reducing greenhouse gases. The EPA may elect to promulgate such guidelines, or an intermediate alternative, should evolving global climate change policies indicate that more control is warranted.

Next, EPA compared Regulatory Alternatives 2 and 3. Regulatory Alternative 2 provides a proportional 11 percent increase in NMOC emission reduction and a proportional 33 percent increase in methane reduction in comparison to Regulatory Alternative 3. These reductions are achieved at a per unit cost of emission reduction comparable to previous decisions for VOC control under Section 111 where cocontrol and other concerns are evident. The average and incremental cost effectiveness for NMOC emission reduction (shown in Table 6) do not include the ancillary benefits of methane reduction such as global warming abatement, and reductions of toxic compounds, explosion hazard and odor nuisance. Nor do they include any consideration of the potential energy savings (leading to cost savings) resulting from the selection of energy recovering control devices. Although these benefits have not been quantified, they support qualitatively the judgment that the incremental costs of Regulatory Alternative 2 are reasonable. As shown in Table 7, Regulatory Alternative 2 affects roughly 60 percent more landfills than Regulatory Alternative 3. Of these additional landfills, nearly 85 percent are greater than 1 million Mg (1.11 million tons) in design capacity, and 113 of them, roughly 50 percent, have design capacities in excess of 5 million Mg (5.6 million tons). Regulatory Alternative 3 would not require control at these larger landfills which emit relatively large quantities of NMOC's (between 150 and 250 Mg/yr [167 and 278 tpy]), which

could pose significant health and welfare risks. Based on economic impact analysis, roughly less than 10 percent of the households served by existing MSW landfills installing controls in compliance with Regulatory Alternative 2 would incur annual costs of $30 or more. These costs are based on the use of flares for control, and will be lessened by the selection of energy recovery for control. Based on this analysis, and considering the ancillary benefits of the methane reductions, EPA concludes that Regulatory Alternative 2 would result in reasonable economic impacts. Based on these considerations, EPA proposes Regulatory Alternative 2 (an emission level cutoff of 150 Mg/yr [167 tpy] NMOC) as BDT for existing landfills.

In selecting Regulatory Alternative 2, EPA judged the application of well-designed gas collection systems and 98 percent efficient recovery/destruction control systems to landfills emitting more than 150 Mg/yr (167 tpy) of NMOC's to represent BDT for existing landfills. The EPA finds that this is the best demonstrated technological system of continuous emission reduction for MSW landfills, taking into consideration costs and other relevant factors. The application of collection and control systems to those existing landfills emitting 150 Mg/yr (167 tpy) of NMOC's or more will significantly reduce emissions without causing any unreasonable cost, environmental, or energy impacts.

The EPA believes that these controls are technologically feasible for landfills emitting less than 150 Mg/yr (167 tpy) of NMOC's. However, as stated above, EPA qualitatively considered the estimated methane reduction when selecting the regulatory cutoff. The EPA solicits comments on whether and how to consider reductions of methane more directly in the regulatory decision. For instance, if Regulatory Alternative 2 were set at 100 Mg/yr (111 tpy), an additional 3 percent reduction in NMOC emissions could be achieved, and methane emissions could be reduced by an additional 8 percent. An additional 41 existing landfills, or a total of 307, would require control. The EPA is still considering whether the additional benefits obtained under a stringency level of 100 Mg/yr are reasonable. The EPA seeks comments on the pros and cons and benefits and costs of regulating to a more stringent level, such as Regulatory Alternative 1, 25 Mg/yr (28 tpy) of NMOC.

4. Selection of the Format of the Standards and Guidelines

In developing this rulemaking, the format for the standards and guidelines was determined prior to the selection of BDT. This section describes in greater detail how this format was selected. The format of today's proposed standards and guidelines was selected considering the unique nature of MSW landfills as a source category. The formats for the proposed standards for new sources and the proposed guidelines for existing sources are identical. This is reasonable because BDT is the same for new and existing landfills. Also, since collection and control systems would always be installed at an MSW landfill after a certain amount of refuse has been landfilled and emissions reach a certain level, there would be little difference in the feasibility of installation of controls at new and existing facilities.

This section will present the rationale for each of two formats for the proposed standards and guidelines, one for determining applicability, and one for the specific requirements of the standards.

Format for Applicability. The EPA determined that a format for determining applicability would be necessary because MSW landfill emissions change over time due to the volume of refuse in place, the age of refuse, whether or not the landfill is still accepting waste, and other factors discussed elsewhere. The format for the applicability of the standards proposed today includes both the determination of when controls are to be put in place, and the determination of when controls are no longer required. That is, it is reasonable to collect and control emissions at a given landfill after a certain emission level (or some other criteria such as volume of waste in place) is reached; but it is not reasonable to continue control long after the level of emissions has declined significantly. Establishing an initial applicability criterion focuses control efforts on those landfills with the greatest potential emissions, and associated health and welfare hazards. It avoids large expenditures for control of landfills where emissions are very low and where costs are unreasonable relative to the potential emission reduction achievable. Establishing criteria for removal of controls is also reasonable because, as previously noted, the emission rate and associated health and welfare hazards decline over time after a landfill is closed. At some point, emissions are so low that they pose relatively reduced public health and welfare impacts and the cost of control would no longer be warranted.

The EPA evaluated several parameters in order to establish an appropriate criteria upon which to make the applicability determination. Four options were evaluated in order to determine what parameter or parameters should be used to identify the landfills to be controlled, when controls should be applied, and when they are no longer needed. These options are: (1) Installations based on the amount of refuse in place, with removal based on number of years since closure; (2) both installation and removal based on consideration of costs and emission reductions; (3) both installation and removal based on NMOC emission rate; and (4) installation based on NMOC emission rate, and removal based on consideration of costs and emission reductions. The advantages and disadvantages, as well as the relative effectiveness of each of these options, are discussed below.

The amount of refuse in place is considered to be the easiest of the four options to implement in the proposed standards because it requires a minimum of calculations and requires no projections of future levels of refuse acceptance or emissions. When to remove controls is less straightforward. For this analysis, the number of years after closure was selected.

The refuse in place option costs more than any of the other three options to achieve the same emission reduction. This option also required controls to be installed at more than twice as many landfills as any other option, but did not produce greater emission reduction overall. Thus, EPA discarded this option.

The second option is consideration of cost and emission reductions on a site-by-site basis. This option was the most complex and burdensome of the four, and achieved only marginally more emissions reductions than the next option, which is based on the NMOC emission rate. Although this option has the advantage of being the most cost effective, this option is very difficult to implement. The calculation of cost per unit of emission reduction involves projections of both future emission levels and operating costs. The capital costs of the system are amortized over the useful life of the system, which impacts the cost per unit of emission reduction. Controls are installed when the capital and operating costs per Mg ($/Mg [$/ton]) NMOC reduction meet a certain dollar criterion. The system is later removed when the cost per Mg (ton) falls below the criterion again. The

projections and calculations needed are complex and uncertain, and may involve iterations of this calculation to arrive at a mathematical solution to define the appropriate dollar criterion. In addition to the burden on the owner or operator to make the projections and perform the "real world" calculations, the permit authority would be obligated to judge the projections as well. A variation from the applicant's assumptions would require that all the calculations be repeated, and a very different answer could result. This could introduce inequities in the application of the standards. Finally, for many owners and operators the sophistication of the projections and calculations may necessitate hiring a contractor to prepare the annual compliance report, thereby increasing the cost.

The third option considered in selecting the format for the standards and guidelines was the NMOC emission rate which was previously discussed. The major advantage with this option is that the emission rate cutoff above which controls are required can be selected to maximize the overall emission reduction while avoiding excessive costs. Another advantage to using this option is its close correlation with emission reduction. Although this option is slightly more costly than the cost-effectiveness option for a comparable amount of emission reduction, the difference is not significant. In addition, controls are generally required at fewer landfills under this option, compared to the cost-effectiveness option, while emissions reductions are similar. A final advantage of this option is the relative ease with which it could be developed and implemented. Calculation of emission rate is feasible and less complex and burdensome than calculation of cost per unit of emission reduction.

The final option in this comparison was a combination requiring installation of controls at a given emission rate, and allowing removal based on consideration of cost and emission reduction. Although this combination in theory could combine the advantages of each option, in this evaluation it cost more than the second option, and obtained less emission reduction overall than the third (NMOC emission rate) option. Even though consideration of cost and emission reduction is only used to determine when to remove controls, this option would require almost immediate projections and calculations in order to determine for how long the cost per unit of emission reduction will be reasonable, and when controls can be removed. The complexity and burden this introduces parallels that of the second option.

The Administrator has selected the NMOC emission rate as the parameter to be used to determine when to install and remove controls for these standards and guidelines. This parameter was selected based on its clarity and ease of implementation, its ability to maximize emission reduction, its cost, and the number of landfills which would require control compared to the emission reduction achieved.

Specific Requirements. The format of the standards and guidelines proposed today is a combination of a design and operation standard for the gas collection system, and a percent reduction requirement for the control device. Today's proposed standards require properly designed and operated gas collection systems, and include specifications that are used to evaluate the design and operation of these systems. The standards proposed for the control device require the use of an open flare in compliance with 40 CFR 60.18 or a reduction of the NMOC's by 98 percent by weight.

Section 111 of the CAA requires that performance standards, or emission limits, be prescribed unless, in the judgment of the Administrator, it is not feasible to prescribe or enforce such standards. Specifically, paragraph 111(h)(1) states that

"* * * if in the judgment of the Administrator, it is not feasible to prescribe or enforce a standard of performance, he may instead promulgate a design, equipment, work practice, or operational standard, or combination thereof, which reflects the best technological system of continuous emission reduction * * *"

Paragraph (2) of section 111(h) defines the phrase "not feasible to prescribe or enforce a standard of performance" to mean any situation where the Administrator determines that

"* * * (A) a pollutant or pollutants cannot be emitted through a conveyance designed and constructed to emit or capture such a pollutant, or that any requirement for, or use of, such a conveyance would be inconsistent with any Federal, State or local law, or (B) the application of measurement technology to a particular class of sources is not practicable due to technological or economic limitations."

For MSW landfills, BDT consists of a gas collection system and an effective control device, achieving 98 percent reduction of landfill emissions for landfills with an NMOC emission potential equal to or greater than 150 Mg/yr (167 tpy). In order to set a performance standard for the gas collection system (e.g., collection efficiency), it would be necessary to quantify the landfill gas available for collection in comparison to the amount collected. It is not technically feasible to measure the amount of gas available for collection, only to *estimate* how much is produced, so a collection efficiency cannot be measured. Emission limits are not applicable to gas collection systems. For this reason the Administrator has proposed design, operational, and work practice standards for collection systems. Design features are required that would ensure effective collection of MSW landfill emissions. The standards and guidelines specify that collection systems must be designed and operated to handle that maximum gas generation rate and to collect gas effectively from all areas of the landfill warranting control and require monitoring and appropriate operation of the collection system. Control is warranted within 2 years of initial waste placement for each area or cell in which refuse has been placed.

In the case of the control device, however, percent reduction is directly measurable for most control devices applicable to air emissions of MSW landfills, and the control efficiencies are well-documented (Chapter 4 of the BID, Docket No. A-88-09, Item No. III-B-1). Although flare outlet concentration is infeasible to measure, EPA acknowledges that reduction beyond 98 percent is not only achievable, but common, and has used open (i.e., elevated) flares in the selection of BDT. For this reason, the Administrator has prescribed that control devices must achieve 98 percent reduction efficiency. If flares are used to meet the standards and guidelines they must meet the specifications in 40 CFR 60.18, since percent reduction is not measurable. Refer to the Subsection 1 above, "Discussion of Demonstrated Technologies" for a discussion of control devices EPA believes can achieve the 98-percent reduction requirement. Owners or operators of MSW landfills intending to use other controls are required to demonstrate the same level of emission reduction.

The standards proposed today include provisions allowing an owner or operator to submit a plan to use an alternative collection system and or control device, provided that the owner or operator is able to demonstrate that such system and/or device is able to achieve an equivalent level of control and emission reduction.

HeinOnline -- 56 Fed. Reg. 24484 1991

F. Selection of Requirements To Implement the Best Demonstrated Technology

1. Introduction

This section describes in detail how the proposed standards and guidelines would be implemented. As discussed in the previous section, EPA has selected as BDT active collection systems and control systems able to reduce NMOC content of the collected gas by 98 percent. These systems are to be installed when the NMOC emission rate at a given landfill is 150 Mg/yr (167 tpy) or more.

First, this section reviews the applicability of the standards and the guidelines, followed by an explanation of the procedures used to determine the site-specific NMOC emission rate. The EPA has developed a tiered method of calculations for determining which affected landfills are required to control, and when to install and remove controls. Conservative defaults were developed for the tiered approach. The discussion of the approach focuses on the defaults generated for Regulatory Alternative 2, 150 Mg/yr (167 tpy) NMOC. Should EPA consider a more stringent cutoff level (i.e., less than 150 Mg/yr [167 tpy]), new defaults will be calculated for that level, using the same methods employed in developing the defaults for Regulatory Alternative 2. The explanation for the method and the differences between the tiers are also presented below. The EPA then presents design considerations for the collection system, and the specifications for the various control devices EPA has determined can be used to demonstrate compliance with the standards or guidelines. Also this section discusses how to use alternative means of emission limitation to comply with the standards and guidelines. The section concludes with a discussion of the requirements and considerations specific to the guidelines proposed under Section 111(d) of the CAA.

Review—Affected Facility (New Source Performance Standards) and Designated Facility (Guidelines). The definition of affected facility under the proposed NSPS is identical to the definition of the designated facility under the proposed guidelines except for the date when construction or modification commences. For the purposes of today's actions, a "municipal solid waste landfill" or "MSW landfill" means an entire disposal facility in a contiguous geographical space where household waste is placed in or on land. An MSW landfill may also receive commercial waste, sludges, and industrial solid waste. Portions of an MSW landfill may be separated by access roads. An MSW landfill may be publicly or privately owned.

An MSW landfill is regulated as an entire unit (i.e., the landfill is considered either new and is subject to the NSPS or existing and subject to the guidelines) because the total emission potential and associated environmental impacts are determined by the entire landfill. A single landfill would not have portions subject to the NSPS and portions subject to the guidelines.

Applicability of the New Source Performance Standards to New Municipal Solid Waste Landfills. Any MSW landfill on which construction or modification began on or after today's date would be regulated under the NSPS. Although portions of a new landfill may subsequently be closed, the entire landfill will be viewed as one landfill for purposes of determining the design capacity and the NMOC emission rate. If installation of collection and control systems is warranted, these systems are to be installed in all areas as well.

The EPA considered the effect of modifications to existing MSW landfills. By definition, a modification is a "physical or operational change to an existing facility which results in an increase in the emission rate to the atmosphere of any pollutant to which a standard applies" (40 CFR 60.14). An existing landfill that is modified is subject to the NSPS. Further, changes to an existing facility already subject to the NSPS that result in an increase in the emission rate may make the facility subject to more stringent control requirements under the standard.

The only physical or operational changes under the control of the owner or operator that EPA has determined may increase emissions are increases in the design capacity of a landfill. The EPA considered other possible physical or operational changes that may constitute a modification, but none were identified that would result in a modification pursuant to § 60.14. For example, if an MSW landfill increased its waste acceptance rate, such a change would be analogous to an increase in production rate at a manufacturing facility. Under § 60.14(e)(2), if "an increase in production rate of an existing facility, * * * can be accomplished without a capital expenditure on that facility" it would not be considered a modification, even if the emission rate of the unit increased.

If modification is defined as an increase in design capacity, then the applicability of this definition to existing landfills is important. The EPA knows of no environmental or administrative reason to subject an MSW landfill to both the proposed standards and emission guidelines. The question raised, then, is under what circumstances changes at an existing MSW landfill trigger the NSPS. The EPA considered two situations:

1. If an existing MSW landfill that is less than 100,000 Mg (111,000 tons) and was not previously affected by either the standards or guidelines increased its design capacity above the 100,000 Mg (111,000 tons); and

2. If an existing MSW landfill affected by the emission guidelines expands its design capacity.

The EPA decided the first case would be a modification and trigger the control requirements of 60.752(b) of the proposed NSPS because the existing MSW landfill was never affected by the standards or emission guidelines. If such a landfill is now affected by the standard, there is no dual coverage. In the second case, since the MSW landfill is already affected by the emission guidelines, to trigger the NSPS in addition to the guidelines would be confusing and inappropriate since BDT is the same for both. Therefore, EPA is proposing that once an existing landfill is covered under the emission guidelines, the landfill remains covered under the guidelines. Changes in the design capacity at the affected landfill do not constitute a modification.

Applicability of the Guidelines to Existing Municipal Solid Waste Landfills. Any existing MSW landfill (i.e., a landfill that commenced construction before today's date) that accepted waste on or after November 8, 1987, or has the potential to accept additional waste and has not documented that it is permanently closed, would be a designated facility subject to State regulations under the guidelines proposed under section 111(d). Although portions of an existing landfill may be closed, all portions of the landfill are subject to the guidelines if any portion of the landfill accepted waste on or after November 8, 1987. This means that all areas of the landfill are to be included in the calculation of the design capacity. When the NMOC emission rate is calculated, however, the regulation would allow the exclusion of any areas of the landfill which can be shown to be producing virtually no gas. Collection and control systems are to be installed in all other areas of the landfill except where asbestos deposits are documented.

Control Requirements of the Standards and Guidelines: The emission

HeinOnline -- 56 Fed. Reg. 24485 1991

control levels of today's proposed standards for new landfills and proposed guidelines for existing facilities are identical. Both new and existing landfills emitting 150 Mg/yr (167 tpy) of NMOC's or more, would be required to install collection and control systems that meet the standard. The determination of whether a landfill emits 150 Mg/yr (167 tpy) or more and must install controls is described below. There are separate requirements for small and large landfills.

Municipal Solid Waste Landfills with Design Capacities Less than 100,000 Mg. Because small landfills are very unlikely to emit 150 Mg/yr (167 tpy) of NMOC's, they would be exempt from control requirements. The only requirements for affected (new) and designated (existing) MSW landfills with design capacities less than 100,000 Mg (111,000 tons) are to file an initial design capacity report, and to report any changes in capacity. These landfills would not be required to perform the more detailed calculations (the tiered approach) to determine their NMOC emission rate. This minimizes the regulatory burden on owners or operators of small MSW landfills.

In establishing the 100,000 Mg (111,000 tons) design capacity exemption, EPA analyzed various factors that could be used to characterize those landfills that EPA considers will be highly unlikely to ever produce NMOC emissions at a rate of 150 Mg/yr (167 tpy) or more. Design capacity and acceptance rate both correlated well with NMOC emission rate. Therefore, these two factors were evaluated as potential criteria upon which to base an exemption.

The exemption in today's standards and guidelines is based on design capacity and not acceptance rate for several reasons. Design capacity is closely related to NMOC emission rate, information on design capacity of landfills is generally available, and it does not change frequently. Design capacity is generally documented in a RCRA or State permit, and any change in design capacity is usually accompanied by a permit revision. An exemption based on acceptance rate would be impractical to implement. Acceptance rate is a less stable statistic than design capacity, and typically fluctuates over time due to changes in demand for landfill space.

The 100,000 Mg (111,000 tons) level was selected as the appropriate level for the design capacity exemption based on an EPA analysis of the data relating capacity to NMOC emissions. This level will relieve many owners and operators of small landfills that will never emit 150 Mg/yr (167 tpy) of the requirement to determine and report the NMOC emission rate annually. The EPA solicits comment providing additional data relating design capacity or refuse in place to NMOC emission rates.

Municipal Solid Waste Landfills with Design Capacities Equal to or Greater than 100,000 Mg. New and existing MSW landfills with design capacities equal to or greater than 100,000 Mg (111,000 tons) would install collection and control systems if their calculated NMOC emissions are over 150 Mg/yr (167 tpy). Landfills with capacities of 100,000 Mg (111,000 tons) or more would calculate and report their NMOC emission rate periodically until closure, or until a complying collection and control system is required and installed. Periodic calculation is required because landfill emissions at active sites tend to increase as refuse in place increases and the organic matter generates additional landfill gas. In lieu of an annual report, owners or operators may elect to submit an estimate of the NMOC emission rate for each of the next 5 years, based on the current amount of refuse in place and the estimated waste acceptance rate for each of the 5 years, provided that the estimated NMOC emission rate is less than 150 Mg/yr (167 tpy) for each of the 5 years reported. The 5-year estimate would be updated and resubmitted at least every 5 years. The standards and guidelines provide a formula and procedures for these calculations, which are discussed in the next subsection. Municipal solid waste landfills with calculated NMOC emission rates equal to or greater than 150 Mg/yr (167 tpy) would install collection and control systems within 2½ years, in compliance with specific design and operating criteria. The periodic calculation of emissions is not required while such collection and control systems are operating.

After closure, emissions from landfills decline as the organic matter that generates landfill gas decomposes. At some point continued operation of the collection and control system is not warranted. Both the standards and the guidelines specify removal of controls would be permitted only after all three of the following conditions are satisfied: (1) The collection and control devices must have been in operation for a minimum of 15 years; (2) the landfill would have to be permanently closed, and (3) the calculated NMOC emission rate must be less than 150 Mg/yr (167 tpy) on three successive test dates which are no closer than 3 months apart, and no longer than 6 months apart. The rationale for these conditions is provided below.

Although EPA has decided that equipment installation and removal should be based principally on the NMOC emission rate, for some landfills this may mean removal could occur relatively soon after installation. This does not make sense when the capital cost has already been incurred and the equipment is still useful, and could be further reducing emissions. These further reductions are obtained for less cost than an equivalent amount of reduction at a new site where capital must be invested "up front." The EPA concluded that after collection and control systems are installed, the systems should be maintained and operated over their entire useful life. Based on engineering/costing principles, the equipment life of control systems was conservatively estimated to be 15 years or more. Based on an EPA study of the impact of a minimum control period, EPA predicts only a small portion of controlled landfills would ever be both closed and emitting below 150 Mg/yr (167 tpy) within 15 years of equipment life. Therefore, both the standards and the guidelines would specify a minimum control period of 15 years.

The EPA analyzed the nature of gas generation from MSW landfills and concluded that emission "peak" at or near the time of permanent closure. Therefore, permanent closure of the entire landfill is also required before collection and control devices could be removed. For purposes of the standards and guidelines, a landfill is considered closed if it meets the RCRA definition of a closed landfill and files a closure report. The recent RCRA proposal (53 FR 33314, August 30, 1988) has defined "closed" as no longer accepting waste and having completed the closure procedures noted in the landfill's closure plan for each cell of a landfill as it closes. The RCRA proposal would also require that a landfill file a permanent record at final closure, such as an attachment to the property deed. The RCRA proposal (53 FR 33314, August 30, 1988) would require a 30-year post-closure period that includes a gas monitoring system. The gas monitoring system proposed under RCRA is different from the gas collection and control system proposed in this action. For existing MSW landfills, the States would have to establish a means of certifying closure when closure has preceded the effective date of the RCRA program.

The third condition for removal of controls is calculations showing that the NMOC emission rate is below 150 Mg/yr (167 tpy). Since the NMOC emission rate at a given landfill may fluctuate

seasonally with changes in temperature, moisture, and other factors, a series of NMOC calculations over three successive time periods would be required. The 3- to 6-month time intervals provide a representation of at least two seasons. This provision helps to assure that collection and control will not be suspended based on one isolated test that may not be representative of the annual emission rate and provides confirmation that the NMOC emission rate has declined to below the cutoff of 150 Mg/yr (167 tpy).

2. Calculation of the Nonmethane Organic Compounds Emission Rate Tiered Approach.

The standards and guidelines provide a tiered system for calculating the NMOC emission rate to determine if the NMOC emission rate is equal to or greater than 150 Mg/yr (167 tpy). A flow diagram of the three tiers is provided in Figure 1. Emission rates vary widely from landfill to landfill and can be established with a high degree of certainty only through testing. Alternatively, a conservative emission model can be used to provide a less precise, yet less costly approach. While such a model would overestimate emissions, the extra precision afforded by source testing it not always warranted. For example, in cases where conservative estimation results in an NMOC emission rate which falls below the 150 Mg/yr (167 tpy) emission rate, testing would not be warranted. Likewise, testing would not be warranted if modeled emissions were substantially above 150 Mg/yr (167 tpy).

BILLING CODE 6560-50-M

HeinOnline -- 56 Fed. Reg. 24487 1991

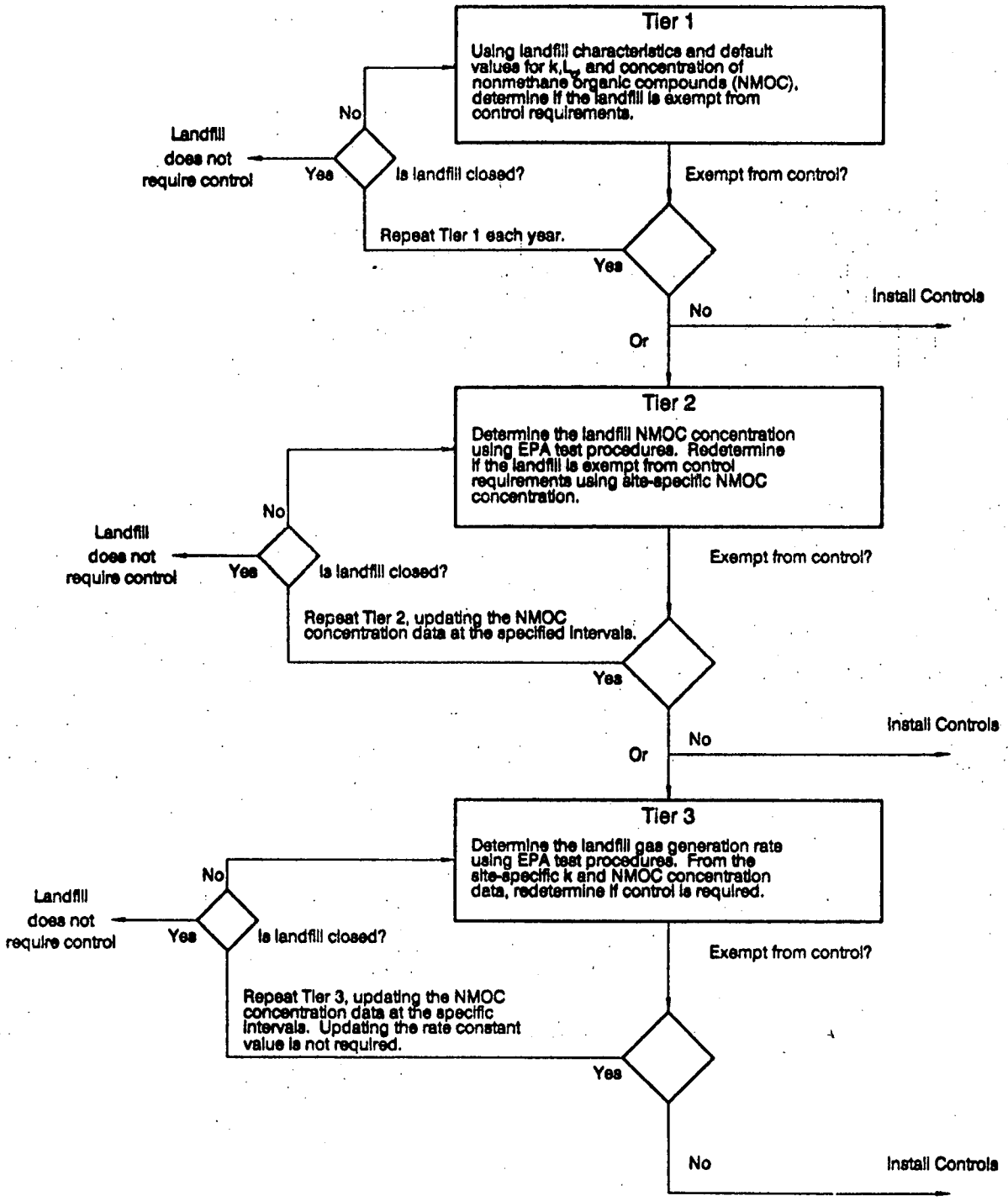

Figure 1. Overall three-tiered approach for determination of control requirements.

BILLING CODE 6560-50-C

The tiered method of NMOC emission rate calculation was developed to provide landfill owners or operators with the flexibility to choose among several options, each with a different level of precision and cost. The goals of the tiered method are to identify those MSW landfills that are emitting at least 150 Mg/yr (167 tpy) of NMOC's, to reduce the cost and burden of this determination as much as reasonably possible, to allow the use of site-specific data derived from testing, and to permit facilities which exceed the 150 Mg (167 tpy) cutoff to install collection and control systems at any point without being required to complete all the available levels of testing.

All three tiers are based on the calculation of the NMOC emission rate using a first order decomposition rate equation. The model uses site-specific information on landfill age and waste acceptance rate. Three critical emission parameters are combined in the model: k (the refuse decay rate), L_o (the refuse methane generation potential), and the NMOC concentration. The three tiers differ in how the values for these three variables are obtained. The equation is provided in the regulation under § 60.753, "Test Methods and Procedures."

Tier 1. Under Tier 1, the landfill owner or operator combines readily available data about a given landfill with conservative default values for k, the NMOC concentration in the landfill gas, and L_o. The default values for these three variables are specified in the standards and guidelines. These values were established as a result of an EPA analysis of 931 landfills that took part in the Office of Solid Waste (OSW) landfill survey (Docket No. A-88-09, Item No. II-A-25). The objective of the analysis was to produce a set of default values which would distinguish between landfills warranting additional testing or control and those landfills not emitting above 150 Mg/yr (167 tpy). The rationale and approach used in the analysis are presented in the docket (see "Rationale for Selecting Tier 1 Default Values" and "Applicability of Selected Tier 1 Default Values to the 150 Mg/yr Stringency Level" [Docket No. A-88-09, Item Nos. II-B-32 and II-B-40]). Because conservative values for k, L_o, and NMOC concentration are used, Tier 1 would be highly likely to overestimate the NMOC emission rate. For those landfills where the Tier 1 calculation results in an emission estimate below 150 Mg/yr (167 tpy) of NMOC's, collection and control systems would not be installed, but calculations would be repeated periodically, as previously described. For those landfills whose Tier 1 calculations result in an NMOC emission rate equal to or greater than 150 Mg/yr (167 tpy), the owner or operator may either install collection and control systems, or may perform the field measurement procedures detailed in Tier 2 to determine emissions more precisely.

Tier 2. The equation used to calculate NMOC emissions in Tier 2 is the same as in Tier 1, but the landfill owner or operator conducts sampling to determine a site-specific NMOC concentration to substitute for the default value in the equation. Measurement of the NMOC concentration was chosen for Tier 2 because it is variable from landfill to landfill and over time, and the more precise value obtained by sampling and analysis will affect the results of the emissions calculation. Furthermore, NMOC concentration is easier and less expensive to determine than k. Sampling procedures for NMOC concentration are provided in the standards and guidelines, and the samples are analyzed using Method 25C. If the average NMOC concentration from the samples results in a calculated NMOC emission rate below the cutoff of 150 Mg/yr (167 tpy), the owner or operator must demonstrate that there is statistically at least an 80-percent confidence level that the true value is below 150 Mg/yr (167 tpy). The procedures for this demonstration are adapted from standard EPA procedures. If an 80-percent confidence level can be demonstrated, controls would not need to be installed. The EPA judged that an 80-percent confidence level was sufficient because the k and L_o used in Tier 2 will still produce a conservative NMOC emission rate. If the resulting NMOC emission rate is equal to or greater than 150 Mg/yr (167 tpy), the owner or operator may install controls or may perform the field testing procedures detailed in Tier 3 to determine NMOC emissions more precisely.

The EPA has determined that a one-time assessment of the NMOC concentration is inadequate for making a finding that emissions are below 150 Mg/yr (167 tpy) using the Tier 2 approach. The limited data available indicate that of the three parameters effecting NMOC emission rate, k, L_o and NMOC concentration, the NMOC concentration is most likely to vary at a given landfill over time. The standards and guidelines, therefore, specify periodic confirmation of NMOC concentration levels. Two different retest frequencies were chosen so that a landfill whose level of emissions is far below the cutoff of 150 Mg/yr (167 tpy) is not required to retest as frequently as a landfill whose emission rate is close to the cutoff. The testing must be repeated every 5 years for those landfills whose average NMOC mass emission rate is within two standard deviations (95 percent confidence interval) of the 150 Mg/yr (167 tpy) of NMOC's cutoff. However, landfills whose NMOC emission rates are far below the cutoff (i.e., more than two coefficients of variation below the cutoff) would be required to retest only every 10 years. The EPA believes that extreme changes in NMOC concentrations are not likely over periods less than 5 years. While testing of NMOC concentrations is required only every 5 or 10 years, periodic calculation of NMOC emissions would be required as previously described.

Tier 3. If calculated emissions are over 150 Mg/yr (167 tpy) using the site-specific NMOC concentration determined in Tier 2, the owner or operator again has the option of installing controls or proceeding to Tier 3. Under Tier 3, the site-specific MSW landfill methane generation rate constant k, is determined by gas flow testing. Tier 3 distinguishes between MSW landfills with known histories of where and when MSW was deposited and those with little known history. Cluster wells may be used when the history is known, and equal-volume wells when history is not known. (Cluster wells are groupings of three wells fairly close together whereas equal-volume wells are evenly spaced throughout the landfill.) For landfills with known histories, guidance is provided on where to locate cluster wells to provide good estimates of k. For these landfills, the cluster well method allows k to be estimated with greater statistical confidence, and is less expensive than locating equal-volume wells throughout the landfill. However, if landfill history is not known, the equal-volume well method produces estimates with greater statistical confidence. Tier 3 testing is performed using Method 2E, which is proposed to be included in appendix A of 40 CFR part 60 (see proposed Method 2E at the end of this notice).

Calculation of the Nonmethane Organic Compounds Emission Rate for Previously Installed Collection Equipment. For landfills which have a collection system already installed, landfill owners or operators could either use the tier system or sample directly from their existing collections systems to determine the NMOC emission rate.

The standards and guidelines provide formulas and procedures for calculating NMOC emissions using samples and gas flow data obtained from an existing collection system. The EPA has determined that the most accurate estimation of the NMOC emission rate would be obtained by such direct sampling, provided correct procedures are used. Additionally, determining the NMOC emission rate after controls are in place is easier, because it is simpler to obtain the samples and gas flow data. Landfill owners or operators using direct sampling would have to demonstrate that there is not excessive air infiltration into their system, and that there was not positive pressure at any well head when sampling and gas flow tests are performed. The landfill owner or operator must also be able to document that the collection system is effectively collecting landfill gas from all gas producing areas of the landfill. These provisions ensure that the flowrate obtained is accurate. Air infiltration would result in an overestimation, while positive pressure would result in an underestimation.

While this method is optional for determining applicability of the standards or guidelines, it is the only method permitted for determining whether control systems can be removed. As discussed in the preceding section, three conditions must be met in order to remove a collection and control system that is operating in compliance with the standards or guidelines. One of these conditions is that the NMOC emission rate must be below 150 Mg/yr (167 tpy). The formula and procedures for sampling and determining the gas flow directly from the system must be used when calculating the NMOC emission rate for this purpose. The tiered approach is not permitted. These direct sampling procedures provide the most accurate estimate of the NMOC emission rate. It is, therefore, reasonable to require this method of calculation prior to permanent removal of collection and control equipment.

3. Collection System Design

As discussed previously under "Selection of Best Demonstrated Technology," BDT for the collection of MSW landfill emissions is the installation of an effective collection system when the calculated NMOC emission rate equals or exceeds 150 Mg/yr (167 tpy). An effective collection system has the following capabilities: (1) Wells or trenches located to effectively collect gas from all areas of the landfill; (2) gas moving equipment able to handle the maximum landfill gas generation rate predicted over the life of the equipment if an active system is used; (3) design provisions for monitoring and adjusting the operation of individual wells and trenches, if an active system is used; and (4) the ability to expand as new areas require collection.

The proposed standards and guidelines included in today's notice would require a landfill owner or operator to construct the collection and control system according to design specifications stated in the regulations, or according to a collection system design plan that is submitted to EPA or to the State, as appropriate, for review. In addition to these provisions, landfill owners or operators can use Section 111(h)(3) of the CAA to request approval of gas collection systems that provide equivalent control but do not comply with either the specifications in the regulation or with the plan development and review requirements. The plan would be submitted to the appropriate air program office to allow a review of the plan and requests under section 111(h)(3) would be submitted to EPA for consideration.

The EPA realizes that landfill owners or operators that have no experience with gas collection system design may need very detailed specifications on how to design an acceptable system. Therefore, EPA has identified the key attributes of a good collection system and developed detailed specifications on how to design an approvable system. The EPA considered including only extensive design specifications in the regulation itself. However, in order to allow owners and operators flexibility in choosing the most effective collection and control system and to encourage innovation, EPA decided to adopt an approach that gives the owner or operator the option of following exact specifications to demonstrate compliance with the standards. Alternatively, the regulations also allow innovation through a system of design plan submittal and review. These design plans are required to include enough information to ensure that the collection and control system has been properly designed, thus eliminating the need for using the regulatory equivalency provisions of section 111(h)(3) of the CAA. The technology of landfill gas extraction is continuing to evolve, with new and more sophisticated methods of optimizing gas extraction being developed by both landfill owners and developers who are specializing in gas recovery at landfills. Providing only rigid design specifications or requiring the use of section 111(h)(3) would tend to limit this creativity, and prohibit the introduction of innovative systems currently under development.

In the case where the specifications in § 60.758 are not followed, the design plans would be used to ensure that BDT had been designed and would be installed. For active collection systems, this plan would be required to include: (1) A calculation of the maximum expected gas flow over the life of the landfill; (2) specifications for the gas moving equipment, including any future capacity increases planned; (3) a description of the design provisions for future expansion, if the landfill is still accepting waste; (4) the well head or trench vacuum; (5) the radii of influence used for well/trench spacing; (6) the well/trench specifications; and (7) a plot plan of the landfill showing the locations of each well/trench. For passive collection systems, the plan would be required to include: (1) The liner system design and specifications; (2) the landfill pressure determined using portions of Method 2E; (3) a description of the design provisions for future expansion, if the landfill is still accepting waste; (4) the collection/control system pressure drop; (5) the estimated radii of influence; (6) the well specifications, including the liner seal; and (7) a plot plan of the landfill showing the location of each well.

Section 60.758 provides design specifications for active vertical systems only. If these specifications are followed, the submittal of a design plan is not required. The selection of an active horizontal system or a passive system, or the design of an active vertical system not based on the specifications provided in § 60.758, would require that a plan be submitted and reviewed. Design specifications are outlined below for active vertical collection systems and also for active horizontal and passive vertical collection systems to aid landfill owners and operators in developing plans, if they choose not to install an active vertical system using the specifications in § 60.758. They are discussed further in chapter 9 of the BID. Although the collection systems designed under this system may vary considerably, systems are expected, at a minimum, to meet the criteria outlined below and in chapter 9 of the BID in order to demonstrate compliance, unless adequate site-specific justification is provided.

The EPA has provided these specifications in order to assist owners and operators in designing successful systems. The specifications were developed with substantial comment and technical data on alternative designs, materials, and engineering

HeinOnline -- 56 Fed. Reg. 24490 1991

practices which are being used in designing landfill gas collection systems by representatives from the waste disposal and gas recovery industries. The Agency is interested in additional information about designs and materials which are presently in use at successful sites.

Selection of the collection system type depends on the landfill characteristics and landfill operating practices. The following sections present design considerations and specifications for an active vertical collection system, which EPA has evaluated and determined can most effectively satisfy the criteria above. The standards and guidelines require an active collection system unless the owner or operator can demonstrate that the passive system is capable of achieving a comparable level of collection. Some of the design considerations for active horizontal and passive collection systems are presented as well. An active horizontal trench collection system may be preferred when a landfill employs a layer-by-layer landfilling method. However, considerations such as the presence of a high water table would decrease the collection efficiency for this system. Additional information is provided in chapter 9 of the BID.

Active collection systems. Active collection systems employ mechanical blowers or compressors to create a pressure gradient and extract the landfill gas. Active collection systems consist of various configurations of gas extraction wells and/or trenches and gas moving equipment such as header piping and blowers. Active collection systems can be further categorized as vertical well systems and horizontal trench systems. In vertical systems, extraction wells are installed in the landfill refuse and in the perimeter of the landfill, while in horizontal trench systems, trenches are installed horizontally in layers starting at or near the base of the landfill.

Gas extraction wells or trenches must be configured to collect gas effectively from all areas that warrant collection. For the purposes of today's proposed regulation, any area or cell where refuse has been deposited for at least 2 years warrants control, with two exceptions. Areas where asbestos has been deposited should be excluded, and the regulation provides a method for excluding areas with very low gas generation. Otherwise, extraction wells must be placed throughout the landfill. Each extraction well or trench has a radius of influence within which landfill gas can be effectively collected. The radius of influence determines the spacing between extraction wells or location of trenches. For active systems the well spacing must be adequate to collect the gas generated without overdraw of air into the landfill.

Vertical collection systems. Today's proposed standards and guidelines recommend that EPA Method 2E be used to determine the radius of influence to use in determining vertical well spacing. The method distinguishes between perimeter and interior wells. Wells placed along the perimeter of the landfill are to be placed in the refuse but no more than one perimeter radius of influence from the perimeter of the landfill, and no more than two times the perimeter radius of influence apart. Interior wells are to be placed no more than two times the interior radius of influence apart, and to be positioned in such a way as to cover all areas of the landfill where refuse is placed. The design specifications in § 60.758 provide an alternative method for determining an appropriate radius of influence to use in spacing wells for those owners or operators who have not performed EPA Method 2E. Chapter 9 of the BID provides additional guidance on siting active vertical extraction wells.

Vertical extraction wells for active collective systems are to be constructed of polyvinyl chloride (PVC), high density polyethylene (HDPE) pipe, fiberglass, stainless steel, or a similar nonporous material, at least 0.075 m (3 in.) in diameter. Wells should extend to at least 75 percent of the landfill depth, but should not be deeper than the landfill in order to protect the integrity of the landfill liner. The bottom two-thirds are to be perforated. A minimum requirement for perforations is slots or holes with an open area equivalent to four 0.01 m (½ in.) diameter holes spaced at 90 degrees every 0.1 to 0.2 m (4 to 8 in.). If slotted pipe is used, the width of the slots should not exceed the size of the gravel in which it is placed. The pipe is placed in the center of a 0.6 m (2 ft) diameter bore and the bore is then backfilled with gravel to a level at least 0.3 m (1 ft) above the perforated section. The remainder of the bore is filled with at least 1.2 m (4 ft) of backfill material, then at least 0.9 m (3 ft) of bentonite, and finally material of equal or lower permeability than the cover.

Each well is connected to the collection header pipes by a well head. The well head and assembly must be equipped to allow monitoring and adjustment of the gas flow and the collection of gas samples. Chapter 9 of the BID and EPA Method 2E (at the end of this notice) provide both diagrams and specifications for the well head and assembly.

Landfill gas is conveyed through a gas collection header system by a blower or compressor to the control device. In designing adequate gas moving equipment, blowers or compressors and header pipes need to be sized to handle the maximum landfill gas generation rate expected over the life of the control equipment (normally 15 years). The size and type of compressor or blower depends on total gas flowrate, total system pressure drop, and vacuum requirements. The proposed standards and guidelines give a formula for calculating the maximum expected gas flowrate based on the age of the landfill and the average annual refuse acceptance rate.

The gas collection header system must be designed to handle the addition of new wells as new areas of the landfill require control. Today's standards and guidelines require that additional wells are to be installed in each area of the landfill within 2 years of the first deposition of refuse in that area.

Operation of the active vertical collection system. Gas generation at a given well may vary slightly over time. The EPA has determined that the following monitoring and adjustments are necessary to maximize collection, while minimizing air infiltration. Excessive air infiltration poses a safety hazard, because too much air may lead to an explosion or landfill fire. Nitrogen concentration is used as a surrogate measure for air infiltration. Based on these safety concerns, EPA has determined that N_2 concentration should be maintained under 1 percent by volume. When the N_2 concentration at a well head exceeds 1 percent, a slight closing of the valve at the well head assembly would decrease the flow from that well, which will decrease the vacuum, and should decrease air infiltration.

If the pressure at the well head is positive, the valve should also be opened. If the valve has been fully opened and the measured pressure is still positive, additional wells must be installed and added to the collection system. It should be noted that some systems may exhibit positive pressure at the well head during initial startup. These systems should reach equilibrium within 30 to 60 days.

The EPA is aware of an alternative method used by the South Coast Air Quality Management District (SCAQMD) to determine if a collection system is adequately collecting the landfill gas or if additional wells are required. In this method, surface

emissions are tested for the presence of methane across the landfill. If the concentration is above 50 ppmv, the collection system is considered to be inadequate for that area of the landfill and additional wells or increased suction is required. The EPA has not incorporated this testing method into the standards at this time due to the uncertain concentration at which additional wells would be warranted. Additionally, this method may not detect the lateral migration of the landfill gas. If, however, more data were available to resolve these concerns, EPA would consider the appropriate use of this method in the final standards. The EPA therefore requests technical comments providing additional information and data about the effectiveness of this method for making flowrate adjustment and for determining the need for additional wells.

An additional consideration in the design of an active vertical collection system is condensation of water and organic compounds which may occur in the header pipes due to the cooler temperatures above the surface of the landfill. This condensate should be handled according to RCRA Subtitle D requirements.

Active horizontal collection systems. Although EPA Method 2E is based on a vertical well test, the results of this method can be used to determine the radii of influence in the horizontal direction. Additionally, the design specifications in § 60.758 provide an alternative method for determining an appropriate radius of influence to use for trench spacing in situations where EPA Method 2E has not been performed. Active horizontal trenches should be positioned no more than two times the radius of influence apart in the horizontal direction. Since compaction of the refuse causes refuse permeability to be lower in the vertical direction, EPA recommends a vertical spacing of one-fourth the horizontal spacing.

Horizontal trenches may be constructed of slotted or perforated PVC, HDPE, corrugated steel piping, or a similar suitable nonporous material. Each layer of trenches should be connected to a common header leg that extends to the surface, and connects to the gas header pipes in the same way as active vertical collection systems. One design consideration is whether to pull the vacuum (i.e., actively collect landfill gas) from only one or both ends of the trench. When the vacuum is pulled at only one end, there will be a pressure drop along the length of the trench. The effective length of the trench will be limited by this pressure drop.

The sizing of gas moving equipment for active horizontal systems is evaluated in the same maner as for active vertical systems. Monthly testing of pressure and air content is performed at the common header leg and the adjustments are made at the valve in the header leg. Additional information about horizontal systems is provided in chapter 9 of the BID.

Passive collection systems. Passive gas collection systems rely on the natural pressure gradient (i.e., internal landfill pressure created due to landfill gas generation) or the concentration gradient to convey the landfill gas to the collection system. While EPA believes that active collection systems are the most effective means of collecting landfill gas, passive systems will be allowed when the following two conditions are met: (1) The owner or operator can demonstrate that the well spacing is adequate to effectively collect gas from all areas of the landfill and (2) the landfill is contained by synthetic liners on all sides, including top and bottom. Liners help to prevent lateral gas migration and, thus, increase the volume of gas collected.

Passive wells must be spaced based on field testing to determine the static landfill pressure, and the pressure drop across the control device (typically a flare), flame arrester, and collection header piping. Chapter 9 of the BID provides a diagram to determine the radius of influence after subtracting the pressure drop from the static landfill pressure. This radius of influence is used to space the wells so that gas is collected from every area of the landfill, and the distance between the wells is no more than two times the radius of influence.

The wells must also meet prescribed design criteria (i.e., constructed of PVC or HDPE or other suitable nonporous material, provided with a tight seal around the cap to maintain integrity of the cover). These design criteria are detailed in chapter 9 of the BID.

Monitoring and adjustments are not necessary for passive wells because the wells are under positive pressure and air infiltration is not a concern. Good containment is the principal concern in operating an effective passive collection system.

4. Specifications for Control Systems

As noted previously, for effective control of landfill air emissions, collected landfill gas must be directed through an emission control device that achieves destruction of NMOC's by 98 percent by weight, except for lean-burn I.C. engines, which are discussed below. The EPA has determined that the following control devices are capable of achieving this destruction efficiency and can be used to comply with the standards and guidelines if the specifications described below are met.

Open flares. The selection of BDT for the control device was based on the use of open flares, meeting the specifications in 40 CFR 60.18. Because emissions from open flares cannot be easily measured, the conditions necessary to achieve 98 percent reduction have been detailed in 40 CFR 60.18, and flares meeting those specifications will be acceptable for the purposes of the proposed standards and guidelines.

Enclosed combustion devices. The EPA will also allow the use of enclosed ground flares, which are currently in use at several MSW landfills. These flares are positioned at ground level and are closely enclosed with a shell of fire-resistant walls which extend above the top of the flame. The EPA characterizes enclosed ground flares as "enclosed" combustors. Other kinds of enclosed combustion devices that can be used to comply with the standards and guidelines include boilers, gas turbines, I.C. engines, and incinerators. These enclosed combustors can be used only if they can be shown to meet the 98-percent destruction requirement or to result in an NMOC outlet concentration of 20 ppmvd, as hexane, at 3 percent O_2. Method 25 must be used to measure NMOC concentration for either demonstration.

The EPA is aware that lean-burn I.C. engines are currently in use in NO_x nonattainment areas. However, these engines may not be able to achieve the 98-percent destruction efficiency required in the proposed standard under typical operating conditions. The EPA requests comment about the appropriateness of the use of low-NO_x, lean-burn I.C. engines at MSW landfills in nonattainment areas, and if so, at what destruction efficiency.

Purification systems. Various purification systems can also be used to meet the standards and guidelines. These systems market the purified methane gas. Such systems would comply with the standards or guidelines only if vent streams from the system are routed to any of the control devices above, meeting the same specifications. Alternatively, a demonstration that a total of at least 98 percent destruction of NMOC's is achieved by the control of some portion of the vent streams will be permitted. This second option was developed in consideration that the control of some very minor vents is not warranted when a net reduction of 98

HeinOnline -- 56 Fed. Reg. 24492 1991

percent can be achieved through the control of the bulk of the vent streams.

5. Implications of the Guidelines for Municipal Solid Waste Landfills With Pre-existing Systems

The EPA is aware that over 100 MSW landfills already have some form of collection and/or control systems in place. Any of these landfills that are subject to the proposed emission guidelines may be required to upgrade their system in order to achieve compliance. In this section the evaluation and upgrading of existing systems is discussed.

Existing collection systems. Today's proposed guidelines would not require that existing collection systems meet all of the design specifications for newly installed systems; however, operating guidelines for existing collection systems are specified by the guidelines. These operating guidelines are designed to insure effective collection of landfill gas from all areas of the landfill and that air infiltration will not exceed safe levels. Under the proposed guidelines, N_2 is used as a measurement surrogate for air infiltration. The guideline specifies that the N_2 content of the collected gas be monitored, and adjustments be made in the flow to maintain the N_2 content slightly below 1 percent. This is to prevent explosions and fires, and is considered a reasonable and necessary requirement for existing as well as new collection systems.

Under the proposed guidelines, the installation of additional wells would occur under either of two conditions. The first condition is the detection of positive pressure at any well head even after the flow is increased as much as possible. Positive pressure indicates that the number of wells is inadequate to collect the total volume of gas that is being generated. The second condition is when wells have not been placed in all areas of the landfill where waste has been deposited for at least 2 years. The wells or trenches already in place could be used, along with pressure probes, to calculate the radius of influence of the wells in the current collection system. The owner or operator could use this radius of influence along with the guidance provided in Chapter 9 of the BID to site additional wells. New wells added to an existing system would have to comply with the design specifications provided in the guidelines. Owners or operators who find they must replace or add additional wells should submit a description of the number and location of additional wells they plan to install to the appropriate State agency along with a schematic of the existing system.

During the development of the proposed guidelines, EPA considered whether or not requiring such upgrades adversely impacts those owners or operators who have already invested in collection systems. However, the cost of upgrading the collection system by the addition of wells is small relative to the cost for a complete system, and was judged reasonable and necessary when the existing wells are inadequate to handle the gas being generated. It is reasonable to expect that landfills that already have systems in place are already paying staff to operate and monitor the equipment. Labor costs are a significant component of the overall collection costs. Thus, EPA does not expect that the replacement or addition of wells would result in significant additional operating costs due to labor.

In those situations where collection systems exist, but the collected emissions are vented to the atmosphere uncontrolled, the collection system must first be evaluated and upgraded if necessary, and then control devices meeting BDT for control devices must be added on. Such a requirement is reasonable because without control, emission reduction does not occur.

Existing control systems. For those MSW landfills where control systems are already in place, but the emission reduction achieved by the current system does not meet the level of emission reduction in the proposed guideline for control devices, the guideline would require the owner or operator to either upgrade or replace the control system to improve the destruction efficiency to meet the State's approved emission limitation.

As explained in Section I below, State emission standards developed pursuant to the guidelines must ordinarily be at least as stringent as the guidelines. However, State standards may be less stringent on a case-by-case basis where compelling justification can be demonstrated in each case. The level of control already achieved at a particular landfill and site-specific economic factors can be considered by the States in developing their standards.

G. Test Methods and Procedures

Test methods proposed in this notice are Method 25C, Method 3C, and Method 2E. Method 25C provides instruction on sampling the landfill gas and is used to determine the NMOC concentration of landfill gas. Method 3C is used to measure the concentration of N_2 in landfill gas and Method 2E is used to determine the flowrate of landfill gas from the landfill.

The proposed methods may be found at the end of this notice. Although these methods were developed with input from many landfill operators who are already involved in some form of landfill gas collection and control, EPA recognizes that some additional parties may have useful input to offer. Therefore, EPA requests technical comments and data, where applicable, on these methods.

Method 25C. A sampling probe is perforated at one end and driven or augured to a depth of 0.9 m (3 ft) below the bottom of the landfill cover. Sampling from the probe is done similarly to Method 25, except that there is no cold trap to collect the moisture. Landfill gas is extracted from the probe with an evacuated cylinder at the rate of 100 milliliters per minute (ml/min) [6.1±0.6 cubic inches per minute (in^3/min)], and the carrier gas bypass valve is used to pressurize the cylinder with helium to approximately 1.060 millimeters (mm) mercury [567 in. water (H_2O)] absolute pressure.

The analysis for the cylinder gas is the same as Method 25, that is, the NMOC content of the sample gas is determined by injecting a portion of the gas into a gas chromatographic column to separate the NMOC from CO, CO_2, and methane. The NMOC are then oxidized to CO_2, reduced to methane, and measured by a flame ionization detector (FID). In this manner, the variable response of the FID associated with different types of organics is eliminated.

The cold trap is excluded from Method 25C because landfill gas is not expected to contain enough water to condense in the cylinder and cause analytical problems.

Method 3C. Method 3C is used to determine the N_2 concentration in landfill gas samples by injecting a portion of the gas into a gas chromatograph (GC) and determining the N_2 concentration by a thermal conductivity detector (TCD) and integrator. The concentrations of methane, CO_2, and O_2 can also be determined.

In Tier 2, when the NMOC concentration in the landfill gas is determined by Method 25C, Method 3C is used as a check on the integrity of the sample. Nitrogen is used as a surrogate for air, and N_2 concentrations of greater than 1 percent in the sample indicate improper sampling probe installation or sampling technique.

In Tier 3, when Method 2E is used to determine the flowrate of landfill gas from the landfill, Method 3C is used to determine the presence of N_2 in a landfill gas sample, which is an indication of infiltration of air into the landfill.

HeinOnline -- 56 Fed. Reg. 24493 1991

Method 3C is also used to leak check the above ground extraction well apparatus. The landfill gas is extracted from the landfill by a blower and the flowrate is measured by an orifice meter. Leaks in the well piping may affect the flowrate measured by the orifice meter significantly. The concentration of N_2 is measured at the well head sample port and at the outlet sample port, and a difference of greater than 10,000 ppm indicates a leak.

Method 2E. In Tier 3, the landfill owner or operator determines the landfill gas flowrate from the landfill with Method 2E by installing a single cluster of three extraction wells or five wells equally spaced over the landfill. The cluster wells are recommended but may be used only if the composition, age of the refuse, and the landfill depth of the test area can be determined. The construction of the extraction well is specified in the method.

Pressure probes are located along three radial arms 120° apart at distances of 3, 15, 30, and 45 m (10, 50, 100, and 150 ft) from each extraction well. The probes 15, 30, and 45 m (50, 100, and 150 ft) from each well are called deep probes and they extend to a depth equal to one-third the depth of the extraction wells. The three probes located 3 m (10 ft) from the well are called shallow probes and extend to a depth equal to one-sixth of the depth of the extraction wells. The method specifies that the bottom two-thirds of the pressure probes are to be perforated, with the area of the perforations specified in the method. The EPA is aware that alternative perforation patterns or areas are in use and may be applicable to these pressure probes. The EPA is also aware that some landfill gas collection systems are currently designed based on tests using shallow uniform pressure probes with a depth of 3 m (10 ft), rather than a depth which is site-specific. The EPA welcomes comment on alternative designs for effective pressure probes as well as on the relative merits of uniform shallow pressure proble depth versus pressure probe depth determined by the depth of the test well.

After the wells have been installed and the static flowrate of the landfill gas from the wells has been measured, short-term testing is done on each extraction well to determine: (1) The maximum vacuum that can be applied by a blower to the wells without infiltration of air into the landfill and (2) the maximum radius of influence associated with the maximum blower vacuum. The radius of influence is the distance from the extraction well affected by the blower.

A leak check is required to ensure accurate flowrate and safety, using proposed Method 3C. The EPA is aware that portable oxygen meters have been used in similar applications. Therefore, EPA requests comment about the appropriateness of portable oxygen meters, or the use of an alternative chemical species for leak detection in the header system.

Maximum blower vacuum is determined by increasing the vacuum and testing for infiltration of air into the landfill. Infiltration is considered to have occurred when the landfill gas N_2 concentration is greater than 1 percent (using Method 3C) or when one of the shallow probes has a negative gauge pressure. Once infiltration is indicated, the maximum blower vacuum is determined by reducing the blower vacuum until the N_2 concentration is less than 1 percent and the gauge pressures of all of the shallow probes are positive.

The maximum radius of influence is the radial distance from the extraction well affected by the maximum blower vacuum. The deep pressure probes are used to determine this distance.

Once the maximum blower vacuum and the maximum radius of influence have been established, long-term testing begins. Long-term testing consists of withdrawing landfill gas until two void volumes have been extracted. A void volume is the amount of landfill gas in a cylindrical volume defined around the extraction well with a radius equal to the maximum radius of influence.

During the long-term testing, a stabilized flowrate is established and used to determine k, the landfill gas generation constant. The landfill NMOC concentration is determined using Method 25C and then the NMOC mass emission rate is determined by equations in Method 2E.

H. Reporting and Recordkeeping Requirements—New Municipal Solid Waste Landfills

The proposed standards would require owners and operators of all affected facilities to submit notifications of construction or reconstruction as required under the General Provisions (40 CFR 60.7). This notification would include the maximum design capacity of the landfill, data of anticipated start-up, and the anticipated refuse acceptance rate. For the purposes of this proposed standard, startup means the date upon which initial acceptance of waste occurs.

Although an MSW landfill may start up, (i.e., accept refuse) under today's proposed standards and guidelines, the requirement to install collection and control systems will not occur until such time that the calculated NMOC emission rate equals or exceeds 150 Mg/yr (167 tpy). Therefore, the recordkeeping and reporting requirements of today's proposed standards are tailored to this unique characteristic of this source category.

Notifications of construction from MSW landfills with initial design capacities less than 100,000 Mg (111,000 tons) would fulfill all of the recordkeeping and reporting requirements for these landfills. This is because EPA has determined that MSW landfills with a maximum design capacity of 100,000 Mg (111,000 tons) would be highly unlikely to ever emit NMOC's at 150 Mg/yr (167 tpy), the level at which collection and control systems would be required. Changes in the design capacity would have to be reported in an amended design capacity report.

Those landfills with initial or amended design capacities greater than 100,000 Mg (111,000 tons) must submit additional reports, based on the additional requirements of the proposed standard. Each owner or operator of an MSW landfill with a design capacity equal to or greater than 100,000 Mg (111,000 tons) must submit an annual calculation of the NMOC emission rate. Alternatively, the owner or operator could elect to provide an estimate of the NMOC emission rate for each of the next 5 years using the Tier 1 formula and an estimate of the refuse acceptance rate for each of the 5 years, provided that the estimated NMOC emission rate does not exceed 150 Mg/yr (167 tpy) in any of the 5 years reported. The initial annual NMOC emission rate report or the 5-year estimate must be submitted within 90 days of start-up, i.e., refuse acceptance.

The owner or operator must also update and submit the 5-year estimate within at least 5 years of submittal of the first 5-year estimate. If the actual waste acceptance rate exceeds the estimated waste acceptance rate in any of the 5 years for which an estimated NMOC emission rate was reported, a revised estimate must be submitted. The 5-year period reported in the revised 5-year estimate would commence with the year in which the actual waste acceptance rate exceeded the estimated waste acceptance rate. This provision requires the owner or operator to keep track of how quickly the landfill is approaching the level where actual annual calculation and reporting of the emission rate are warranted.

These provisions are intended to prevent the owner or operator from

having to submit an NMOC emission report annually until such time as the landfill NMOC emission rate is actually approaching the level at which collection and control will be required. The EPA's evaluation of landfill emissions indicate that the emission rate increases as refuse accumulates in the landfill, but that the rate is not just a function of landfill mass, but is also affected by how fast the refuse accumulates, as well as the other factors already discussed. Tier 1 provides a conservative estimate of the NMOC emission rate which takes both time and amount of refuse in place into account. By using the Tier 1 formula and these two factors to estimate when collection and control may be warranted, the landfill owner or operator may choose to avoid the annual submittal of the NMOC emission rate calculation until the time approaches when controls will be required.

After the NMOC emission rate calculated using Tier 1 equals or exceeds 150 Mg/yr (167 tpy), the proposed standards would require the submission of a notification of intent to install a collection and control system based on the design specifications in section 60.758, or a collection system design plan for review, within a year. If the landfill owner or operator elects to perform the Tier 2 sampling or Tier 3 testing in order to generate a site-specific NMOC concentration or gas generation rate to use for the calculation of a more precise NMOC emission rate, the recalculated emission rate must be reported within 1 year of the initial Tier 1 calculation as well. If the recalculated emission rate still equals or exceeds 150 Mg/yr (167 tpy), the notification of intent or collection system design plan must also be submitted within the same 1-year time period since the Tier 1 calculation which equaled or exceeded 150 Mg/yr (167 tpy).

In the case of the design plan, EPA or the delegated agency would review and propose any amendments to the design plan. It is expected that such review should be completed and any amendments proposed within 6 months. After final review, 1 year would be permitted for installation, with an additional 90 days allowed for the submission of the initial performance test. Owners or operators electing to design and install a collection system based on the specifications provided in § 60.758 would be allowed 18 months to install the system, and an additonal 90 days for the submission of the initial performance test.

The EPA believes that this time schedule is reasonable because of the nature of the individual tiers. Tier 2 sampling to determine NMOC concentration would require about 6 months to complete, and based on the EPA's evaluation of landfill emissions, is more likely to result in an estimation of NMOC emission rate below the regulatory cutoff. This is because available information on the NMOC concentration and landfill gas flowrate indicate that the NMOC concentration is more variable. Therefore, it is more likely that the default NMOC concentration provided in Tier 1 differs substantially from the NMOC concentration resulting from the performance of Tier 2. However, since EPA believes that the length of time necessary to collect and analyze the samples in some cases may exceed 6 months, a full year from the submission of the Tier 1 calculation will be allowed for submittal of the Tier 2 calculation and design plan, if necessary. In fairness to those owners or operators who begin to design a system after Tier 1 or 2, EPA has not extended the time period allowed for submission of the design plan when owners or operators elect to perform Tier 3 testing. While Tier 3 testing will also require about 6 months, the EPA's analysis indicates that only a few landfills electing to perform the Tier 3 tests will actually obtain a final NMOC emission rate less than 150 Mg/yr (167 tpy). For this reason EPA recommends that those owners or operators performing Tier 3 testing begin to design a collection and control system while the testing proceeds. The Tier 3 test will have value for even those landfills that will still need to install collection systems, because the flowrates obtained may be used in designing the collection system. Additionally, the test wells can serve as collection wells.

After the collection and control systems have been installed and the initial performance test has been completed and submitted, the proposed regulation would require the submission of semiannual compliance reports. These reports would include: (1) Any period in which the value of any of the monitored operating parameters falls outside the ranges identified in the initial performance test, (2) results of all annual performance tests, (3) identification of any periods for which data were excluded from these calculations, and (4) any period when air pollution control equipment malfunction occurred.

The proposed NSPS would also require that certain types of records be maintained. Records of the accumulated refuse in place, collection system design (including proposed and subsequent well or trench spacing), control device vendor specifications, the initial performance test results, and the monitoring parameters established during the initial performance test, must be maintained on site as long as the collection system and control devices are required to be operated.

Any replacement of system components which results in a change in the level of any parameter that is monitored in order to demonstrate 98 percent NMOC destruction efficiency must be entered into this permanent record, and reported in the next semiannual compliance report. Monitoring records and all data and calculations from each semiannual and annual compliance report would be maintained for 2 years following the date of such records, after which they may be discarded.

The reporting and recordkeeping requirements in the proposed standards are necessary to inform enforcement personnel of the compliance status of new MSW landfills that initiate operation. The EPA predicts that the design capacity calculation required to be included in the notification of construction report will exclude a large majority of all new MSW landfills from the further provisions of the proposed standards, and will alert enforcement personnel to the remaining population of landfills that may be required to install collection and control systems in the future.

The annual NMOC emission rate report will serve as a compliance demonstration for all MSW landfills approaching the cutoff NMOC emission rate, and will verify that collection and control systems are not yet warranted at these landfills. This report will not impose an unreasonable burden on MSW landfill owners or operators, amounting to about 2 hours per reporting landfill annually. The EPA analysis of landfill emission factors indicate that gas generation and NMOC concentrations may increase significantly over relatively short periods of time. Therefore, EPA has judged annual reporting of NMOC emission rate is warranted. The alternative of estimates at set intervals as a landfill's emissions increase toward the regulatory cutoff provides relief for landfills emitting at rates well below the cutoff. The inclusion of the anticipated acceptance rate and the 5-year estimate of the NMOC emission rate will help enforcement personnel keep track of when specific landfills are likely to warrant control.

HeinOnline -- 56 Fed. Reg. 24495 1991

The submission of the collection system design plan, the initial performance test for the control device(s), and subsequent semiannual compliance reports would provide the data and information necessary to ensure continued compliance of controlled MSW landfills with the proposed standards. At the same time, these requirements would not impose an unreasonable burden on MSW landfill owners or operators.

I. Reporting and Recordkeeping Guidelines—Existing Municipal Solid Waste Landfills

As explained previously, the proposed guidelines would achieve the same level of control for existing MSW landfills which have accepted waste at any time since November 8, 1987, or which intend to accept additional waste in the future, as is required for new MSW landfills under the proposed standards. Therefore, State agencies will need the same kinds of information to implement their plans under the proposed guidelines. The minor differences in the requirements necessitated by the differences between new and existing MSW landfills are explained below.

In the case of an existing landfill, the notification of the date of construction would be replaced by the submittal of an initial design capacity report, which would contain the amount of refuse in place in addition to the acceptance rate. This report will fulfill all the reporting and recordkeeping requirements of the guidelines for those existing MSW landfills whose design capacities are less than 100,000 Mg (111,000 tons). For existing MSW landfills whose design capacities are equal to or greater than 100,000 Mg (111,000 tons), this report must also include either the first annual NMOC emission rate report, or an estimate of the NMOC emission rates for the next 5 years. This notification must be submitted within 90 days of the effective date of the EPA-approved State plan.

J. Compliance Times

Demonstrations of compliance for new and existing landfills under the proposed standards and emission guidelines involve two parts. The first is the timely submission of annual or periodic NMOC emission rate reports for affected and designated landfills with NMOC emission rates below 150 Mg/yr (167 tpy). The second aspect of compliance for affected and designated landfills with NMOC emission rates of 150 Mg/yr (167 tpy) or greater involves the timely submission of a notification of intent to install a collection system designed in accordance with the specifications in § 60.758, or submission of a collection system design plan for review, and subsequent installation of a complying collection system. A discussion of the rationale for the frequency of the NMOC emission rate reports was presented under the previous sections on reporting and recordkeeping requirements, and will not be repeated here. After a brief review of the schedule for the NMOC emission rate reports, a discussion of the compliance times for the design and installation of collection and control systems will be presented. Since there is little difference between the design and installation of collection and control systems for new and existing landfills, EPA believes that State plans developed in response to the proposed guidelines should be based on the same overall time intervals.

The first annual NMOC emission rate report must be submitted within 90 days of initial refuse acceptance for new landfills. For existing landfills the first annual NMOC emission rate report should be submitted within 90 days of the date of promulgation of the State emission standard. The initial report may include an estimate of the NMOC emission rate for each of the next 5 years, provided that each of the five estimates is less than 150 Mg/yr (167 tpy). This estimate would permit the owner or operator to report the NMOC emission rate less frequently than annually. Landfills which submit either the annual NMOC emission rate reports or the 5-year estimates in a timely manner are in compliance with the standards until the NMOC emission rate using the EPA's Tier 1 formula and default values reaches 150 Mg/yr (167 tpy).

The time necessary for the installation of collection and control systems proposed under both the standards and the guidelines includes four components. These are: (1) The time between an initial Tier 1 determination that a landfill is emitting above the regulatory cutoff of 150 Mg/yr (167 tpy) of NMOC's and the completion of any additional site-specific sampling or testing to verify this determination, (2) the time needed to prepare and submit a notification of intent to install a collection system designed in accordance with § 60.758 or a collection and control system design plan for review, (3) the time necessary for the design plan (if one has been submitted for review) to be reviewed, and (4) the time necessary to actually install the approved system. The proposed standards and guidelines allow 2½ half years for this combined process. The rationale for this time period is provided below.

Once a 150 Mg/yr (167 tpy) emission rate has been reported using the Tier 1 formulas and defaults, the owner or operator would be required to submit a notice of intent to install a collection system designed in accordance with § 60.758, or a collection system design plan, or data and calculations demonstrating that the site's NMOC emission rate is actually below 150 Mg/yr (167 tpy) using the Tier 2 procedures If further sampling and testing are selected, the site-specific NMOC concentration to use in the Tier 2 calculation of the NMOC emission rate is determined through on-site sampling using Method 25C. The EPA has analyzed how much time would be needed to perform this sampling, and as a result of possible delays in the analysis of the samples, believes that as much as 6 months may be necessary to complete the sampling and analysis, and to submit a revised NMOC emission rate report.

The resulting emission rate may be below the level of the regulatory cutoff, and collection and control systems would not be required at that time. If the revised annual NMOC emission rate still exceeds the regulatory cutoff of 150 Mg/yr (167 tpy) of NMOC's, the owner or operator may again decide to forego further testing and begin to design a collection and control system. Alternatively, the owner or operator may elect to perform Tier 3 testing using Method 2E to determine a site-specific landfill gas flowrate to use in the calculation of the NMOC emission rate. The EPA has determined that Method 2E will also take up to 6 months to complete. Therefore, the proposed standards allow up to 1 year for the performance of site-specific testing and sampling to verify the NMOC emission rate.

Since EPA believes that the majority of owners and operators performing Method 2E to make Tier 3 calculations will actually be required to install collection and control systems either immediately or in the near future, EPA believes that the collection system design phase should coincide with the performance of Method 2E. The EPA has determined that up to 6 months may be needed to produce a design plan of the collection system meeting the specifications of the proposed standards. Therefore, the proposed standards will require the submittal of both the revised NMOC emission rate report and the collection system design plan within 6 months of the earlier NMOC emission rate report revised on

HeinOnline -- 56 Fed. Reg. 24496 1991

the basis of the NMOC concentration (Tier 2). This would be 1 year after the first Tier 1 emission calculation report with an NMOC emission rate above 150 Mg/yr (167 tpy). Those owners or operators whose Method 2E testing results in an NMOC emission rate below the regulatory cutoff would need to submit the revised NMOC emission rate report including the test results upon which the revised emission rate is based. Subsequent annual NMOC emission rate reports would utilize the landfill gas flowrate obtained through the performance of Method 2E.

The EPA has not required that site-specific sampling and testing be performed by each owner or operator, and cannot predict to what extent owners or operators will elect to sample or test. The sampling and testing would result in a more accurate NMOC emission rate, but are time consuming and may be costly. The compliance times proposed under both the standards and the guidelines reflect the situation in which the owner or operator elect to perform all the site-specific sampling and testing which is permitted.

As detailed below, 6 months are expected for State agency review of those plans submitted for review. Although owners or operators electing to install systems based on the design specifications provided in § 60.758 will not be delayed by the review process, the design and installation of a system installed without review may be more involved than installation of a system installed after review. For this reason, owners or operators electing to design and install systems based on the specifications provided in § 60.758 will be given the same total amount of time between the submission of the notification of intent and the initial performance test report that is given operators submitting designs for review between design submittal and the initial performance test report.

After submittal of the design plan, review and negotiations resulting in changes to the plan may occur. The proposed standards anticipate a total of 180 days (6 months) for the completion of review of the collection system design plan. This period of time could be necessary because the reviewing agency may require the submission of additional data, or revisions to the plan which may require time to resolve. The 180 days are the sum of 60 days for initial review and comment, 60 days for the owner or operator response and design amendment, and 60 days for final review. The EPA acknowledges that this time period may be longer than generally necessary, but since a finding of noncompliance may result if the collection and control systems are not put into place within the specified time periods, EPA wishes to be conservative in its estimation of compliance times. Comment is requested from interested parties, especially States and other agencies likely to be responsible for reviewing the design plans.

Based on limited information from existing landfills at which collection and control systems have already been installed, EPA believes the systems may be installed within 1 year of final plan review. Therefore, the proposed standards allow an additional year after review and approval of the system design for the installation and startup of the system. The EPA believes that 1 year is adequate because the owner or operator would have to consult vendors and suppliers in order to submit the design plan. Therefore, only the time for actual ordering, delivery, or installation of collection and control systems is included, not the time for and possible difficulties in locating vendors. An additional 90 days would be allowed for the submission of the initial performance test of the control system.

The total time permitted for the collection and control system installation and compliance demonstration is, therefore, 3 years. This includes 90 days for the initial Tier 1 calculation and report of an NMOC emission rate of 150 Mg/yr (167 tpy) or more, 1 year for additional site-specific testing and calculations (if elected by the owner or operator) and collection and control system design, 6 months for State or EPA approval of the design plan, 1 year to order and install the collection and control system, and 90 days to conduct a performance test. This 3-year time period is appropriate for existing as well as new landfills. Since, in both cases, controls are installed after refuse is in place, there would not be significant retrofit delays for existing landfills.

K. Additional Considerations and Solicitation of Comments

During the development of today's proposed standards, EPA considered three additional alternatives. These involve the adoption of materials separation requirements in the standards, development of a methane emission limitation, and inclusion of specific energy recovery provisions. These three alternatives are associated with the EPA's goals of pollution prevention as well as providing a direct regulatory approach that responds to broader environmental concerns. The outcome of the EPA's consideration of these alternatives would affect the selection of BDT for MSW landfills. The EPA is not proposing any specific requirements in today's action based on these alternatives. Nevertheless, EPA is specifically requesting comment and information on these alternatives and will consider all comments in the final decisions.

1. Should materials separation requirements be adopted for municipal solid waste landfills under the Clean Air Act?

Materials separation of 25 percent of the solid waste stream had been proposed in the rulemaking for municipal waste combustors (MWC's) (54 FR 52255, December 20, 1989) and public comment was solicited on the requirements. However, due to the wide range of potential economic impacts, and other uncertainties, EPA elected not to include materials separation in the MWC standards at promulgation (56 FR 5488 and 56 FR 5514; February 11, 1991).

During the development of today's proposed standards and guidelines, EPA considered adding a similar requirement for source separation. However, EPA has decided not to include such a requirement in this proposal because the Agency is planning to propose a source separation requirement under the authority of RCRA for MSW landfills. The Agency believes that RCRA is the appropriate vehicle to address the wide-ranging issues associated with solid waste management for landfills.

The EPA requests comments and information on any direct or indirect linkage of materials separation efforts and reduction of air emissions for MSW landfills and any nonair quality health and environmental impacts that can be discerned. In addition, EPA requests comments on using RCRA Subtitle D authority instead of the CAA to address materials separation.

2. Should Best Demonstrated Technology Be Selected Explicitly for Methane?

Estimates of methane emission rates from MSW landfills in the United States are uncertain, but are believed to range from 8 to 18 million Mg/yr (8.9 to 20 million tpy) and are expected to increase annually as solid waste generation increases (Docket No. A-88-09, Item No. II-B-31). This estimate is approximately 7 percent of the total estimated global methane emission rate In light of the contribution of methane to possible global warming, EPA considered whether to develop standard that would directly achieve additional methane control—selecting a regulatory alternative to require control at all

landfills above a prescribed annual methane emission level.

The designated pollutant being proposed today is MSW landfill emissions. This designation represents a collection of air pollutants, including methane and NMOC's . As a surrogate measure for MSW landfill emissions, NMOC's were selected to determine which landfills must install gas collection and control systems. The selection of the NMOC emission level, above which control is required, places the greatest emphasis on nonmethane emissions (the fraction that includes toxic compounds), but also specifically achieves significant methane reductions. Under this approach, a 60-percent emission reduction of methane will be achieved from existing MSW landfills by regulating 12 percent of the existing landfills. To achieve additional methane emission reduction, EPA considered whether to select a separate regulatory cutoff for methane alone, which is discussed below.

Adopting a separate methane emission requirement would address one of the many sources of global warming gases. On the other hand, there are several reasons not to establish a separate methane requirement at this time. First, while EPA believes global warming is a potential public health and welfare concern and that methane is a greenhouse gas, there is still uncertainty as to the rate and magnitude of possible global climate change and the resulting effects. However, as the international community moves toward the Climate Change Convention in 1992, the state of knowledge may change over the next 2 years. In addition, the cost of methane control increases as controls are extended beyond the landfills affected by today's proposed standards to more, and generally smaller, landfills with lower methane emission potential. Third, because methane emissions occur from many sources, EPA believes that any methane control strategy should consider the total problem and all control options. Until this is done, and due to the uncertainties of the estimates and the potentially high cost involved, EPA has no basis at this time for selecting a level of control for landfill methane that would be reasonable relative to other methane sources. It would be inappropriate to focus solely on only one source under the CAA or other statutory framework without the benefit of an overall stragegy. As a result of these considerations, EPA decided not to develop a separate methane emission level for this action.

The EPA requests comment and information on the control of methane in light of the continuing scientific discussion on global warming, the significance of MSW landfills to methane emissions, and suggestions on an overall strategy for control of methane (and other global warming air pollutants).

3. Should Specific Energy Recovery Requirements Be Included?

The EPA considered using energy recovery as a basis for the selection of BDT. Energy recovery at MSW landfills involves collecting and routing gas to energy recovery systems (i.e., I.C. engines, gas turbines, boilers) that could generate electricity, heat, or steam, and therefore, has a positive energy benefit. The use of such systems would further the goal of pollution prevention, since these energy recovery systems can offset some particulate, CO_2, and NO_x emissions from utilties while using an otherwise lost resource. Such offsets do not result when flares are used.

There are currently about 100 MSW landfills using energy recovery in the United States and the number has been growing. In developing these standards, EPA received and reviewed information from numerous MSW landfills currently recovering the landfill gas for energy production. The EPA has concluded, however, that choosing energy recovery for MSW landfills should be a site-specific decision. There are two major reasons for this decision. First, some landfills may not have a market available for the recovered energy. Second, there are many factors that affect the generation of landfill gas and these cannot be predicted with certainty. Therefore, developers of landfill gas energy recovery systems accept risks similar to those of oil and natural gas developers. It is possible for an individual MSW landfill to install energy recovery systems and discover later that the landfill's gas generation does not meet the initial predictions. Such mistakes are costly.

The EPA visited an MSW landfill located in Raleigh, North Carolina, where landfill gas is being collected and routed to a steam-generating boiler offsite. This landfill currently has approximately 2.7 million Mg (3 million tons) of waste in place with 10 years active waste acceptance life remaining. The collection system contains 48 wells and produces 0.034 million cubic meters per day (m^3/day) [1.2 million cubic feet per day (ft^3/day)] of landfill gas. Since its startup, the energy recovery system has been successful and has paid the City of Raleigh a percentage of its revenue.

On the other hand, EPA also visited an MSW landfill located in Greensboro, North Carolina, where a system was installed to purify the landfill gas to high Btu quality for residential use. This landfill, in an area with an expected rainfall similar to that in Raleigh, has approximately 2.7 million Mg (3 million tons) of waste in place since receiving its permit in 1978. The landfill has 15 to 20 years of active waste acceptance life remaining. The collection system contains 48 wells and was designed for flowrates between 0.028 and 0.084 million m^3/day (between 1 and 3 million ft^3/day) of landfill gas. After the start-up of this system, actual landfill gas generation never matched the initial predicted quantities, due in part to low moisture content. Subsequently, the energy recovery project has been suspended.

The EPA considered four options involving energy recovery in the standard. Option I would not require energy recovery in the standard itself, but would provide information to enable the landfill owners or operators to make their own decisions based on site-specific considerations. Option II would require owners or operators to undertake an analysis of energy recovery potential and present the result and decision on energy recovery for comment at a public meeting. Option III would require the owners or operators to perform the analysis following the EPA procedures and require energy recovery for affected landfills if the net costs are projected to break even (i.e., equal to or less than the flaring costs). Option IV would require owners or operators to perform the analysis following the EPA procedures and require energy recovery if the net cost projected is less than a specific amount (i.e., $/Btu) to be determined by EPA.

While all four options further pollution prevention and energy goals, Option II through IV would provide more assurance of the use of energy recovery and pollution prevention. Additionally, Options II through IV would result in significant reductions in methane, a greenhouse gas. However, these options, especially Options III and IV, involve significant financial risks. The EPA's ability to provide formulas for determining where or when net benefits occur for energy recovery is limited. The capability to predict energy recovery for MSW landfills is still developing, a venture that can be risky in light of many factors that affect the amount of gas that can be generated by an MSW landfill. The EPA believes many large MSW landfills will recover energy based on their own initiative. It is expected that both publicly and privately owned MSW landfills, with the

help of consulting firms involved in landfill gas development, will select the least-cost approach—especially where energy recovery would be less costly than flaring.

As a result of considering the factors associated with this alternative, EPA decided not to propose to use energy recovery as the basis for the selection of BDT in this action, but to provide information to assist in these decisions (Option I). However, EPA will continue to consider the remaining options and solicits comment on any of the options and rationales discussed and any preferences for the options, on the problem of MSW landfills with no markets for recovered energy, and on the basis of the reasoning that both publicly and privately owned MSW landfills would recover energy on their own initiative.

4. Should EPA Consider Developing an Alternate Regulatory Cutoff Format?

The EPA selected an annual mass emission rate of NMOC's as the basis of the regulatory format. Specifically, landfills emitting more than 150 Mg/yr of NMOC's must control their landfill gas emissions with an active gas collection system and an add-on control device. Landfills can discontinue the operations of controls only after (1) the annual mass emissions are less than 150 Mg/yr; (2) the landfill is closed; and (3) the controls are in place for at least 15 years. The regulatory format is based on using 150 Mg/yr NMOC as the same regulatory cutoff for both the placement of controls and the "removal" of controls.

During development of the standards and guidelines, questions were raised about having separate annual mass emission rates for the placement and removal of controls. It would be possible to consider having a less stringent emission rate cutoff for the placement of controls and, once the controls are in place, to use a more stringent (or lower) cutoff for the removal of the controls. This approach is based on the assumption that most of the capital (for design plans and construction of active collection systems and control devices) is spent initially. If capital is spent "up front" then the marginal costs of control in the future is less. If it costs less to control future emissions once the system is in place, then the regulatory cutoff associated with the period of control can then be extended by setting a separate and lower regulatory cutoff for the removal of controls, obtaining additional reductions in emissions.

The EPA's approach calls for the same annual emission rate for both placement and removal of controls. In making this decision, EPA modeled the emissions (as dicussed in IV.E.2.) and costs of control for MSW landfills. This model predicts that emissions increase as waste is placed and decrease overtime after closure. The costs, while initially relatively large, are spread out over time reflecting what landfill operators will experience. Based on this modeling, EPA determined that the most efficient means of establishing a cutoff is to use the same emission cutoffs for both placement and removal of controls. Second, the EPA does not disagree that using a less stringent level for placement of controls and a more stringent level for removal of controls may get more emissions reduction. However, if the goal is to get more emission reduction in a cost effective manner, EPA believes, based on its current modeling, that it may make more sense to use a slightly more stringent level for both the placement and removal of controls to maximize emission reduction than to only tighten the requirements for removing the controls.

In EPA's modeling effort, initial costs of controls and costs of replacement of controls (control device, blowers, headers) are calculated every 15 years throughout the period of control. Controls for affected landfills can be placed at any point along the emission profile. For landfills with short control periods, for example, less than 10 years, the cost of control is spent up front with no replacement costs. The EPA expects very few MSW landfills to have very short control periods. For landfills estimated with long periods of control, for example, greater than 50 years, the replacement costs would be needed at least 3 times along with typical operation and maintenance costs for the duration of the control period. In this case, the marginal costs for future control are not necessarily small. The argument to have a lower regulatory cutoff for removal of controls due to lower future control costs would not be met in this case.

Given the complexity of analyzing, selecting, and then implementing separate regulatory cutoffs, the EPA elected to use the same emission rate for both placement and removal of controls. However, given the uncertainty of our analysis, the EPA would consider comments on establishing separate emission cutoffs for the placement and removal of controls.

V. Considerations for Prevention of Significant Deterioration

Today's rulemaking under section 111(b) would establish a new classification of pollutants subject to regulation under the Act: "MSW landfill emissions." A consequence of this action is that PSD rules will now apply to all subject major stationary sources which would have significant increases in this pollutant. Absent any significance levels in the regulations to exempt *de minimis* situations, PSD review would be triggered by any increase in MSW landfill emissions. In order to maintain a manageable review process which focuses resources on environmental priorities, EPA is today proposing significance thresholds for this pollutant.

Today's notice proposes that emissions of NMOC be measured as a surrogate for overall MSW landfill emissions. Further NMOC constitutes a small fraction of overall emissions. Available data on the composition of NMOC is sparse and indicates a high degree of variability. These factors combine to make the selection of *de minimis* difficult. Vinyl chloride, for example, is one component of NMOC and was previously given a 0.9 Mg/yr (1 tpy) *de minimis* level. Some components of NMOC include that overall class of compounds typically referred to as VOC's and these also include various toxic chemicals. For the purpose of controlling ozone formation, EPA has previously established the *de minimis* for VOC at 36 Mg/yr (40 tpy). At this time, EPA proposes a *de minimis* of 36 Mg/yr (40 tpy) MSW landfill emissions expressed as NMOC. In effect this level is more stringent than that chosen for VOC, because NMOC includes photochemically unreactive compounds and less stringent than that chosen for toxics such as vinyl chloride, since NMOC contains many nontoxic compounds. Public comment on the reasonableness of this selection is requested.

In the August 1980 **Federal Register**, EPA provided exemptions from the otherwise required PSD air quality analyses for those sources which could demonstrate that their maximum expected air quality impact could be less that the values indicated (45 FR 52676, 52709). Those air quality values were generally set at levels reflecting a multiple of the lowest detectable ambient concentration that could be measured by available monitoring equipment. The MSW landfill emissions being regulated today present a somewhat different situation in that no ambient monitoring methods exist to measure this specific classification of pollutant. For this reason, the Administrator will not at this time require PSD permit applicants to monitor MSW landfill emissions concentrations, and therefore, no

HeinOnline -- 56 Fed. Reg. 24499 1991

exemption from this requirement is needed. Applications for permits will, of course, continue to be responsib.e for performing appropriate monitoring for other pollutants.

The EPA recognizes that the determination of significance thresholds for review of increases in MSW landfill emissions is important. Comment on the proposed threshold and approach used to determine the significance threshold is therefore solicited and will be carefully reviewed.

VI. Administrative Requirements

A. Public Hearing

A public hearing will be held, if requested, to discuss the proposed standards and guidelines in accordance with section 307(d)(5) of the CAA. Persons wishing to make oral presentations should contact EPA at the address given in the **ADDRESSES** section of this preamble. Oral presentations will be limited to 15 minutes each. Any member of the public may file a written statement with EPA before, during, or within 30 days after the hearing. Written statements should be addressed to the Air Docket Section address given in the **ADDRESSES** section of this preamble.

A verbatim transcript of the hearing and written statements will be available for public inspection and copying during normal working hours at the EPA's Air Docket Section in Washington, DC (see **ADDRESSES** section of this preamble).

B. Docket

The docket is an organized and complete file of all the information submitted to or otherwise considered by EPA in the development of this proposed rulemaking. The principal purposes of the docket are: (1) to allow interested parties to identify and locate documents so that they can effectively participate in the rulemaking process, and (2) to serve as the record in case of judicial review (except for interagency review materials [Section 307(d)(7)(A)]).

C. Clean Air Act Procedural Requirements

1. Administrator Listing—Section 111

As prescribed by Section 111 of the CAA, as amended, establishment of standards of performance and emission guidelines for MSW landfills is accompanied in this notice by the Administrator's determination that these sources contribute significantly to air pollution which may reasonably be anticipated to endanger public health or welfare. The rationale for this determination appears elsewhere in this notice.

2. Periodic Review—Section 111

These regulations will be reviewed 4 years from the data of promulgation as required by the CAA. This review will include an assessment of such factors as the need for integration with other programs, the existence of alternative methods, enforceability, improvements in emission control technology, and reporting requirements.

3. External Participation—Section 117

In accordance with Section 117 of the Act, publication of this proposal was preceded by consultation with appropriate advisory committees, independent experts, and Federal departments and agencies. In addition, numerous discussions were held with industry representatives and trade associations during development of the proposed standards and guidelines. The Administrator will welcome comments on all aspects of the proposed regulations, including economic and technological issues.

4. Economic Impact Assessment—Section 317

Section 317 of the CAA requires the Administrator to prepare an economic impact assessment for any new source performance standard promulgated under section 111(b) of the Act. An economic impact assessment was prepared for the proposed regulations and guidelines and for other regulatory alternatives. All aspects of the assessment were considered in the formulation of the proposed standards and guidelines to ensure that today's proposal would represent the best system of continuous emission reduction considering costs. The economic impact assessment is included in Chapter 8 of the BID.

D. Office of Management and Budget Reviews

1. Paperwork Reduction Act

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget under the Paperwork Reduction Act of 1980, 44 U.S.C. 3501 *et seq.* Comments on these requirements should be submitted to the Office of Information and Regulatory Affairs of OMB, marked "Attention: Desk Officer for EPA," as well as to EPA. The final rule will respond to any OMB or public comments on the information collection requirements.

2. Executive Order 12291 Review

Executive Order 12291 requires each Federal agency to determine if a regulation is a "major rule" as defined by the order and "to the extent permitted by law," to prepare and consider a Regulatory Impact Analysis (RIA) in connection with every major rule. Major rules are defined as those likely to result in:

1. An annual cost to the economy of $100 million or more; or
2. A major increase in costs or prices for consumers or individual industries; or
3. Significant adverse effects on competition, employment, investment, productivity, innovation, or international trade.

The EPA has judged the proposed standards and guidelines to limit air emissions from MSW landfills to be major rules based on estimated national control costs (i.e., annualized costs in excess of $100 million). The EPA has prepared a draft RIA that includes estimates of costs, benefits, and net benefits associated with three stringency levels (25, 100, and 250 Mg/yr [28, 111, and 278 tpy] of NMOC). The draft analysis, titled "Regulatory Impact Analysis of Air Pollutant Emission Standards and Guidelines for Municipal Solid Waste Landfills," is available in the docket.

The standards will cost the nation approximately $26 million annually, and the guidelines about $240 million annually. If the costs to individual controlled MSW landfills were added to landfill tipping fees, the results for most affected new landfills would be increases of less than $10 per household per year. For the guidelines the increase for most affected existing landfills would be less than $15 per household per year. These numbers are based on the flare option and on the selection of a regulatory emissions cutoff of 150 Mg/yr (167 tpy) of NMOC for the standards and the guidelines.

The economic impacts of the standards and guidelines are expected to be small. Privately owned landfills that are already closed and must install emissions controls may be significantly impacted by the regulatory alternatives, because they have no easy way of recovering compliance costs. However, there are few closed, privately owned landfills that are affected under any of the regulatory alternatives. All of the regulatory alternatives will stimulate the adoption of energy recovery technologies at affected landfills.

The absence of sufficient exposure-response and valuation information precludes a comprehensive benefits analysis at this time. However, a surrogate benefits analysis indicates that substantial benefits from the egulation are probable.

HeinOnline -- 56 Fed. Reg. 24500 1991

The draft RIA has been submitted to OMB for review under E.O. 12991. Any written comments from OMB to EPA and any response to these comments will be included in Docket No. A-88-09. This docket is available for public inspection at the EPA's Air Docket Section, which is listed under the **ADDRESSES** section of this notice. A final RIA will be issued at the time of promulgation of the final rulemaking.

E. Regulatory Flexibility Act Compliance

The Regulatory Flexibility Act (RFA) requires consideration of the impacts of proposed regulations on small entities including small businesses, organizations, and jurisdictions. A small business is defined as any business concern which is independently owned and operated and not dominant in its field as defined by the Small Business Administration regulations under Section 3 of the Small Business Act (SBA). Similarly, a small organization is defined by the SBA as a not-for-profit enterprise, independently owned and operated, and not dominant in its field. A small jurisdiction is defined as any government district with a population of less than 50,000 people.

Pursuant to the Provisions of 5 U.S.C. 605(b), I hereby certify that these rules, if promulgated, will not have a significant economic impact on a substantial number of small business entities because the number of small entities that would be affected, if any, is not substantial.

List of Subjects

40 CFR Parts 51 and 52

Air pollution control, Reporting and recordkeeping requirements.

40 CFR Part 60

Air pollution control, Incorporation by reference, Intergovernmental relations, Reporting and recordkeeping requirements, Municipal solid waste landfills.

Dated: May 16, 1991.

William K. Reilly,

Administrator.

PART 51—REQUIREMENTS FOR PREPARATION, ADOPTION AND SUBMITTAL OF IMPLEMENTATION PLANS

For reasons set forth in the preamble, it is proposed that parts 51, 52, and 60, chapter I, title 40 of the Code of Federal Regulations be amended as follows:

1. The authority citation for part 51 continues to read as follows:

Authority: Secs. 101(b)(1), 160–169, 171–178, and 301(a) of the Clean Air Act, 42 U.S.C. 7401(b)(1), 7410(b)(1), 7410, 7470–7479, 7501–7508, and 7601(a).

2. Section 51.166 is amended by revising paragraph (b)(23)(i) to read as follows:

§ 51.166 Prevention of significant deterioration of air quality.

* * * * *

(b) * * *

(23)(i) *Significant* means, in reference to a net emissions increase or the potential of a source to emit any of the following pollutants, a rate of emission that would equal or exceed any of the following rates:

Pollutant and Emissions Rate

Carbon monoxide:
100 tons per year (tpy)
Nitrogen oxides:
40 tpy
Sulfur dioxide:
40 tpy
Particulate matter:
25 tpy of particulate matter emissions
15 tpy of PM_{10} emissions
Ozone:
40 tpy of volatile organic compounds
Lead:
0.6 tpy
Asbestos:
0.007 tpy
Beryllium:
0.0004 tpy
Mercury:
0.1 tpy
Vinyl Chloride:
1 tpy
Fluorides:
3 tpy
Sulfuric acid mist:
7 tpy
Hydrogen sulfide (H_2S):
10 tpy
Total reduced sulfur (including H_2S):
10 tpy
Reduced sulfur compounds (including H_2S):
10 tpy
Municipal solid waste landfills emissions:
40 tpy of nonmethane organic compounds (as measured by Method 25C)

* * * * *

PART 52—APPROVAL AND PROMULGATION OF IMPLEMENTATION PLANS

1. The authority citation for part 52 continues to read as follows:

Authority: 42 U.S.C. 7401–7642.

2. Section 52.21 is amended by revising paragraph (b)(23)(i) to read as follows:

§ 52.21 Prevention of significant deterioration of air quality.

* * * * *

(b) * * *

(23)(i) *Significant* means, in reference to a net emissions increase or the potential of a source to emit any of the following pollutants, a rate of emission that would equal or exceed any of the following rates:

Pollutant and Emissions Rate

Carbon monoxide:
100 tons per year (tpy)
Nitrogen oxides:
40 tpy
Sulfur dioxide:
40 tpy
Particulate matter:
25 tpy of particulate matter emissions
15 tpy of PM_{10} emissions
Ozone:
40 tpy of volatile organic compounds
Lead:
0.6 tpy
Asbestos:
0.007 tpy
Beryllium:
0.0004 tpy
Mercury:
0.1 tpy
Vinyl Chloride:
1 tpy
Fluorides:
3 tpy
Sulfuric acid mist:
7 tpy
Hydrogen sulfide (H_2S):
10 tpy
Total reduced sulfur (including H_2S):
10 tpy
Reduced sulfur compounds (including H_2S):
10 tpy
Municipal solid waste landfills emissions:
40 tpy of nonmethane organic compounds (as measured by Method 25C)

* * * * *

PART 60—STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES

1. The authority citation for part 60 continues to read as follows:

Authority: 42 U.S.C. 7401, 7411, 7414, 7416, and 7601.

2. Part 60 is amended by adding a new Subpart WWW to read as follows:

Subpart WWW—Standards of Performance for Municipal Solid Waste (MSW) Landfills

Sec.
60.750 Applicability and designation of affected facility.
60.751 Definitions.
60.752 Standards for air emissions from MSW landfills.
60.753 Test methods and procedures.
60.754 Compliance provisions.
60.755 Monitoring of operations.
60.756 Reporting requirements.
60.757 Recordkeeping requirements.
60.758 Design specifications for active vertical collection systems.

HeinOnline -- 56 Fed. Reg. 24501 1991

Subpart WWW—Standards of Performance for Municipal Solid Waste (MSW) Landfills

§ 60.750 Applicability and designation of affected facility.

The provisions of this subpart apply to each municipal solid waste (MSW) landfill that began accepting waste on or after May 30, 1991.

§ 60.751 Definitions.

(a) As used in this subpart, all terms not defined herein shall have the meaning given them in the Act or in subpart A of this part.

Closed landfill means a landfill in which refuse is no longer being placed, and in which no additional wastes will be placed without first filing a notification of modification as prescribed under § 60.14.

Commercial solid waste means all types of solid waste generated by stores, offices, restaurants, warehouses, and other nonmanufacturing activities, excluding residential and industrial wastes.

Controlled landfill means any landfill at which collection and control systems are required as a result of the NMOC emission rate. The landfill is considered controlled at the time a collection and control system design plan is submitted in compliance with § 60.752(b)(2)(i).

Design capacity means the maximum amount of waste landfill can accept, as specified in the construction permit issued by the county or State agency responsible for regulating the landfill.

Household waste means any solid waste (including garbage, trash, and sanitary waste in septic tanks) derived from households (including single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas).

Industrial solid waste means solid waste generated by manufacturing or industrial processes, that is not a hazardous waste regulated under subtitle C of the Resource Conservation and Recovery Act. Such waste may include, but is not limited to, the following manufacturing processes: electric power generation; fertilizer/agricultural chemicals; food and related products/by-products; inorganic chemicals; iron and steel manufacturing; leather and leather products; nonferrous metals manufacturing/foundries; organic chemicals; plastics and resins manufacturing; pulp and paper industry; rubber and miscellaneous plastic products; stone, glass, clay, and concrete products; textile manufacturing; transportation equipment; and water treatment. This term does not include mining waste or oil and gas waste.

Landfill means an area of land or an excavation in which wastes are placed for permanent disposal, and which is not a land application unit, surface impoundment, injection well, or waste pile.

Municipal solid waste landfill or *MSW landfill* means an entire disposal facility in a contiguous geographical space where household waste is placed in or on land. An MSW landfill may also receive commercial waste, sludges, and industrial solid waste. Portions of an MSW landfill may be separated by access roads. An MSW landfill may be publicly or privately owned.

Muncipal solid waste landfill emissions or MSW landfill emissions means any gas derived through a natural process through the decomposition of organic waste deposited in an MSW waste disposal site or from the evolution of volatile organic species in the waste.

NMOC or *NMOC's* means nonmethane organic compounds, as measured according to the provisions of § 60.753.

Sludge means any solid, semi-solid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatement plant, or air pollution control facility exclusive of the treated effluent from a wastewater treatment plant.

Solid waste means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges that are point sources subject to permit requirements under 33 U.S.C. 1342, or sources of special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

§ 60.752 Standards for air emissions from MSW landfills.

(a) Each owner or operator of an MSW landfill having a maximum design capacity less than 100,000 megagrams (Mg) (111,000 tons), shall submit an initial design capacity report to the Administrator as provided for in § 60.756. This report shall fulfill the requirements of this regulation except as provided for in paragraphs (a) (1) and (2) of this section.

(1) An amended design capacity report as provided for in § 60.756(a)(2) is required providing notification of any increase in the design capacity of a landfill subject to the provisions of this subpart, whether the increase results from an increase in the area or depth of the landfill, a change in the operating procedures of the landfill, or any other means.

(2) Any increase in the maximum design capacity of a landfill exempted from the additional provisions of this subpart on the basis of the design capacity cutoff in paragraph (a) of this section, which results in a maximum design capacity equal to or greater than 100,000 Mg (111,000 tons), shall nullify the exemption and subject the owner or operator to the provisions of paragraph (b) of this section.

(b) Each owner or operator of an MSW landfill having a design capacity equal to or greater than 100,000 Mg (111,000 tons) shall calculate an NMOC emission rate for the landfill using the procedures provided in § 60.753. The NMOC emission rate shall be recalculated annually, except as provided for in § 60.756(b)(1)(ii) below. Each owner or operator shall compare the calculated NMOC emission rate to 150 Mg/yr (167 tpy) NMOC.

(1) If the calculated NMOC emission rate is less than 150 Mg/yr (167 tpy), the owner or operator shall:

(i) Submit an annual emission report to the Administrator, except as provided for in § 60.756(b)(1)(ii); and

(ii) Recalculate the NMOC emission rate periodically as provided for § 60.756(b)(1)(ii) until such time as the calculated NMOC emission rate is equal to or greater than 150 Mg/yr (167 tpy) and a collection and control system is installed, or the landfill is closed.

(A) If the calculated NMOC emission rate is equal to or greater than 150 Mg/yr (167 tpy) on any subsequent calculation, the owner or operator shall install a collection and control system in compliance with paragrah (b)(2) of this section.

(B) If the landfill is permanently closed, a closure notification shall be submitted to the Administrator as provided for in § 60.756.

(2) If the calculated NMOC emission rate is equal to or greater than 150 Mg/yr (167 tpy), the owner or operator shall:

(i) Submit either (A) or (B) paragraph (b)(2)(i) of this section:

(A) A notification of intent to install a collection and control system conforming to the specifications provided in § 60.758 below.

(B) A collection and control system design plan to the Administrator or

designated reviewing Agency. The collection and control system shall be designed in conformance to the guidance provided in Chapter 9 of the background information document (BID), EPA-450/3-90-011(a), and shall effectively address the design parameters provided in paragraph (b)(a)(ii) of this section.

(ii) Install a collection and control system within 1½ years of the submittal of the design plan or notification of intent. The collection system shall effectively capture the gas that is generated within the landfill. The collection system shall:

(A) Be designed to handle the maximum expected gas flowrate over the lifetime of the gas control or treatment system equipment from the entire area of the landfill that warrants control over the equipment lifetime;

(B) Collect gas from each area, cell, or group of cells in the landfill in which refuse has been placed for a period of 2 years or more.

(C) Collect gas at a sufficient extraction rate.

(iii) Route the collected gas to a control or treatment system in compliance with paragraph (b)(2)(iii) (A), (B) or (C) of this section.

(A) Route the collected gas to an open flare designed and operated in accordance with 40 CFR 60.18.

(B) Route the collected gas to a control system designed and operated within the parameters demonstrated in the performance test to reduce NMOC's by 98 weight-percent. When an enclosed combustor is used for control, reduction of the outlet NMOC concentration to 20 ppmvd as hexane at 3 percent oxygen shall fulfill this requirement. The ppmvd shall be established by Method 25.

(C) Route the collected gas to a treatment system that processes the collected gas for subsequent sale or use. The sum of all emissions from any atmospheric vent from the gas treatment system shall be subject to the requirements of paragraph (b)(2)(ii)(A) of this section.

(iv) Operate the collection and control device in compliance with §§ 60.754 and 60.755 of this subpart.

(v) The collection and control system may be capped or removed provided the conditions of each of paragraphs (b)(2)(v) (A), (B), and (C) of this section are met:

(A) The landfill must be no longer accepting waste and be permanently closed. A closure report must be submitted to the Administrator as provided for in § 60.766;

(B) The collection and control system must have been in continuous operation a minimum of 15 years; and

(C) Following the procedures in § 60.753(b), the calculated NMOC emission rate must be less than 150 Mg/yr (167 tpy) on three successive test dates. The test dates must be no closer than 3 months apart, and no longer than 6 months apart.

§ 60.753 Test methods and procedures.

(a) The landfill owner or operator shall estimate the NMOC emission rate using either the equation provided in paragraph (a)(1)(i) of this section or the equation provided in paragraph (a)(1)(ii) of this section.

(1)(i) The following equation shall be used if the actual year-to-year acceptance rate is known.

$$Q_T = \sum_{i=1}^{n} 2\,k\,L_o\,M_i\,(e^{-kt_i})\,(C_{NMOC})\,(3.595 \times 10^{-9})$$

where,

Q_T = Total NMOC emission rate from the landfill, Mg/yr

k = landfill gas generation constant, 1/yr

L_o = methane generation potential, m^3/Mg

M_i = mass of refuse in the ith section, Mg

t_i = age of the ith section, yrs

C_{NMOC} = concentration of NMOC, ppmv

3.595×10^{-9} = conversion factor

The NMOC emission rate is the sum of each NMOC emission rate for each yearly submass.

(ii) The following equation shall be used if the actual year-by-year refuse acceptance rate is unknown.

$$M_{NMOC} = 2L_o\,R\,(1 - e^{-kt})\,(C_{NMOC})\,(3.595 \times 10^{-9})$$

where,

M_{NMOC} = mass emission rate of NMOC, Mg/yr

L_o = refuse methane generation potential, m^3/Mg refuse

R = average annual acceptance rate, Mg/yr

k = methane generation rate constant, 1/yr

t = age of landfill, yrs

C_{NMOC} = concentration of NMOC, ppmv as hexane

3.595×10^{-9} = conversion factor

In the absence of site-specific data, the values to be used for k, L_o, and NMOC concentration are 0.02/yr, 230 m^3/Mg, and 8,000 ppmv as hexane, respectively.

(2) The owner or operator shall compare the calculated NMOC mass emission rate to the standard of 150 Mg/yr (167 tpy).

(i) If the calculated NMOC emission rate is less than 150 Mg/yr (167 tpy), then the landfill owner shall submit an emission rate report as provided in § 60.756(b)(1), and shall recalculate the NMOC mass emission rate periodically.

(ii) If the calculated NMOC emission rate is equal to or greater than 150 Mg/yr (167 tpy), then the landfill owner shall either install controls in compliance with § 60.752(b)(2), or determine a site-specific NMOC concentration using the procedures provided in paragraph (a)(3) of this section.

(3) The landfill owner or operator shall estimate the NMOC mass emission rate using the following sampling procedure. The landfill owner or operator shall install a minimum of five sample probes. The owner shall collect and analyze at least one sample of landfill gas from each probe for NMOC concentration using Method 25C. The landfill owner shall recalculate the NMOC mass emission rate using the average NMOC concentration from the collected samples instead of the default value in the equation provided in paragraph (a) of this section.

(i) If the resulting mass emission rate is equal to or greater than 150 Mg/yr (167 tpy), then the landfill owner or operator shall install controls in compliance with § 60.752(b)(2), or determine the site-specific gas generation rate constant using the procedure provided in paragraph (a)(4) of this section.

(ii) If the resulting NMOC mass emission rate is less than 150 Mg/yr (167 tpy), then the landfill owner or operator shall demonstrate that the NMOC mass emission rate is below the level of the standard with 80 percent confidence.

(A) The owner or operator shall use the following equation to determine the number of samples required to show 80 percent confidence:

$$n = \frac{(t_{.20})^2\,s^2}{D^2}$$

where,

n = number of samples required to demonstrate 80 percent confidence.

$t_{.20}$ = student-t value for a two-tailed confidence interval and a probability of .20.

s = standard deviation of the initial set of samples, ppmv.

The landfill owner shall install the required number of probes or 50 probes, whichever is less. At least one sample of landfill gas from each probe must be collected and analyzed using Method 25C.

(B) The landfill owner or operator shall recalculate the NMOC mass emission rate using the new average NMOC concentration in the formula provided in § 60.753(a).

(iii) The landfill owner or operator shall compare the NMOC mass emission rate obtained in paragraph (a)(3)(ii)(B) of this section to the standard of 150 Mg NMOC/yr (167 tpy).

(A) If the NMOC mass emission rate is equal to or greater than 150 Mg/yr (167 tpy), then the owner or operator

shall install controls in compliance with § 60.752(b)(2), or proceed to paragraph (a)(4) of this section.

(B) If the NMOC emission rate is less than 150 Mg/yr (167 tpy), the owner or operator shall submit an annual, or a 5-year estimate of the emission rate report as provided in § 60.756(b)(1)(ii) and shall update the site-specific NMOC concentration using the procedures provided in § 60.753(a)(3) every 5 or 10 years. If the average NMOC mass emission rate plus two standard deviations is less than 150 Mg/yr (167 tpy), the owner or operator shall update the site-specific NMOC concentration every 10 years. If the average NMOC mass emission rate plus two standard deviations is greater than 150 Mg/yr (167 tpy), then the owner or operator shall update the site-specific NMOC concentration every 5 years.

(4) The landfill owner or operator shall estimate the NMOC mass emission rate using a site-specific landfill gas generation rate constant, k. The site-specific landfill gas generation rate constant and the resulting NMOC mass emission rate shall be determined using the procedures provided in Method 2E, which is incorporated by reference. The landfill owner or operator shall compare the resulting NMOC mass emission rate to the standard of 150 Mg/yr (167 tpy).

(i) If the NMOC mass emission rate is equal to or greater than 150 Mg/yr (167 tpy), then the owner or operator shall install controls in compliance with § 60.752(b)(2).

(ii) If the NMOC mass emission rate is less than 150 Mg/yr (167 tpy), then the owner or operator shall submit an annual emission rate report as provided in § 60.756(b) and shall recalculate the NMOC mass emission rate annually, using the site-specific landfill gas generation rate constant and NMOC concentration obtained in paragraph (a)(2) of this section. The calculation of the landfill gas generation rate constant is performed only once, and the value obtained is used in all subsequent annual NMOC emission rate calculations.

(b) After the installation of a collection and control system in compliance with § 60.752(b)(2), the owner or operator shall estimate the NMOC emission rate using the equation below:

$$M_{NMOC}=1.89\times10^{-3}\,Q_{LFG}\,C_{NMOC}$$

where,

M_{NMOC} = mass emission rate of NMOC, Mg/yr
Q_{LFG} = flowrate of landfill gas, m^3/min
C_{NMOC} = NMOC concentration, ppmv

(1) The flowrate of landfill gas, Q_{LFG}, shall be obtained by measuring the total landfill gas flowrate at the common header pipe that leads to the control device using an orifice meter as described in Method 2E.

(2) The average NMOC concentration, C_{NMOC}, shall be determined by collecting and analyzing landfill gas sampled from the common header pipe using Method 25C.

§ 60.754 Compliance provisions.

(a) The following methods shall be used to determine whether the gas collection system is in compliance with § 60.752(b)(2)(ii).

(1) For the purposes of calculating the maximum expected gas generation flowrate from the landfill to determine compliance with § 60.752(b)(2)(ii)(A), the following equation shall be used:

$$Q_m=2L_o\,R\,(1-e^{-kt})$$

where,

Q_m = maximum expected gas generation flow rate, m^3/yr
L_o = refuse methane generation potential, m^3/Mg refuse
R = average annual acceptance rate, Mg/yr
k = methane generation rate constant, 1/yr
t = age of the landfill plus the gas mover equipment life or active life of the landfill, whichever is less, in years.

A value of 230 m^3/Mg shall be used for L_o. If Method 2E has been performed, the value of k determined from the test shall be used: if not, a value of 0.02 $years^{-1}$ shall be used. A value of 15 years shall be used for gas mover equipment life. The active life of the landfill is the age of the landfill plus the estimated number of years until closure.

(2) For the purposes of calculating the area of influence of the gas collection system to determine compliance with § 60.752(b)(2)(ii)(B), the owner or operator should use Method 2E.

(3) For the purpose of demonstrating whether the gas collection system flowrate is sufficient to determine compliance with § 60.752(b)(2)(ii)(C), the owner/operator shall measure gauge pressure in the gas collection header. If a positive pressure exists, the gas collection system flowrate shall be increased until a negative pressure is measured.

(4) If the gauge pressure at a wellhead is positive, the valve shall be opened to restore negative pressure. If negative pressure cannot be achieved, an additional well shall be added.

(b) To determine whether the control device designed and operated according to the parameters established in § 60.18 (for open flares), or for other control devices the parameters in the performance test to reduce NMOC's by 98 weight-percent, is in compliance with § 60.752(b)(2)(iii), the parameters shall be monitored provided in § 60.755.

(c) An owner or operator seeking to demonstrate compliance with § 60.752(b)(2)(iii) using a device other than an open or enclosed flare, boiler, gas turbine, incinerator or I.C. engine shall provide to the Administrator information demonstrating that the standards can be continuously achieved.

§ 60.755 Monitoring of operations.

(a) Each owner or operator seeking to comply with § 60.752(b)(2)(ii) for the gas collection system shall install a sampling port at each well and measure the gauge pressure in the gas collection header on a monthly basis.

(b) Each owner or operator seeking to comply with § 60.752(b)(2)(iii) using an enclosed combustion device shall monitor the residence time and temperature established during the initial performance test to reduce NMOC's by 98 percent. Each owner or operator shall calibrate, maintain, and operate according to the manufacturer's specifications, the following equipment:

(1) A temperature monitoring device equipped with a continuous recorder and having an accuracy of ±1 percent of the temperature being measured expressed in degrees Celsius or ±0.5°C, whichever is greater.

(2) A flow indicator that provides a record of gas flow to the control device at intervals of every 15 minutes.

(c) Each owner or operator seeking to comply with § 60.752(b)(2)(iii) using an open flare shall install, calibrate, maintain, and operate according to the manufacturer's specifications the following equipment:

(1) A heat sensing device, such as an ultraviolet beam sensor or thermocouple, at the pilot light to indicate the continuous presence of a flame.

(2) A flow indicator that provides a record of gas flow to the flare at intervals of every 15 minutes.

(d) Each owner or operator seeking to demonstrate compliance with § 60.752(b)(2)(iii) using a device other than an open flare or a closed combustion device shall provide to the Administrator information describing the operation of the control device and the operating parameters that would indicate proper performance. The Administrator will specify appropriate monitoring procedures.

§ 60.756 Reporting requirements.

(a) Each owner or operator subject to the requirements of this subpart shall submit an initial design capacity report to the Administrator. The initial design capacity report must be submitted within 90 days of the issuance of the

construction or operating permit, or within 30 days of the date construction, or reconstruction as defined under § 60.15, of an affected facility commences, or initial acceptance of refuse, whichever is earlier. The initial design capacity report shall fulfill the requirements of the notification of the date construction is commenced as required under § 60.7(a)(1).

(1) The initial design capacity report shall contain the following information:

(i) A map or plot of the landfill, providing the size and location of the landfill, and identifying all areas where refuse may be landfilled according to the provisions of the State or county permit;

(ii) The maximum design capacity of the landfill. Where the maximum design capacity is specified in the State or county construction or RCRA permit, a copy of the permit specifying the maximum design capacity may be submitted. If the maximum design capacity of the landfill is not specified in the permit, the maximum design capacity must be calculated using good engineering principles. The calculations must be provided, along with such parameters as depth of refuse, refuse acceptance rate, and compaction practices. The State, county, or Administrator may request other reasonable information as may be necessary to verify the maximum design capacity of the landfill.

(2) An amended design capacity report must be submitted to the Administrator, providing notification of any increase in the size of the landfill, whether the increase results from an increase in the permitted area or depth of the landfill, a change in the operating procedures, or any other means which results in an increase in the maximum design capacity of the landfill. The amended design capacity report must be submitted within 90 days of the issuance of an amended construction or operating permit, or the actual use of additional land, or the change in operating procedures which will result in an increase in maximum design capacity, whichever comes first.

(b) Each owner or operator subject to the requirements of this subpart shall submit an annual NMOC emission rate report to the Administrator, except as provided for in paragraph (b)(1)(ii) of this section. The State or county agency or the Administrator may request such additional information as may be reasonably necessary to verify the reported NMOC emission rate.

(1) The annual, or 5-year estimate of the NMOC emission rate shall be calculated using the formula and procedures provided in § 60.753.

(i) The initial NMOC emission rate report shall be submitted within 90 days of the date waste acceptance commences and may be combined with the initial design capacity report required in paragraph (a) of this section. Subsequent NMOC emission rate reports shall be submitted annually thereafter, except as provided for in paragraphs (b)(1) (ii) and (iii) of this section.

(ii) The owner/operator may elect to submit an estimate of the NMOC emission rate for the next 5 years in lieu of the annual report, provided that the estimated NMOC emission rate in each of the 5 years is less than 150 Mg/yr (167 tpy). This estimate must include the current amount of refuse-in-place and the estimated waste acceptance rate for each of the 5 years for which an NMOC emission rate is estimated. All data and calculations upon which this estimate is based must be provided. This estimate must be revised at least every 5 years.

(iii) If the actual waste acceptance rate exceeds the estimated waste acceptance rate in any year reported in the 5-year estimate, a revised 5-year estimate must be submitted. The revised estimate shall cover the five years beginning with the year in which the actual waste acceptance rate exceeded the estimated waste acceptance rate.

(2) The annual, or 5-year estimate of the NMOC emission rate report shall include all the data, calculations, sample reports and measurements used.

(3) Each owner or operator subject to the requirements of this subpart is exempted from the requirements of paragraph (b) of this section after the installation of collection and control systems in compliance with § 60.752(b)(2) during such time as the collection and control system is in continuous operation and in compliance with § 60.754.

(c) Each owner or operator of a controlled landfill shall submit a closure report to the Administrator. For the purposes of this subpart, closure means that refuse is no longer being placed in the landfill, and that no additional wastes will be placed into the landfill without filing a notification of modification as prescribed under § 60.14. The Administrator may request such additional information as may be reasonably necessary to verify that permanent closure has taken place.

(d) Each owner or operator of a controlled landfill shall submit an equipment removal report to the Administrator prior to removal or cessation of operation of the control equipment.

(1) The equipment removal report shall contain the following items:

(i) A copy of the closure report submitted in accordance with paragraph (c) of this section;

(ii) A copy of the initial performance test report demonstrating the 15 year minimum control period has expired;

(iii) Dated copies of the three successive NMOC emission rate reports demonstrating that the landfill is no longer emitting above the level of the standard.

(2) The Administrator may request such additional information as may be reasonably necessary to verify that all of the conditions for removal in § 60.752(b)(2)(v) have been met.

(e) Each owner or operator of a controlled landfill shall submit to the Administrator semiannual reports of the following recorded information. The initial report shall be submitted within 90 days of installation and startup of the collection and control system, and shall include the initial performance test report required under § 60.8.

(1) Exceedance of parameters monitored under § 60.755 (a) and (b)(1).

(2) All periods when the gas stream is diverted from the control device or has no flowrate.

(3) All periods when the control device was not operating.

(4) For control devices using open or enclosed flares, all periods when the pilot flame of the flare was absent.

(f) Each owner or operator seeking to comply with § 60.752(b)(2)(i)(A) shall include the following with the initial performance test report required under § 60.8:

(1) A diagram of the collection system showing vertical extraction well spacing, including the locations of any areas excluded from collection and the proposed sites for the future addition of wells;

(2) The data upon which the radii of influence and the gas mover sizing are based;

(3) The documentation of the presence of asbestos for each area from which collection wells have been excluded based on the presence of asbestos:

(4) The sum of the gas generation rates for all areas from which collection wells have been excluded based on the presence of nondegradable materials and the calculations of gas generation rate for each excluded area; and

(5) The provisions for increasing gas mover capacity with increased gas generation rate, if the present gas mover is inadequate to move the maximum flowrate expected over the life of the landfill.

HeinOnline -- 56 Fed. Reg. 24505 1991

§ 60.757 Recordkeeping requirements.

(a) Each owner or operator of an MSW landfill subject to the provisions of § 60.752(b) shall keep up-to-date, readily accessible records of the maximum design capacity, the current amount of refuse-in-place, and the year-by-year waste acceptance rate.

(b) Each owner or operator of a controlled landfill shall keep up-to-date, readily accessible records of the following data measured during the initial performance test/compliance determination for the life of the control equipment. Records of subsequent tests must be maintained for a minimum of 2 years.

(1) Where an owner or operator subject to the provisions of this subpart seeks to demonstrate compliance with § 60.752(b)(2)(ii):

(i) The calculated maximum expected gas generation flowrate using Method 2E.

(ii) The calculated area of influence of the extraction wells.

(iii) Gauge pressure in the gas collection header at the point where each well is connected to the gas collection header pipe.

(2) Where an owner or operator subject to the provisions of this subpart seeks to demonstrate compliance with § 60.752(b)(2)(iii) through use of an enclosed combustion device:

(i) The average combustion temperature measured every 15 minutes and averged over the same time period of the performance testing.

(ii) The percent reduction of NMOC determined as specified in § 60.754(b) achieved by the control device.

(3) Where an owner or operator subject to the provisions of this subpart seeks to demonstrate compliance with § 60.752(b)(2)(iii) through use of a boiler:

(i) A description of the location at which the process vent stream is introduced into the boiler or process heater, and

(ii) The average combustion temperature of the boiler or process heater with a design heat input capacity of less than 44 MW (150 million Btu/hr) measured at least every 15 minutes and averaged over the same time period of the performance testing.

(4) Where an owner or operator subject to the provisions of this subpart seeks to demonstrate compliance with § 60.752(b)(2)(iii) through use of an open flare, the flare type (i.e., steam-assisted, air-assisted, or nonassisted), all visible emission readings, heat content determination, flowrate measurements, and exit velocity determinations made during the performance test, continuous records of the flare pilot flame monitoring, and records of all periods of operations during which the pilot flame is absent.

(c) Each owner or operator of a controlled landfill subject to the provisions of this subpart shall keep up-to-date, readily accessible continuous records of the equipment operating parameters specified to be monitored under § 60.755 as well as up-to-date, readily accessible records for periods of operation during which the parameter boundaries established during the most recent performance test are exceeded.

(1) For enclosed combustion devices except for boilers and process heaters with design heat input capacity of 44 MW (150 million Btu/hour) or greater and nonenclosed flares, all 3-hour periods of operation during which the average combustion temperature was more than 28°C (50°F) below the average combustion temperature during the most recent performance test at which compliance with § 60.752(b)(2)(iii) was determined.

(2) For boilers or process heaters, whenever there is a change in the location at which the vent stream is introduced into the flame zone as required under § 60.757(b)(3)(i).

(3) Each owner or operator subject to the provisions of this subpart shall keep up-to-date, readily accessible continuous records of the indication of flow specified under § 60.755, as well as up-to-date, readily accessible records of all periods when the gas stream is diverted from the control device or has no flowrate.

(4) Each owner or operator subject to the provisions of this subpart who uses a boiler or process heater with a design heat input capacity of 44 MW or greater to comply with § 60.752(b)(2)(iii) shall keep an up-to-date, readily accessible record of all periods of operation of the boiler or process heater. (Examples of such records could include records of steam use, fuel use, or monitoring data collected pursuant to other State or Federal regulatory requirements.)

(5) Each owner or operator subject to the provisions of this subpart shall keep up-to-date, readily accessible continuous records of the flare pilot flame monitoring specified under § 60.754(c)(1), as well as up-to-date, readily accessible records of all periods of operation in which the pilot flame is absent.

§ 60.758 Design specifications for active vertical collection systems.

(a) Each owner or operator seeking to comply with § 60.752(b)(2)(i)(A) shall site active vertical collection wells throughout all gas producing areas of the landfill that contain refuse that is at least 2 years old using the following procedures:

(1) The interior and perimeter radii of influence shall be determined using field test data as provided in paragraphs (a)(1) (i) and (ii) of this section or using theoretical concepts as provided in paragraph (a)(1)(iii) of this section.

(i) If EPA Method 2E has been performed during the determination of the NMOC emission rate, the radius of influence for the perimeter well determined during the long-term extraction test in Method 2E shall be used in siting perimeter wells. The average of the radii of influence of all interior wells determined during the long-term extraction test in Method 2E shall be used in siting interior collection wells.

(ii) If EPA Method 2E was not performed during the determination of the NMOC emission rate, EPA Method 2E may be performed and the perimeter and interior radii of influence from the field test data shall be used in siting collection wells as provided in paragraph (A) above.

(iii) If EPA Method 2E has not been performed, a single radius of influence may be determined by determining the maximum well vacuum using Figure 1 below by locating the intersection of the landfill depth with the appropriate curve for the cover material used. The proposed well vacuum is compared to the maximum blower vacuum provided for the cover material selected in Figure 1. Using the smaller of the proposed or maximum blower vacuum from Figure 1, the corresponding estimated radius of influence is determined from Figure 2. This radius shall be used in siting both perimeter and interior wells.

BILLING CODE 6560-50-M

HeinOnline -- 56 Fed. Reg. 24506 1991

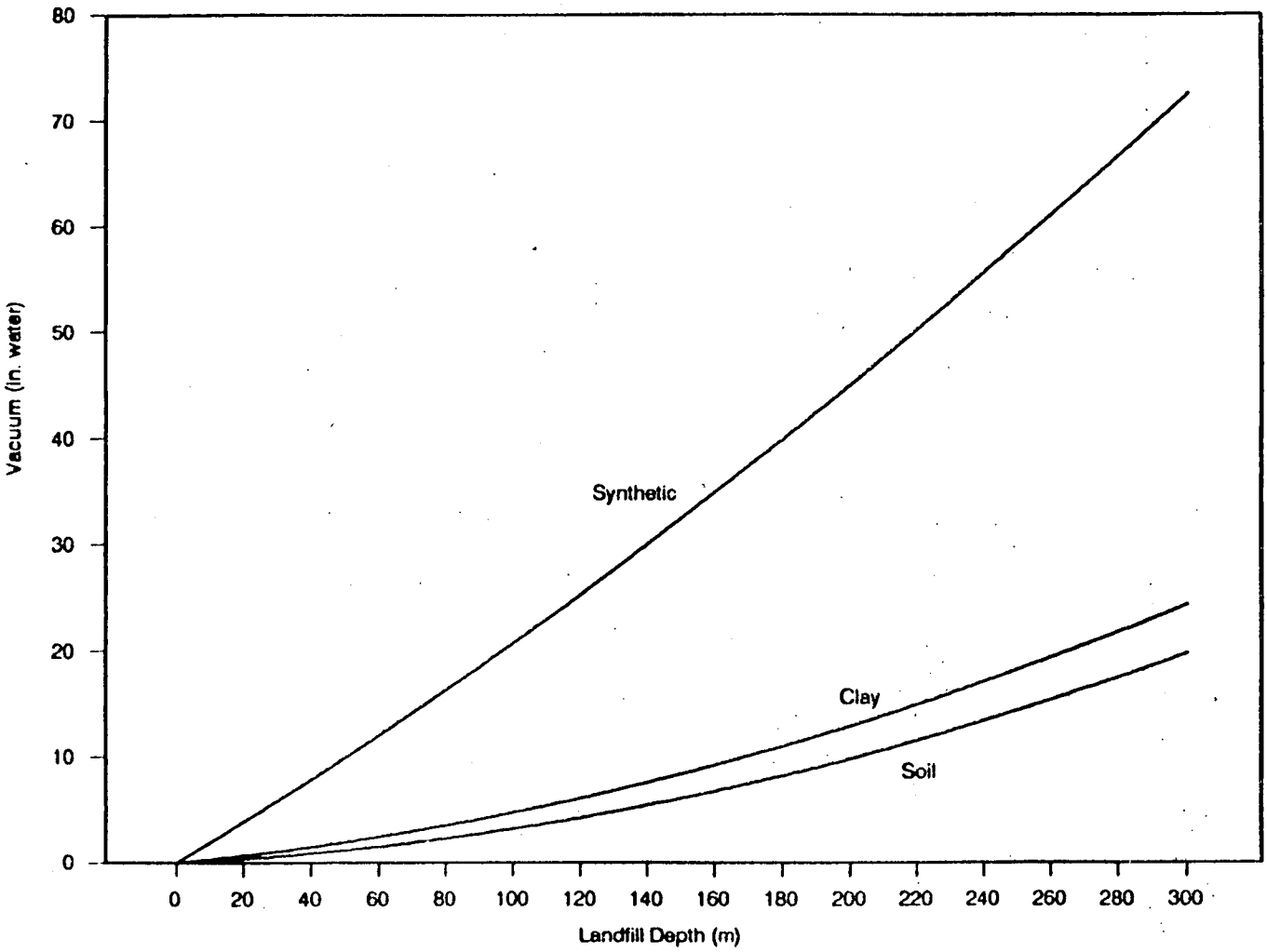

Figure 1 Maximum blower vacuum as a function of landfill depth for three cover types.

HeinOnline -- 56 Fed. Reg. 24507 1991

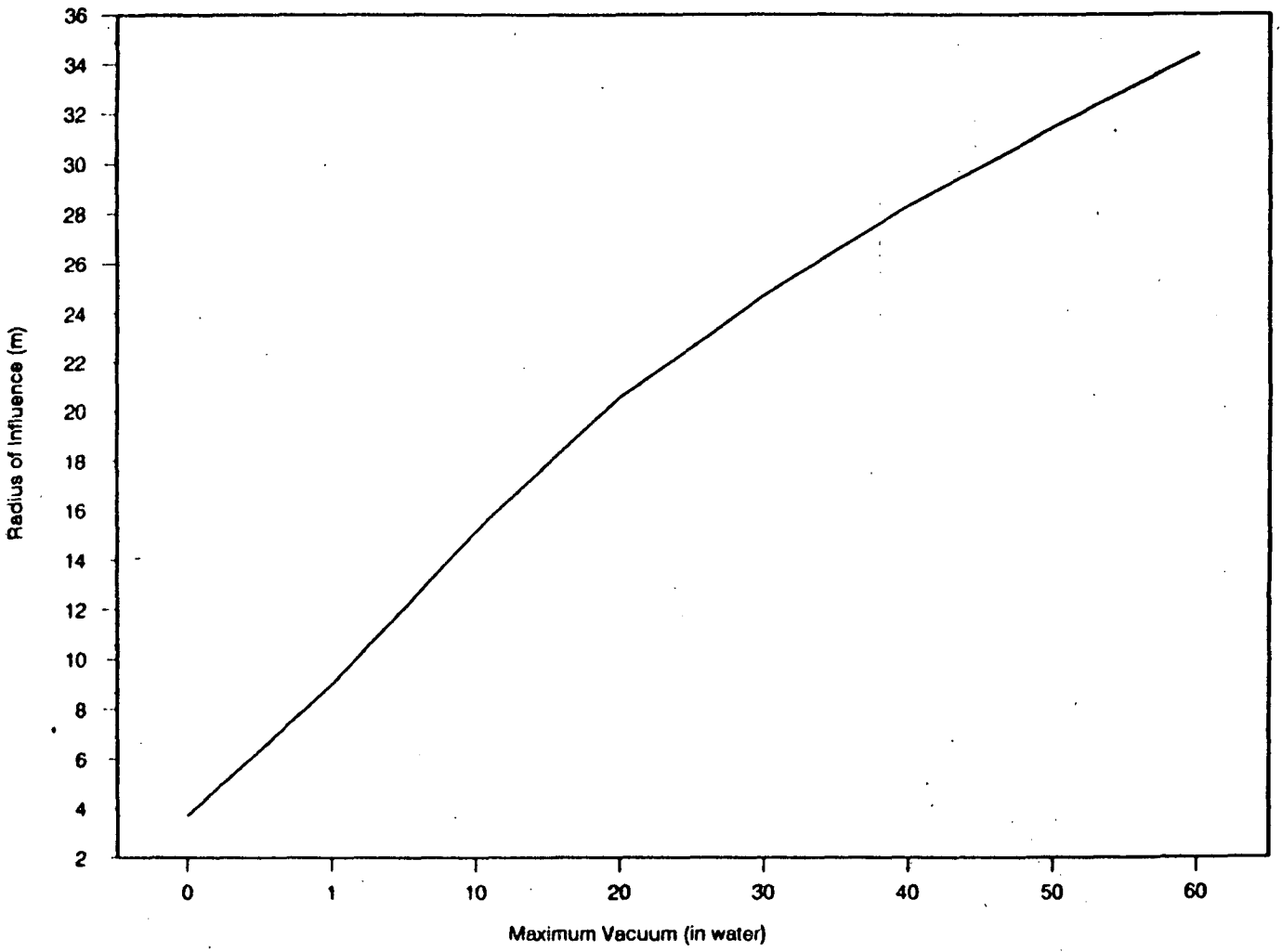

Figure 2. Estimated radius of influence as a function of blower vacuum.

BILLING CODE 6560-50-C

HeinOnline -- 56 Fed. Reg. 24508 1991

(2) The radii of influence determined in paragraph (a)(1), of this section, shall be used to site wells along the perimeter of all gas producing areas of the landfill, at a distance no greater than the perimeter radius of influence from the perimeter and no greater than two times the perimeter radius of influence apart.

(3) After siting the perimeter wells, the interior radius of influence determined in paragraph (a)(1), of this section, shall be used to site the interior wells at distances no greater than two times the interior radius of influence apart, and staggered such that essentially all gas producing areas of the landfill containing refuse at least 2 years old are covered by the radii of influence, except as provided by paragraphs (a)(3) (i) and (ii).

(i) Any area of refuse for which documentation of asbestos deposition exists shall be excluded from collection. The documentation must provide the date, location and approximate amount of asbestos deposited in the landfill, and must be provided to the regulatory agency upon request.

(ii) Any nondegradable area of the landfill may be excluded from collection, provided that the total of all excluded areas can be shown to contribute less than one percent of the total amount of emissions from the landfill. A separate emissions estimate shall be made for each section proposed for exclusion, and the sum of all such sections compared to the emissions estimate for the entire landfill. Emissions from each section shall be computed using the following equation:

$$Q_i = 2\,k\,L_o\,M_i\,(e^{-kt_i})\,(C_{NMOC})\,(3.595\times10^{-9})$$

where:

Q_i = NMOC emission rate from the ith section, Mg/yr

k = landfill gas generation constant, 1/yr

L_o = methane generation potential, m^3/Mg

M_i = mass of the degradable refuse in the ith section, Mg

t_i = age of the refuse in the ith section, yrs

C_{NMOC} = concentration of NMOC, ppmv

3.595×10^{-9} = conversion factor

The values for k, L_o, and C_{NMOC} determined in field testing shall be used, if field testing has been performed in determining the NMOC emission rate or the radii of influence. If field testing has not been performed, the default values for k, L_o and C_{NMOC} provided in Tier 1 of the NMOC emission rate determination shall be used. The mass of nondegradable refuse contained within the given section shall be subtracted from the total mass of the section when estimating emissions.

(b) Each owner or operator seeking to comply with § 60.752(b)(2)(i)(A) shall construct each vertical well using the following equipment or procedures:

(1) The landfill gas extraction well shall be constructed of polyvinyl chloride (PVC), high density polyethylene (HDPE) pipe, fiberglass, stainless steel, or other suitable nonporous material, at least 0.075 m (3 in.) diameter. The pipe shall be the lesser of 75 percent of the depth of the refuse or the depth to the water table in length. The bottom two-thirds of the pipe shall be perforated with a minimum of four 0.012 m (½ in.) diameter holes, or other perforations spaced 90 degrees apart every 0.1 to 0.2 m (4 to 8 in.).

(2) A well drilling rig shall be used to dig a 0.60 m (24 in.) diameter hole in the landfill to a depth equal to a minimum of 75 percent of the landfill depth or the pipe length. The extraction well shall be placed in the center of the hole and the hole shall be backfilled with gravel to a level at least 0.3 m (1 ft) above the perforated section. A layer of backfill material at least 1.2 m (4 ft) thick shall be added on top of the gravel. A layer of bentonite at least 0.9 m (3 ft) thick shall be added on top of the backfill material, and the remainder of the hole shall be backfilled with cover material or material equal to the permeability to the existing cover material. A schematic of extraction well installation is shown in Figure 3.

BILLING CODE 6560-50-M

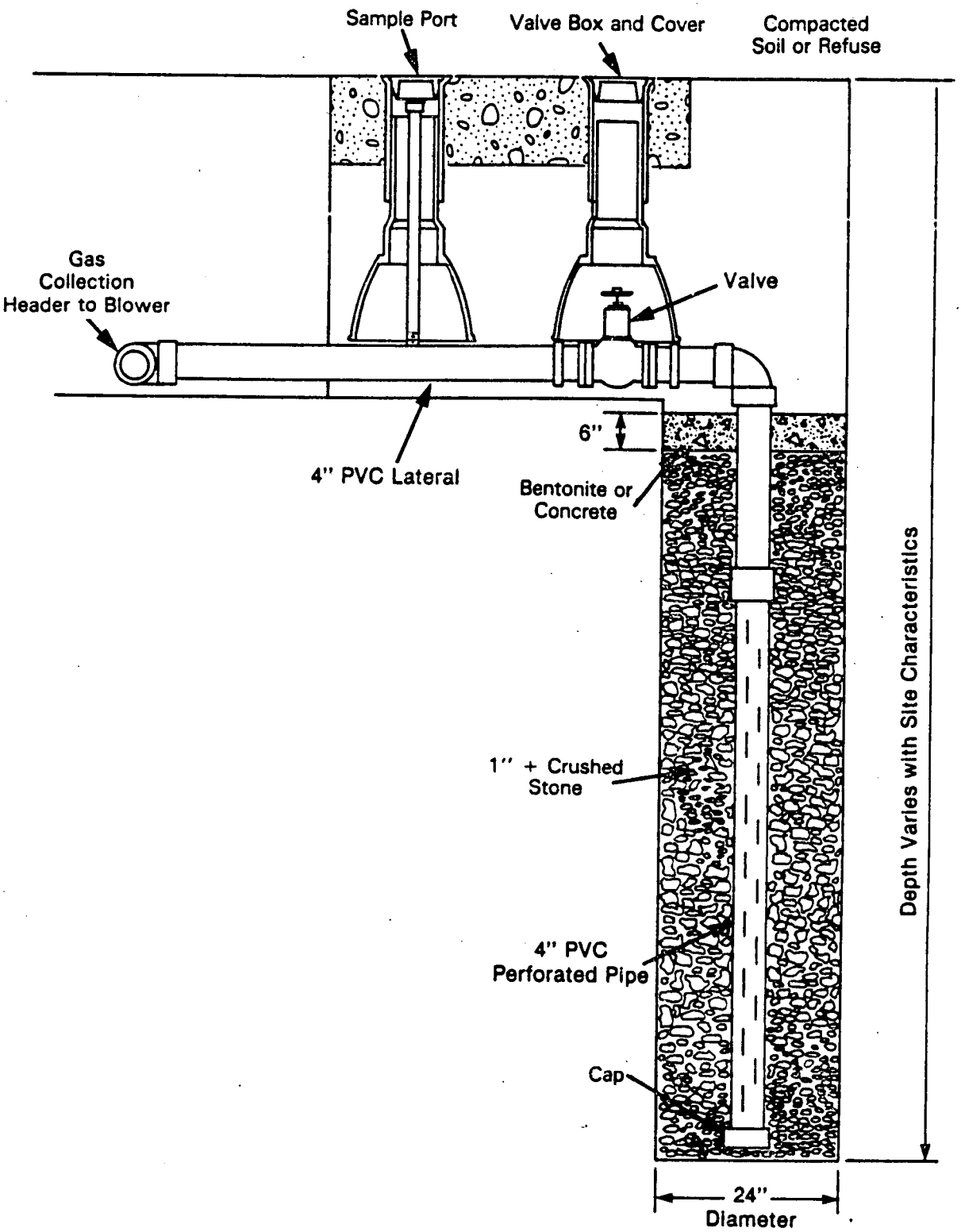

Figure 3. Gas extraction well and well head assembly.

BILLING CODE 6560-50-C

(3) The well head may be connected to the collection header pipes below or above the landfill surface. The well head assembly shall include a PVC ball or butterfly valve, flanges, gaskets, connectors, access couplings and at least one sampling port. The cap and header pipe shall be constructed of PVC or HDPE. A schematic of the extraction well and well head assembly is illustrated in Figure 3.

(c) Each owner or operator seeking to comply with § 60.752(b)(2)(i)(a) shall convey the landfill gas to a control system in compliance with § 60.752(b)(2)(iii) through the collection header pipe(s). The gas mover (i.e., fan, blower, or compressor) system shall be sized to handle the maximum landfill gas flowrate expected over the life of the gas moving equipment. This maximum flowrate shall be projected using the following equation:

$$\text{Peak Flow } [m^3/yr] = 2L_o R (1 - e^{-kt})$$

where,

L_o = refuse methane generation potential, m^3/Mg refuse

R = average annual acceptance rate, Mg/yr

k = methane generative rate constant, 1/yr

t = age of the landfill plus the gas mover equipment life or active life of the landfill, whichever is less, in years

A value of 230 m^3/Mg shall be used for L_o. If Method 2E has been performed, the value of k determined from the test should be used; if not, a value of 0.2 years $^{-1}$ shall be used.

3. Section 60.30 is amended by adding paragraph (c) to read as follows:

§ 60.30 Scope.

* * * * *

(c) Subpart Cc—Municipal Solid Waste Landfills.

4. Part 60 is further amended by adding the following subpart:

Subpart Cc—Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills

Sec.
60.30c Scope.
60.31c Definitions.
60.32c Designated facilities.
60.33c Emission guidelines for MSW landfill emissions.
60.34c Test methods and procedures.
60.35c Reporting and recordkeeping guidelines.

Subpart Cc—Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills

§ 60.30c Scope.

This subpart contains emission guidelines and compliance times for the control of certain designated pollutants from certain designated municipal solid waste (MSW) landfills in accordance with section 111(d) of the Act and subpart B.

§ 60.31c Definitions.

Terms used but not defined in this subpart have the meaning given them in the Act and in Subparts A, B, and WWW of this part.

MSW landfill means an entire disposal facility in a contiguous geographical space where household waste is placed on land, and for which construction or modification is commenced before May 30, 1991. In the event no construction activity has occurred prior to initial placement of waste in the landfill, initial waste placement shall be viewed as *commenced construction.*

§ 60.32c Designated facilities.

(a) The designated facility to which the guidelines apply is each existing MSW landfill for which construction or modification is commenced before May 30, 1991.

(b) Physical or operational changes made to an existing MSW landfill to comply with the emission guideline are not considered a modification or reconstruction and would not bring an existing MSW landfill under the provisions at Subpart WWW [see § 60.750].

§ 60.33c Emission guidelines for MSW landfill emissions.

(a) For approval, a State plan shall include control of MSW landfill emissions at each MSW landfill meeting the following three conditions:

(1) The landfill has accepted waste at any time since November 8, 1987, or has additional capacity available for future waste deposition;

(2) The landfill has a design capacity of 100,000 Mg (111,000 tons) or greater; and

(3) The landfill has a nonmethane organic compound (NMOC) emission rate of 150 megagrams per year (Mg/yr) [167 tons per year (tpy)] or more.

(b) For approval, a State plan shall include the installation of a well-designed gas collection and control system at each MSW landfill meeting the conditions in paragraph (a) of this section. The State plan shall include a process for State review and approval of the site-specific design plans for the gas collection and control system(s).

(c) For approval, a State plan shall include provisions for the control of collected MSW landfill emissions through the use of control devices meeting the provisions of paragraph (c)(1), (2), or (3) of this section, except as provided in § 60.24.

(1) An open flare designed and operated in accordance with the parameters established in 40 CFR 60.18.

(2) A control system designed and operated so as to reduce NMOC by 98 percent; or

(3) An enclosed combustor designed and operated to reduce the outlet NMOC concentration to 20 ppmvd at 3 percent oxygen, or less.

§ 60.34c Test methods and procedures.

For approval, a State plan must include provisions for the calculation of the landfill NMOC emission rate listed in § 60.753, as applicable, to determine whether the landfill meets the condition in § 60.33c(a)(3).

§ 60.35c Reporting and recordkeeping guidelines.

For approval, a State plan shall include the recordkeeping and reporting provisions listed in §§ 60.756 and 60.757, as applicable, except as provided under § 60.24.

§ 60.36c Compliance times.

(a) Except as provided for under paragraph (b) of this section, planning, awarding of contracts, and installation of MSW landfill air emission collection and control equipment capable of meeting the emission guidelines established under § 60.33c can be accomplished within 30 months after the effective date of a State emission standard for MSW landfills.

(b) For each existing MSW landfill meeting the conditions in § 60.33c(a)(1) and § 60.33c(a)(2) whose NMOC emission rate is less than 150 Mg/yr (167 tpy) on the effective date of the State emission standard, installation of collection and control systems capable of meeting emission guidelines in § 60.33c can be accomplished within 30 months of the date when the condition in § 60.33c(a)(3) is met (i.e., the date of the first annual NMOC emission rate which equals or exceeds 150 Mg/yr [167 tpy]).

5. Part 60 is further amended by adding Methods 2E, 3C and 25C to appendix A to read as follows:

Appendix A—Reference Methods

* * * * *

Method 2E—Determination of Landfill Gas Gas Production Flow Rate

1. *Applicability and Principle*

1.1 Applicability. This method applies to the measurement of landfill gas (LFG) production flow rate from municipal solid waste landfills and is used to calculate the flow rate of nonmethane organic compounds (NMOC) from landfills.

1.2 Principle. Extraction wells are installed either in a cluster of three or at five dispersed locations in the landfill. A blower is used to extract LFG from the landfill. LFG composition, landfill pressures, and orifice pressure differentials from the wells are measured and the landfill gas production flow rate is calculated.

2. *Apparatus*

2.1 Well Drilling Rig. Capable of boring a 0.6-m (24-in.) diameter hole into the landfill to a minimum of 75 percent of the landfill depth. The depth of the well shall not exceed the bottom of the landfill or the liquid level.

2.2 Gravel. No fines. Gravel diameter should be appreciably larger than perforations stated in 2.10 and 3.2.

2.3 Bentonite.

2.4 Backfill Material. Clay, soil, and sandy loam have been found to be acceptable.

2.5 Extraction Well Pipe. Polyvinyl chloride (PVC), high density polyethylene (HDPE), fiberglass, stainless steel or other suitable nonporous material capable of transporting landfill gas with a minimum diameter of 3 in.

2.6 Well Assembly. Valve capable of adjusting gas flow, such as a gate, ball or butterfly valve, sampling ports at the well head and outlet and a flow measuring device, such as an in-line orifice meter or pitot tube. A schematic of the well head assembly is shown in Figure 1.

BILLING CODE 6560-50-

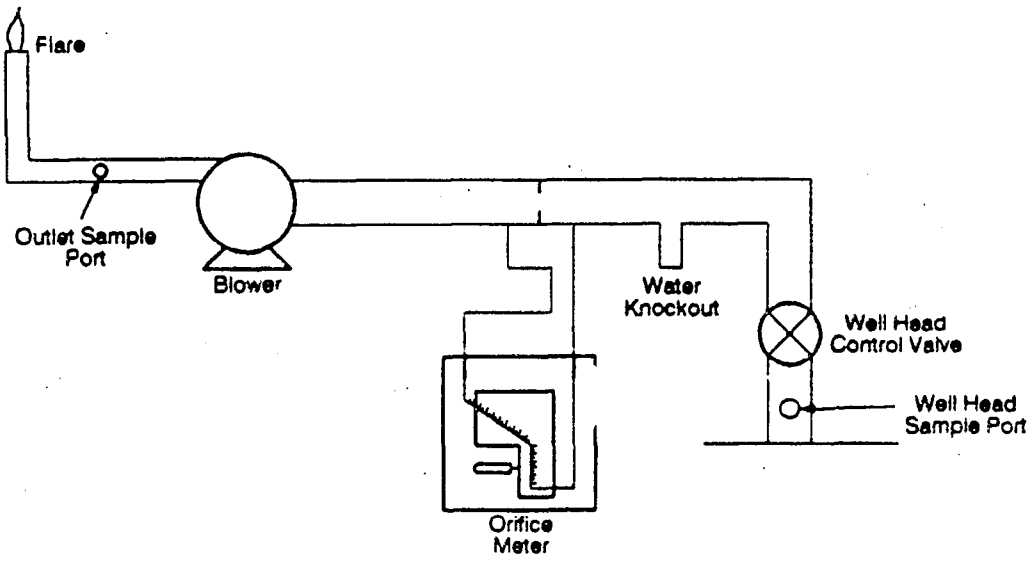

Figure 1. Schematic of above ground assembly.

BILLING CODE 6560-50-C

2.7 Cap. PVC or HDPE.

2.8 Header Piping. PVC or HDPE.

2.9 Auger. Capable of boring a 0.15- to 0.23-m (6- to 9-in.) diameter hole to a depth equal to the top of the perforated section of the extraction well, for pressure probe installation.

2.10 Pressure Probe. PVC or stainless steel (316), 0.025-m (1-in.). Schedule 40 pipe. Perforate the bottom two thirds. A minimum requirement for perforations is slots or holes with an open area equivalent to four 0.006-m (¼-in.) diameter holes spaced 90° apart every 0.15 m (6 in.).

2.11 Blower and Flare Assembly. Explosion-proof blower, capable of extracting LFG at a flow rate of 8.5 m^3/min (300 ft^3/min), a water knockout, and flare or incinerator.

2.12 Standard Pitot Tube and Differential Pressure Gauge for Flow Rate Calibration with Standard Pitot. Same as Method 2, Sections 2.7 and 2.8.

2.13 Orifice Meter. Orifice plate, pressure tabs, and pressure measuring device to measure the LFG flow rate.

2.14 Barometer. Same as Method 4, Section 2.1.5.

2.15 Differential Pressure Gauge. Water-filled U-tube manometer or equivalent, capable of measuring within 0.02 mm Hg (0.01 in. H_2O), for measuring the pressure of the pressure probes.

3. *Procedure*

3.1 Placement of Extraction Wells. The landfill owner or operator may install a single cluster of three extraction wells in a test area or space five wells over the landfill. The cluster wells are recommended but may be used only if the composition, age of the refuse, and the landfill depth of the test area can be determined. CAUTION: Since this method is complex, only experienced personnel should perform the test. Landfill gas contains methane, therefore explosive mixtures may exist at or near the landfill. It is advisable to take appropriate safety precautions when testing landfills, such as refraining from smoking and installing explosion-proof equipment.

3.1.1 Cluster Wells. Consult landfill site records for the age of the refuse, depth, and composition of various sections of the landfill. Select an area near the perimeter of the landfill with a depth equal to or greater than the average depth of the landfill and with the average age of the refuse between 2 and 10 years old. Avoid areas known to contain nondecomposable materials, such as concrete and asbestos. Locate wells as shown in Figure 2.

3.1.1.1 The age of the refuse in a test area will not be uniform, so calculate a weighted average to determine the average age of the refuse as follows:

$$A_{avg} = \sum_{i=1}^{n} f_i A_i$$

where,

A_{avg} = Average age of the refuse tested, yr.

f_i = Fraction of the refuse in the ith section.

A_i = Age of the ith fraction, yr.

3.1.2 Equal Volume Wells. Divide the sections of the landfill that are at least 2 years old into five areas representing equal volumes. Locate an extraction well near the center of each area.

3.2 Installation of Extraction Wells. Use a well drilling rig to dig a 0.6-m (24-in.) diameter hole in the landfill to a minimum of 75 percent of the landfill depth, not to exceed the bottom of the landfill or the liquid level. Perforate the bottom two thirds of the extraction well pipe. A minimum requirement for perforations is holes or slots with an open area equivalent to 0.01-m (½-in.) diameter holes spaced 90° apart every 0.1 to 0.2 m (4 to 8 in.). Place the extraction well in the center of the hole and backfill with gravel to a level 0.30 m (1 ft) above the perforated section. Add a layer of backfill material 1.2 m (4 ft) thick. Add a layer of bentonite 0.9 m (3 ft) thick, and backfill the remainder of the hole with cover material or material equal in permeability to the existing cover material. The specifications for extraction well installation are shown in Figure 3.

BILLING CODE 6560-50-M

HeinOnline -- 56 Fed. Reg. 24514 1991

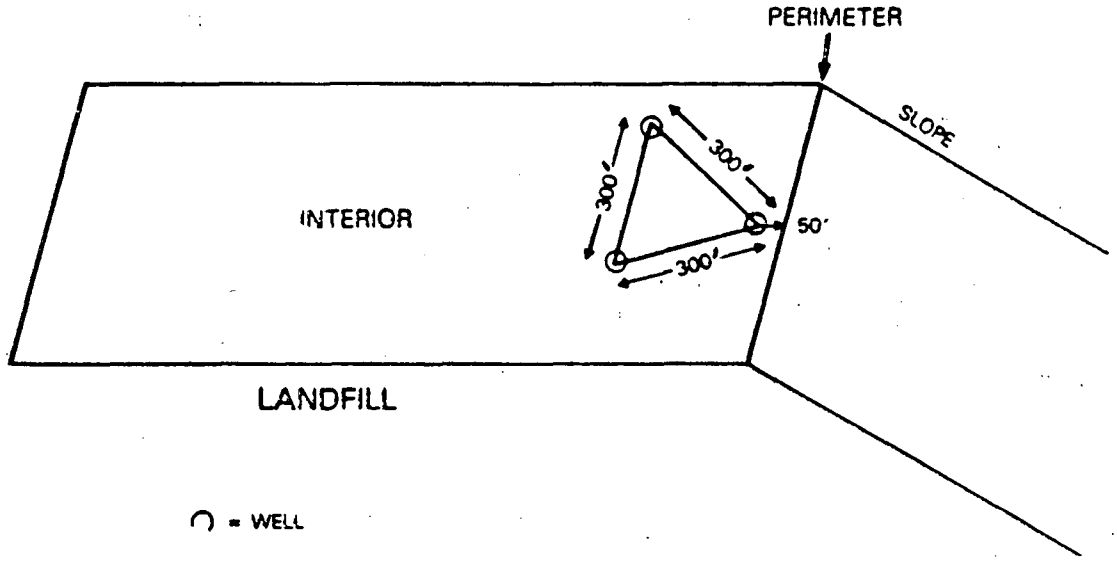

Figure 2. Cluster well placement.

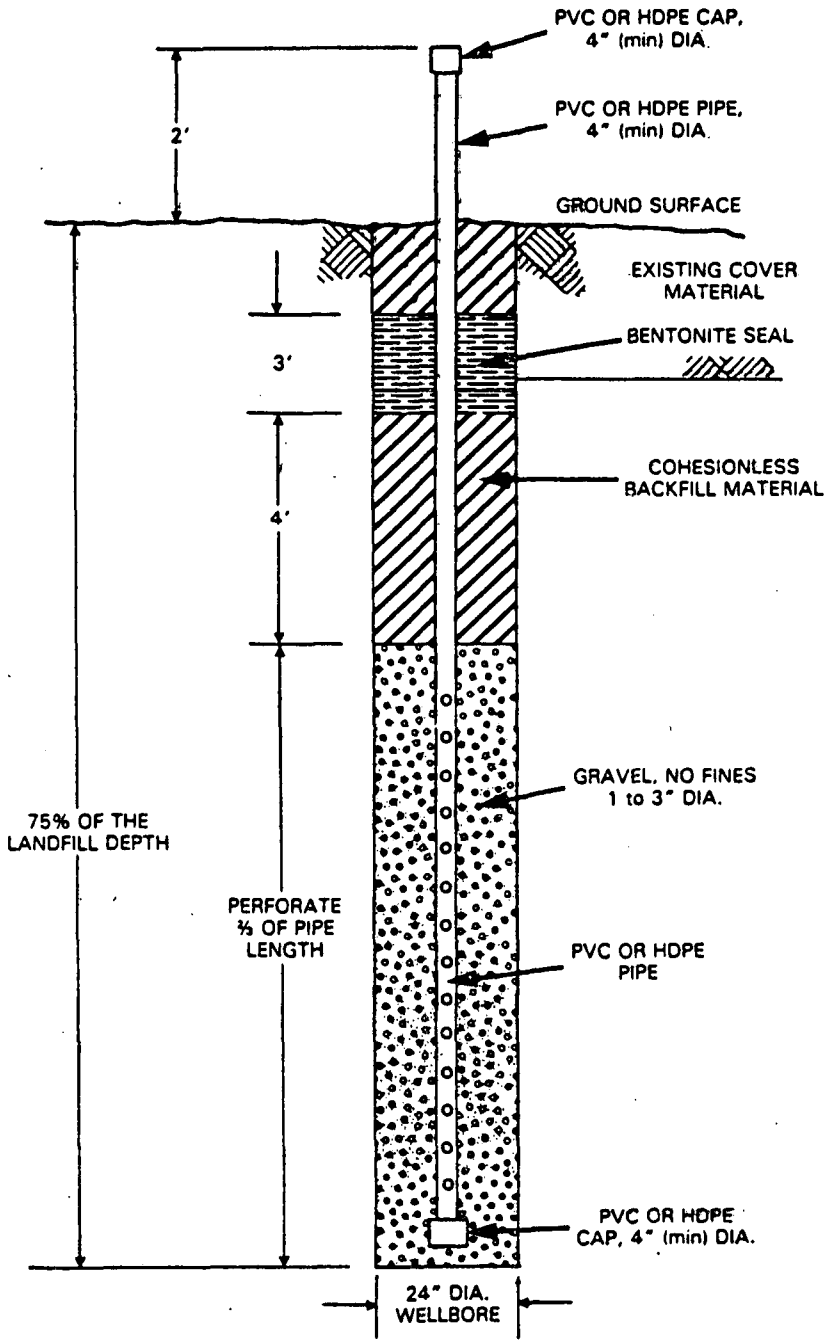

Figure 3. Gas extraction well.

BILLING CODE 6560-50-C

3.3 Pressure Probes. Locate pressure probes along three radial arms approximately 120° apart at distances of 3, 15, 30, and 45 m (10, 50, 100, and 150 ft) from the extraction well. The tester has the option of locating additional pressure probes at distances every 15 m (50 feet) beyond 45 m (150 ft). Example placements of probes are shown in Figure 4. The 15, 30, and 45 m, (50, 100, and 150 ft) probes from each well, and any additional probes located along the three radial arms (deep probes), shall extend to a depth equal to the top of the perforated section of the extraction wells. All other probes (shallow probes) shall extend to a depth equal to half the depth of the deep probes.

BILLING CODE 6560-50-M

HeinOnline -- 56 Fed. Reg. 24517 1991

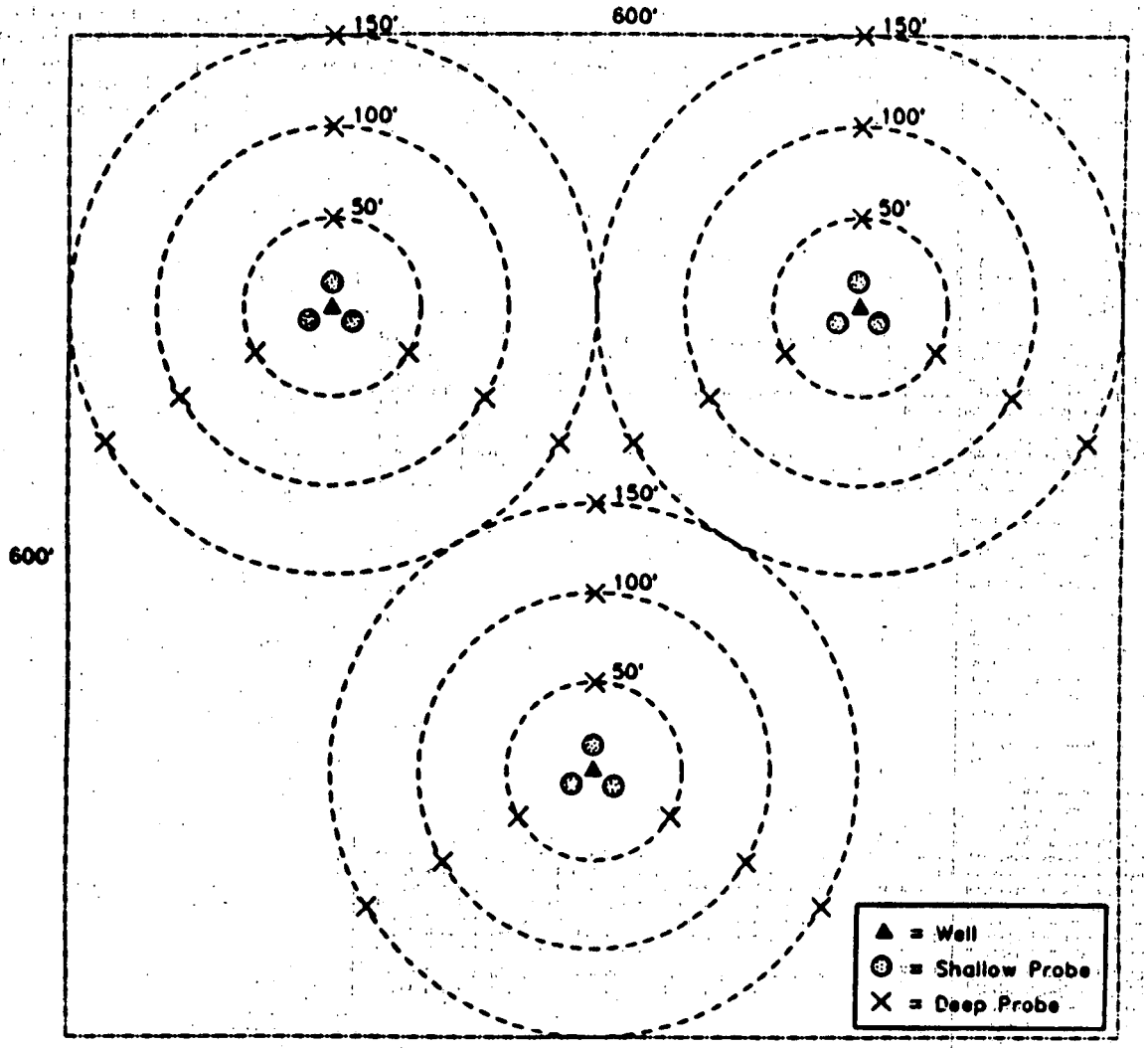

Figure 4. Cluster well configuration

BILLING CODE 6560-50-C

3.3.1 Use an auger to dig a hole, 0.15- to 0.23-m (6- to 9-in.) in diameter, for each pressure probe. Perforate the bottom two thirds of the pressure probe. A minimum requirement for perforations is holes or slots with an open area equivalent to four 0.006-m (1/4-in.) diameter holes spaced 90° apart every 0.15 m (6 in.). Place the pressure probe in the center of the hole and backfill with gravel to a level 0.30 m (1 ft) above the perforated section. Add a layer of backfill material at least 1.2 m (4 ft) thick. Add a layer of bentonite at least 0.3 m (1 ft) thick, and backfill the remainder of the hole with cover material or material equal in permeability to the existing cover material. The specifications for pressure probe installation are shown in Figure 5.

BILLING CODE 6560-50-M

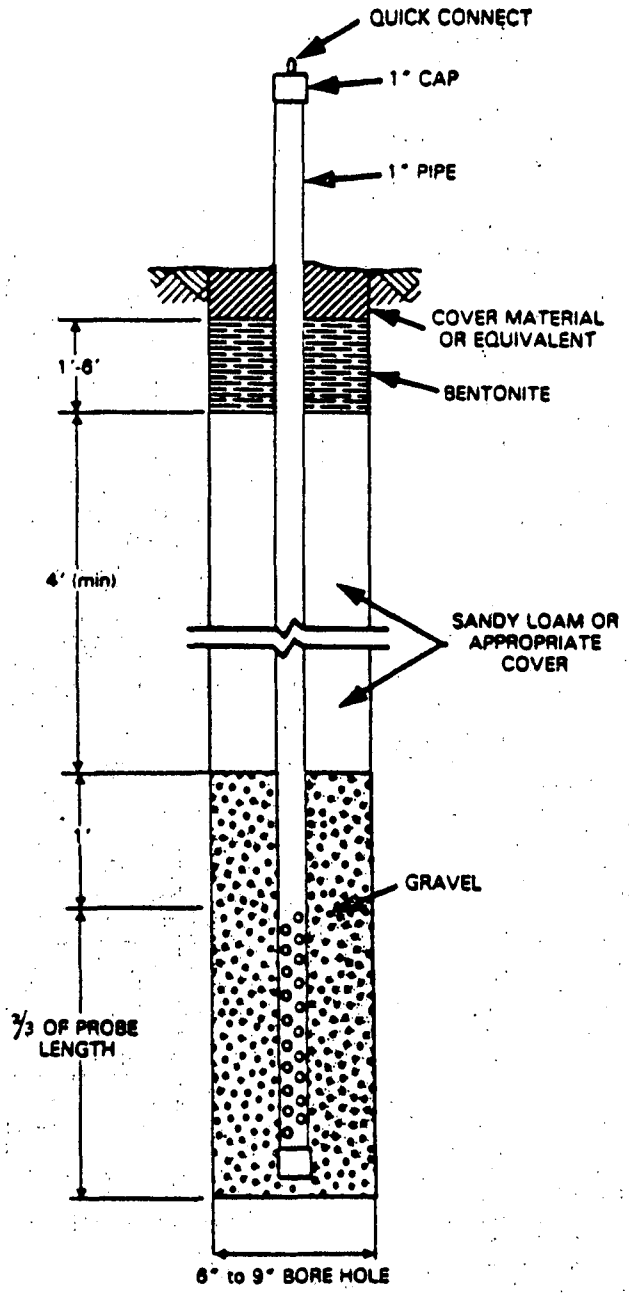

Figure 5. Pressure probe.

BILLING CODE 6560-50-C

3.4 LFG Flow Rate Measurement. Locate flow measurement device, such as an orifice meter, as shown in Figure 1. Attach the wells to the blower and flare assembly. The individual wells may be ducted to a common header so that a single blower and flare assembly and flow meter may be used. Use the procedures in Section 4.1 to calibrate the flow meter.

3.5 Leak Check. A leak check of the above ground system is required for accurate flow rate measurements and for safety. Sample LFG at the well head sample port and at the outlet sample port. Use Method 3C to determine nitrogen (N_2) concentrations. Determine the difference by using the formula below.

$$\text{Difference} = C_o - C_w$$

where,

C_o = Concentration of N_2 at the outlet, ppmv.

C_w = Concentration of N_2 at the wellhead, ppmv.

The system passes the leak check if the differences is less than 10,000 ppmv.

3.6 Static Testing. Close the control valves on the wells during static testing. Measure the gauge pressure (P_g) at each deep pressure probe and the barometric pressure (P_{bar}) every 8 hrs. for 3 days. Convert the gauge pressure of each deep pressure probe to absolute pressure by using the following equation. Record as P_i.

$$P_i = P_{bar} + P_g$$

3.6.1 For each probe, average all of the 8-hr deep pressure probe readings and record as P_{ia}. P_{ia} is used in Section 3.7.6 to determine the maximum radius of influence.

3.6.2 Measure the static flow rate of each well once during static testing.

3.7 Short Term Testing. The purpose of short term testing is to determine the maximum vacuum that can be applied to the wells without infiltration of air into the landfill. The short term testing is done on one well at a time. Burn all LFG with a flare or incinerator.

3.7.1 Use the blower to extract LFG from a single well at a rate at least twice the static flow rate of the respective well measured in Section 3.6.2. If using a single blower and flare assembly and a common header system, close the control valve on the wells not being measured. Allow 24 hrs. for the system to stabilize at this flow rate.

3.7.2 Test for infiltration of air into the landfill by measuing the gauge pressures of the shallow pressure probes and using Method 3C to determine the LFG N_2 concentration. If the LFG N_2 concentration is less than 1 percent and all of the shallow probes have a positive gauge pressure, increase the blower vacuum by 3.7 mm Hg (2 in. H_2O), wait 24 hr, and repeat the tests for infiltration. Continue the above steps of increasing blower vacuum by 3.7 mm Hg (2 in. H_2O), waiting 24 hr, and testing for infiltration until the concentration of N_2 exceeds 1 percent or any of the shallow probes have a negative gauge pressure, at which time reduce the blower vacuum so that the N_2 concentration is less than 1 percent and the gauge pressures of the shallow probes are positive.

3.7.3 At this blower vacuum, measure P_{bar} every 8 hr for 24 hr and record the LFG flow rate as Q_s and the probe gauge pressures for all of the probes as P_f. Convert the gauge pressures of the deep probes to absolute pressures for each 8 hr reading at Q_s as follows.

$$P = P_{bar} + P_f$$

3.7.4 For each probe, average the 8-hr deep pressure probe readings and record as P_{fa}.

3.7.5 For each probe, compare the initial average pressure (P_{ia}) from Section 3.6.1 to the final average pressure (P_{fa}). Determine the furthermost point from the well head along each radial arm where $P_{fa} \leq P_{ia}$. This distance is the maximum radius of influence, which is the distance from the well affected by the vacuum. Average these values to determine the average maximum radius of influence (R_{ma}).

3.7.6 Calculate the depth (D_{st}) affected by the extraction well during the short term test as follows. If the computed value of D_{st} exceeds the depth of the landfill, set D_{st} equal to the landfill depth.

$$D_{st} = WD + R_{ma}^2$$

where,

WD = Well depth, m.

3.7.7 Calculate the void volume for the extraction well (V) as follows.

$$V = 0.40\pi R_{ma}^2 D_{st}$$

3.7.8 Repeat the procedures in Section 3.7 for each well.

3.8 Calculate the total void volume of the test wells (V_v) by summing the void volumes (V) of each well.

3.9 Long Term Testing. The purpose of long term testing is to extract two void volumes of LFG from the extraction wells. Use the blower to extract LFG from the wells. If a single blower and flare assembly and common header system are used, open all control valves and set the blower vacuum equal to the highest stabilized blower vacuum demonstrated by any individual well in Section 3.7. Every 8 hr, sample the LFG from the well head sample port, measure the gauge pressures of the shallow pressure probes, the blower vacuum, the LFG flow rate, and use the criteria for infiltration in Section 3.7.2 and Method 3C to test for infiltration. If infiltration is detected, do not reduce the blower vacuum, but reduce the LFG flow rate from the well by adjusting the control valve on the well head. Adjust each affected well individually. Continue until the equivalent of two total void volumes (V_v) have been extracted, or until $V_t = 2\ V_v$.

3.9.1 Calculate V_t, the total volume of LFG extracted from the wells, as follows.

$$V_t \quad \sum_{i=1}^{n} 60\ Q_i\ t_{vi}$$

where,

V_t = Total volume of LFG extracted from wells, m^3.

Q_i = LFG flow rate measured at orifice meter at the i_{th} interval, m^3/min.

t_{vi} = Time of the i_{th} interval (usually 8), hr.

3.9.2 Record the final stabilized flow rate as Q_f. If, during the long term testing, the flow rate does not stabilize, calculate Q_f by averaging the last 10 recorded flow rates.

3.9.3 For each deep probe, convert each gauge pressure to absolute pressure as in Section 3.7.4. Average these values and record as P_{sa}. For each probe, compare P_{ia} to P_{sa}. Determine the furthermost point from the well head along each radial arm where $P_{sa} \leq P_{ia}$. This distance is the stabilized radius of influence. Average these values to determine the average stabilized radius of influence (R_{sa}).

3.10 Determine the NMOC mass emission rate using the procedures in Section 5.

4. *Calibrations*

4.1 Orifice Calibration Procedure. Locate a standard pitot tube in line with an orifice meter. Use the procedures in Section 3 of Method 2 to determine the average dry gas volumetric flow rate for at least five flow rates that bracket the expected LFG flow rates, except in Section 3.1, use a standard pitot tube rather than a Type S pitot tube. Method 3C may be used to determine the dry molecular weight. It may be necessary to calibrate more than one orifice meter in order to bracket the LFG flow rates. Construct a calibration curve by plotting the pressure drops across the orifice meter for each flow rate versus the average dry gas volumetric flow rate in m^3/min of the gas.

5. *Calculations*

5.1 Nomenclature.

A_{avg} = Average age of the refuse tested, yr.

A_i = Age of refuse in the i_{th} fraction, yr.

A = Age of landfill, yr.

A_r = Acceptance rate, Mg/yr.

C_{NMOC} = NMOC concentration, ppmv as hexane ($C_{NMOC} = C_t/6$).

C_t = NMOC concentration, ppmv (carbon equivalent) from Method 25C.

D = Depth affected by the test wells, m.

D_{st} = Depth affected by the test wells in the short term test, m.

f = Fraction of decomposable refuse in the landfill.

f_i = Fraction of the refuse in the ith section.

k = Landfill gas generation constant, yr^{-1}.

L_o = Methane generation potential, m^3/Mg.

L_o' = Revised methane generation potential to account for the amount of nondecomposable material in the landfill, m^3/Mg.

M_i = Mass of refuse of the ith section, Mg.

M_r = Mass of decomposable refuse affected by the test well, Mg.

P_{bar} = Atmospheric pressure, mm Hg.

P_g = Gauge pressure of the deep pressure probes, mm Hg.

P_i = Initial absolute pressure of the deep pressure probes during static testing, mm Hg.

P_{ia} = Average initial absolute pressure of the deep pressure probes during static testing, mm Hg.

P_f = Final absolute pressure of the deep pressure probes during short term testing, mm Hg.

P_{fa} = Average final absolute pressure of the deep pressure probes during short term testing, mm Hg.

P_s = Final absolute pressure of the deep pressure probes during long term testing, mm Hg.

P_{aa} = Average final absolute pressure of the deep pressure probes during long term testing, mm Hg.
Q_f = Final stabilized flow rate, m^3/min.
Q_i = LFG flow rate measured at orifice meter during the ith interval, m^3/min.
Q_o = Maximum LFG flow rate at each well determined by short term test, m^3/min.
Q_t = NMOC mass emission rate, m^3/min.
R_m = Maximum radius of influence, m.
R_{ma} = Average maximum radius of influence, m.
R_s = Stabilized radius of influence for an individual well, m.
R_{sa} = Average stabilized radius of influence, m.
t_i = Age of section i, yr.
t_t = Total time of long term testing, yr.
V = Void volume of test well, m^3.
V_r = Volume of refuse affected by the test well, m^3.
V_t = Total volume of refuse affected by the long term testing, m^3.
V_v = Total void volume affected by test wells, m^3.
WD = Well depth, m.
ρ = refuse density, m^3 (Assume 0.64 Mg/m^3 if data are unavailable).

5.2 Use the following equation to calculate the depth affected by the test well. If using cluster wells, use the average depth of the wells for WD. If the value of D is greater than the depth of the landfill, set D equal to the landfill depth.

$$D = WD + R_{sa}$$

5.3 Use the following equation to calculate the volume of refuse affected by the test well.

$$V_r = R_{sa}\,\pi\,D$$

5.4 Use the following equation to calculate the mass affected by the test well.

$$M_r = V_r\,\rho$$

5.5 Modify L_o to account for the nondecomposable refuse in the landfill.

$$L_o' = f\,L_o$$

5.6 In the following equation, solve for k by iteration. A suggested procedure is to select a value for k, calculate the left side of the equation, and if not equal to zero, select another value for k. Continue this process until the left hand side of the equation equals zero, ±0.001.

$$k_e^{-k} A_{avg} - \left[\frac{Q_f}{2\,L_o'\,M_r} \right] = 0$$

5.7 Use the following equation to determine landfill NMOC mass emission rate if the yearly acceptance rate of refuse has been consistent (±10 percent) over the life of the landfill.

$$Q_t = 2\,L_o'\,A_r\,(1 - e^{-k\,A})\,C_{NMOC}\,(3.595 \times 10^{-9})$$

5.8 Use the following equation to determine landfill NMOC mass emission rate if the acceptance rate has not been consistent over the life of the landfill.

$$Q_t = 2\,k\,L_o'\,C_{NMOC}\,(3.595 \times 10^{-9}) \sum_{i=1}^{n} M_i\,e^{-k t_i}$$

6. *Bibliography*

1. Same as Method 2, Appendix A, 40 CFR part 60.
2. Emcon Associates, Methane Generation and Recovery from Landfills. Ann Arbor Science, 1982.
3. The Johns Hopkins University, Brown Station Road Landfill Gas Resource Assessment, Volume 1: Field Testing and Gas Recovery Projections. Laurel, Maryland: October 1982.
4. Mandeville and Associates, Procedure Manual for Landfill Gases Emission Testing.
5. Letter and attachments from Briggum, S., Waste Management of North America, to Thorneloe, S., EPA. Response to July 28, 1988 request for additional information. August 18, 1988.
6. Letter and attachments from Briggum, S., Waste Management of North America, to Wyatt, S., EPA. Response to December 7, 1988 request for additional information. January 16, 1989.

* * * * *

Method 3C—Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen from Stationary Sources

1. *Applicability and Principle*

1.1 Applicability. This method applies to the analysis of carbon dioxide (CO_2), methane (CH_4), nitrogen (N_2), and oxygen (O_2) in samples from municipal landfills and other sources when specified in an applicable subpart of the regulations.

1.2 Principle. A portion of the sample is injected into a gas chromatograph (GC) and the CO_2, CH_4, N_2, and O_2 concentrations are determined by using a thermal conductivity detector (TCD) and integrator.

2. *Range and Sensitivity*

2.1 Range. The range of this method depends upon the concentration of samples. The analytical range of TCD's is generally between approximately 10 ppmv and the upper percent range.

2.2 Sensitivity. The sensitivity limit for a compound is defined as the minimum detectable concentration of that compound, or the concentration that produces a signal-to-noise ratio of three to one. For CO_2, CH_4, N_2, and O_2, the sensitivity limit is in the low ppm range.

3. *Interferences*

Since the TCD exhibits universal response and detects all gas components except the carrier, interferences may occur. Choosing the appropriate GC or shifting the retention times by changing the column flow rate may help to eliminate resolution interferences.

To assure consistent detector response, helium is used to prepare calibration gases. Frequent exposure to samples or carrier gas containing oxygen may gradually destroy filaments.

4. *Apparatus*

4.1 Gas Chromatograph. GC having at least the following components:

4.1.1 Separation Column. Appropriate column(s) to resolve CO_2, CH_4, N_2, O_2, and other gas components that may be present in the sample. One column that has been advertised to work in this case is column CTR I available from Alltech Associates Inc., 2051 Waukegan Road, Deerfield, Illinois 60015. NOTE: Mention of trade names or specific products does not constitute endorsement or recommendation by the U.S. Environmental Protection Agency.

4.1.2 Sample Loop. Teflon or stainless steel tubing of the appropriate diameter. **Note:** Mention of trade names or specific products does not constitute endorsement or recommendation by the U.S. Environmental Protection Agency.

4.1.3 Conditioning System. To maintain the column and sample loop at constant temperature.

4.1.4 Thermal Conductivity Detector.

4.2 Recorder. Recorder with linear strip chart. Electronic integrator (optional) is recommended.

4.3 Teflon Tubing. Diameter and length determined by connection requirements of cylinder regulators and the GC.

4.4 Regulators. To control gas cylinder pressures and flow rates.

4.5 Adsorption Tubes. Applicable traps to remove any O_2 from the carrier gas.

5. *Reagents*

5.1 Calibration and Linearity Gases. Standard cylinder gas mixtures for each compound of interest with at least three concentration levels spanning the range of suspected sample concentrations. The calibration gases shall be prepared in helium.

5.2 Carrier Gas. Helium, high-purity.

6. *Analysis*

6.1 Sample Collection. Use the sample collection procedures described in Methods 3 or 25C to collect a sample of landfill gas (LFG).

6.2 Preparation of GC. Before putting the GC analyzer into routine operation, optimize the operational conditions according to the manufacturer's specifications to provide good resolution and minimum analysis time. Establish the appropriate carrier gas flow and set the detector sample and reference cell flow rates at exactly the same levels. Adjust the column and detector temperatures to the recommended levels. Allow sufficient time for temperature stabilization. This may typically require 1 hour for each change in temperature.

6.3 Analyzer Linearity Check and Calibration. Perform this test before sample analysis. Using the gas mixtures in Section 5.1, verify the detector linearity over the range of suspected sample concentrations with at least three points per compound of interest. This initial check may also serve as the initial instrument calibration. All subsequent calibrations may be performed using a single-point standard gas provided the calibration point is within 20 percent of the sample component concentration. For each instrument calibration, record the carrier and detector flow rates, detector filament and block temperatures, attenuation factor, injection time, chart speed, sample loop volume, and component concentrations. Plot a linear regression of the standard concentrations versus area values to obtain the response factor of each compound. Alternatively, response factors of uncorrected component concentrations (wet

basis) may be generated using instrumental integration. NOTE: Peak height may be used instead of peak area throughout this method.

6.4 Sample Analysis. Purge the sample loop with sample, and allow to come to atmospheric pressure before each injection. Analyze each sample in duplicate, and calculate the average sample area (A). The results are acceptable when the peak areas for two consecutive injections agree within five percent of their average. If they do not agree, run additional samples until consistent area data are obtained. Determine the tank sample concentrations according to Section 7.2.

7. *Calculations*

Carry out calculations retaining at least one extra decimal figure beyond that of the acquired data. Round off results only after the final calculation.

7.1 Nomenclature.

A=Average sample area.
B_w=Moisture content in the sample, fraction.
C=Component concentration in the sample, dry basis, ppmv.
C_t=Calculated NMOC concentration, ppmv C equivalent.
C_{tm}=Measured NMOC concentration, ppmv C equivalent.
P_{bar}=Barometric pressure, mm Hg.
P_{ti}=Gas sample tank pressure after evacuation, mm Hg absolute.
P_t=Gas sample tank pressure after sampling, but before pressurizing, mm Hg absolute.
P_{tf}=Final gas sample tank pressure after pressurizing, mm HG absolute.
P_w=Vapor pressure of H_2O (from Table 3C-1), mm Hg.
T_{ti}=Sample tank temperature before sampling, °K.
T_t=Sample tank temperature at completion of sampling, °K.
T_{tf}=Sample tank temperature after pressurizing, °K.
r=Total number of analyzer injections of sample tank during analysis (where j=injection number, 1 * * * r).
R=Mean calibration response factor for specific sample component, area/ppmv.

7.2 Concentration of Sample Components. Calculate C for each compound using Equations 3C-1 and 3C-2. Use the temperature and barometric pressure at the sampling site to calculate B_w. If the sample was diluted with helium using the procedures in Method 25C, use Equation 3C-3 to calculate the concentration.

$$B_w = \frac{P_w}{P_{bar}} \quad \text{3C-1}$$

$$C = \frac{A}{R(1-B_w)} \quad \text{3C-2}$$

$$C = \left[\frac{\dfrac{P_{tf}}{T_{tf}}}{\dfrac{P_t}{T_t} - \dfrac{P_{ti}}{T_{ti}}}\right] \frac{A}{R(1-B_w)} \quad \text{3C-3}$$

8. *Bibliography*

1. McNair, H.M., and E.J. Bonnelli, Basic Gas Chromatography. Consolidated Printers, Berkeley, CA. 1969.

TABLE 3C-1.—MOISTURE CORRECTION

Temperature, °C	Vapor pressure of H_2O, mm Hg
4	6.1
6	7.0
8	8.0
10	9.2
12	10.5
14	12.0
16	13.6
18	15.5
20	17.5
22	19.8
24	22.4
26	25.2
28	28.3
30	31.8

* * * * *

Method 25C—Determination of Nonmethane Organic Compounds (NMOC) in Landfill Gases

1. *Applicability and Principle*

1.1 Applicability. This method is applicable to the sampling and measurement of nonmethane organic compounds (NMOC) as carbon in landfill gases.

1.2 Principle. A sample probe that has been perforated at one end is driven or augered to a depth of 0.9 m [3 feet (ft)] below the bottom of the landfill cover. A sample of the landfill gas is extracted with an evacuated cylinder. The NMOC content of the gas is determined by injecting a portion of the gas into a gas chromatographic column to separate the NMOC from carbon monoxide (CO), carbon dioxide (CO_2), and methane (CH_4); the NMOC are oxidized to CO_2, reduced to CH_4, and measured by a flame ionization detector (FID). In this manner, the variable response of the FID associated with different types of organics is eliminated.

2. *Apparatus*

2.1 Sample Probe. Stainless steel, with the bottom third perforated. The sample probe shall be capped at the bottom and shall have a threaded cap with a sampling attachment at the top. The sample probe shall be long enough to go through and extend no less than 0.9 m (3 ft) below the landfill cover. If the sample probe is to be driven into the landfill, the bottom cap should be designed to facilitate driving the probe into the landfill.

2.2 Sampling Train.

2.2.1 Rotameter with Flow Control Valve. Capable of measuring a sample flowrate of 100±10 ml/min. The control valve shall be made of stainless steel.

2.2.2 Sampling Valve. Stainless steel.

2.2.3 Pressure Gauge. U-tube mercury manometer, or equivalent, capable of measuring pressure to within 1 mm Hg in the range of 0 to 1,100 mm Hg.

2.2.4 Sample Tank. Stainless steel or aluminum cylinder, with a minimum volume of 4 liters and equipped with a stainless steel sample tank valve.

2.3 Vacuum Pump. Capable of evacuating to an absolute pressure of 10 mm Hg.

2.4 Purging Pump. Portable, explosion proof, and suitable for sampling NMOC.

2.5 Pilot Probe Procedure. The following are needed only if the tester chooses to use the procedure described in Section 4.2.1.

2.5.1 Pilot Probe. Tubing of sufficient strength to withstand being driven into the landfill by a post driver and an outside diameter of at least 0.006 m (0.25 in.) smaller than the sample probe. The pilot probe shall be capped on both ends and long enough to go through the landfill cover and extend no less than 0.9 m (3 ft) into the landfill.

2.5.2 Post Driver and Compressor. Capable of driving the pilot probe and the sampling probe into the landfill. The Kitty Hawk portable post driver has been found to be acceptable. NOTE: Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

2.6 Auger Procedure. The following are needed only if the tester chooses to use the procedure described in Section 4.2.2.

2.6.1 Auger. Capable of drilling through the landfill cover and to a depth of no less than 0.9 m (3 ft) into the landfill.

2.6.2 Pea Gravel.

2.6.3 Bentonite.

2.7 NMOC Analyzer, Barometer, Thermometer, and Syringes. Same as in Sections 2.3, 2.4.1, 2.4.2, 2.4.4, respectively, of Method 25.

3. *Reagents*

3.1 NMOC Analysis. Same as in Method 25, Section 3.2.

3.2 Calibration. Same as in Method 25, Section 3.4, except omit Section 3.4.3.

4. *Procedure*

4.1 Sample Tank Evacuation and Leak Check. Conduct the sample tank evacuation and leak check either in the laboratory or the field. Connect the pressure gauge and sampling valve to the sample tank. Evacuate the sample tank to 10 mm Hg absolute pressure or less. Close the sampling valve, and allow the tank to sit for 60 minutes. The tank is acceptable if no change is noted. Include the results of the leak check in the test report.

4.2 Sample Probe Installation. The tester may use the procedure in Sections 4.2.1 or

4.2.2. CAUTION: Since this method is complex, only experienced personnel should perform this test. LFG contains methane, therefore explosive mixtures may exist on or near the landfill. It is advisable to take appropriate safety precautions when testing landfills, such as refraining from smoking and installing explosion-proof equipment.

4.2.1 Pilot Probe Procedure. Use the post driver to drive the pilot probe at least 0.9 m (3 ft) below the landfill cover. Alternative procedures to drive the probe into the landfill may be used subject to the approval of the Administrator.

4.2.1.1 Remove the pilot probe and drive the sample probe into the hole left by the pilot probe. The sample probe shall extend at least 0.9 m (3 ft below) the landfill cover and shall protrude about 0.3 m (1 ft) above the landfill cover. Seal around the sampling probe with bentonite and cap the sampling probe with the sampling probe cap.

4.2.2 Auger Procedure. Use an auger to drill a hole through the landfill cover and to at least 0.9 m (3 ft) below the landfill cover. Place the sample probe in the hole and backfill with pea gravel to a level 0.6 m (2 ft) from the surface. The sample probe shall protrude at least 0.3 m (1 ft) above the landfill cover. Seal the remaining area around the probe with bentonite. Allow 24 hours for the landfill gases to equilibrate inside the augered probe before sampling.

4.3 Sample Train Assembly. Just before assembly, measure the tank vacuum using the pressure gauge. Record the vaccum, the ambient temperature, and the barometric pressure at this time. Assemble the sampling probe purging system as shown in Figure 1.

BILLING CODE 6560-50-M

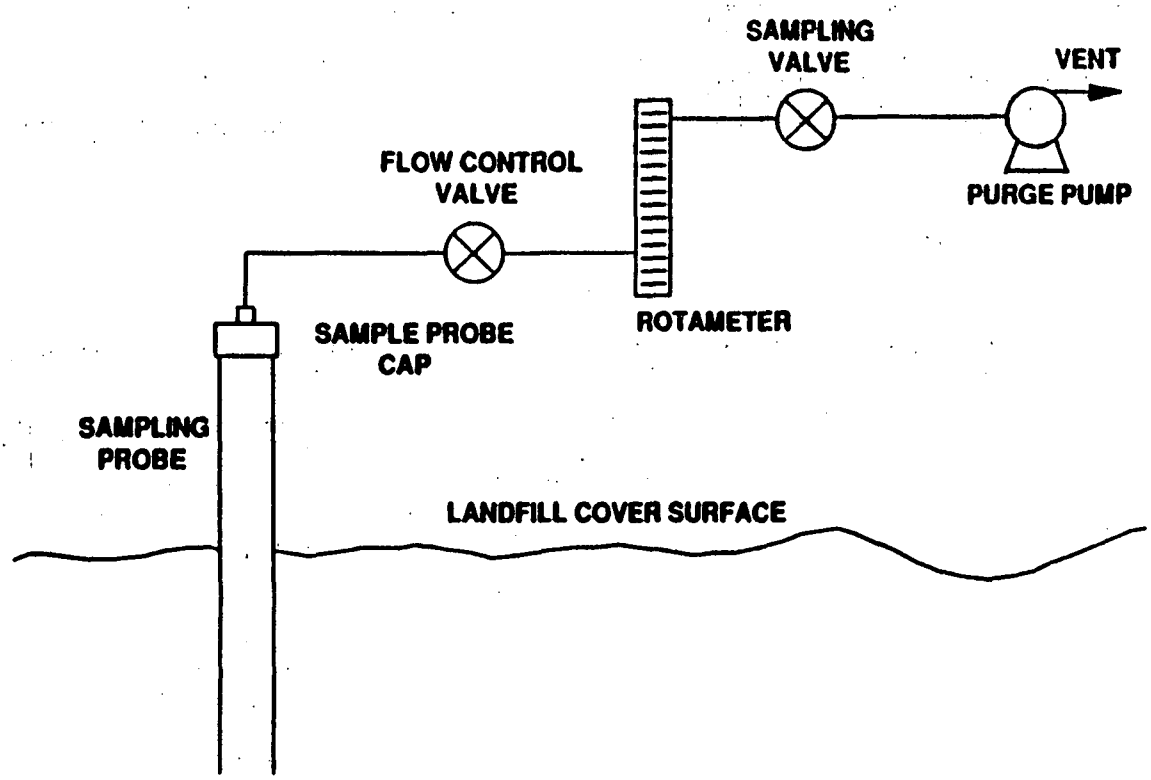

Figure 1. Schematic of sampling probe purging system.

BILLING CODE 6560-50-C

HeinOnline -- 56 Fed. Reg. 24525 1991

4.4 Sampling Procedure. Open the sampling valve and use the purge pump and the flow control valve to evacuate at least two sample probe volumes from the system at a flow rate of 100±10 ml/min (6.1+0.6 in^3/min). Close the sampling valve and replace the purge pump with the sample tank apparatus as shown in Figure 2. Open the sampling valve and the sample tank valves and, using the flow control valve, sample at a flow rate of 100±10ml/min (6.1+0.6 in^3/min) until the sample tank gauge pressure is zero. Disconnect the sampling tank apparatus and use the carrier gas bypass valve to pressurize the sample cylinder to approximately 1,060 mm Hg (567 in.H_2O) absolute pressure with helium and record the final pressure. Alternatively, the sample tank may be pressurized in the lab. If not analyzing for N_2, the sample cylinder may be pressurized with zero air.

BILLING CODE 6560-50-M

HeinOnline -- 56 Fed. Reg. 24526 1991

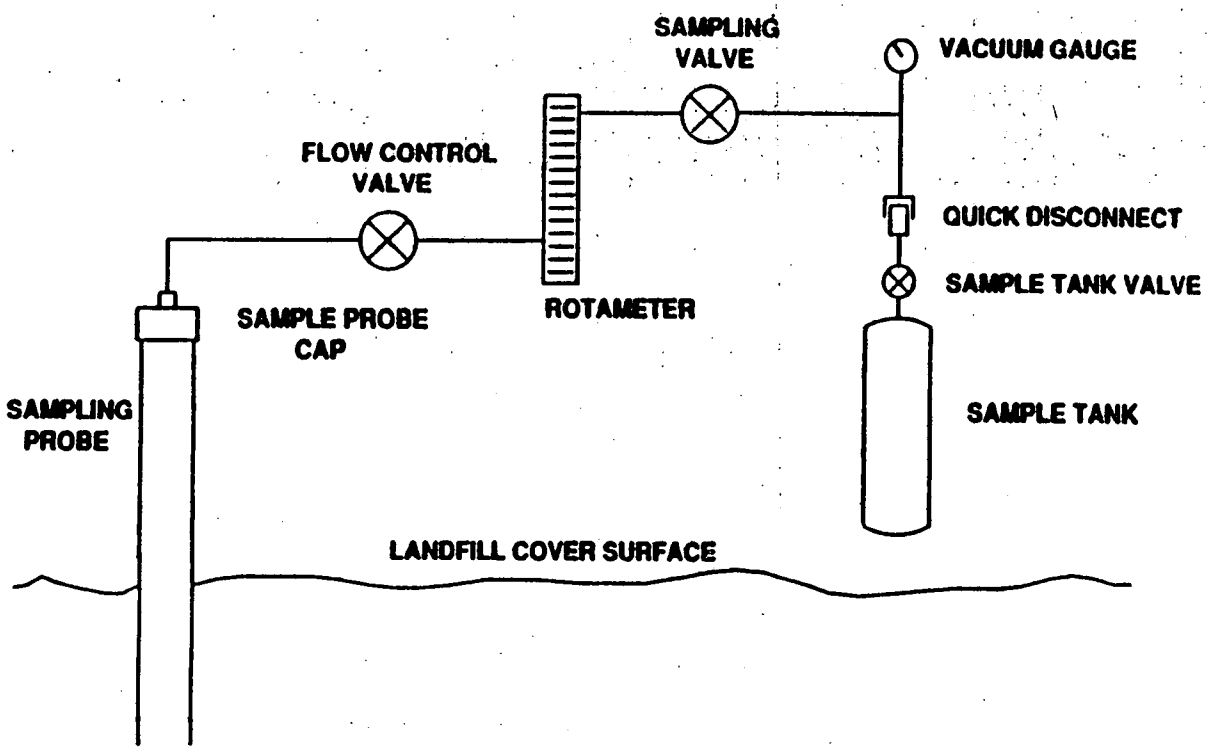

Figure 2. Schematic of sampling train.

BILLING CODE 6560-50-C

4.4.1 Use Method 3C to determine the percent N_2 in the sample. Presence of N_2 indicates infiltration of ambient air into the gas sample. The lanfill sample is acceptable if the concentration of N_2 is less than one percent.

4.5 Analysis. The oxidation, reduction, and measurement of NMOC's is similar to Method 25. Before putting the NMOC analyzer into routine operation, conduct an initial performance test. Start the analyzer, and perform all the necessary functions in order to put the analyzer into proper working order. Conduct the performance test according to the procedures established in Section 5.1. Once the performance test has been successfully completed and the NMOC calibration response factor has been determined, proceed with sample analysis as follows:

4.5.1 Daily Operations and Calibration Checks. Before and immediately after the analysis of each set of samples or on a daily basis (whichever occurs first), conduct a calibration test according to the procedures established in Section 5.2. If the criteria of the daily calibration test cannot be met, repeat the NMOC analyzer performance test (Section 5.1) before proceeding.

4.5.2 Operating Conditions. Same as in Method 25, Section 4.4.2.

4.5.3 Analysis of Sample Tank. Purge the sample loop with sample, and then inject the sample. Under the specified operating conditions, the CO_2 in the sample will elute in approximately 100 seconds. As soon as the detector response returns to baseline following the CO_2 peak, switch the carrier gas flow to backflush, and raise the column oven temperature to 195°C as rapidly as possible. A rate of 30°C/min has been shown to be adequate. Record the value obtained for any measured NMOC. Return the column oven temperature to 85°C in preparation for the next analysis. Analyze each sample in triplicate, and report the average as C_{tm}.

4.6 Audit Samples. Same as in Method 25, Section 4.5.

5. *Calibration and Operational Checks*

Maintain a record of performance of each item.

5.1 Initial NMOC Analyzer Performance Test. Same as in Method 25, Section 5.2, except omit the linearity checks for CO_2 standards.

5.2 NMOC Analyzer Daily Calibration.

5.2.1 NMOC Response Factors. Same as in Method 25, Section 5.3.2.

5.3 Sample Tank Volume. The volume of the gas sampling tanks must be determined. Determine the tank volumes by weighing them empty and then filled with deionized water; weigh to the nearest 5 g, and record the results. Alternatively, measure, to the nearest 5 ml, the volume of water used to fill them.

6 *Calculations*

All equations are written using absolute pressure; absolute pressures are determined by adding the measured barometric pressure to the measured gauge of manometer pressure.

6.1 Nomenclature.

B_w=Moisture content in the sample, fraction.
C_t=Calculated NMOC concentration, ppmv C equivalent.
C_{tm}=Measured NMOC concentration, ppmv C equivalent.
P_b=Barometric pressure, mm Hg.
P_{ti}=Gas sample tank pressure after evacuation, mm Hg absolute.
P_t=Gas sample tank pressure after sampling, but before pressurizing, mm Hg absolute.
P_{tf}=Final gas sample tank pressure after pressurizing, mm Hg absolute.
P_w=Vapor pressure of H_2O (from Table 25C-1), mm Hg.
T_{ti}=Sample tank temperature before sampling, °K.
T_t=Sample tank temperature at completion of sampling, °K.
T_{tf}=Sample tank temperature after pressurizing, °K
r=Total number of analyzer injections of sample tank during analysis (where j=injection number, 1 * * * r).

TABLE 25C-1.—MOISTURE CORRECTION

Temperature, °C	Vapor pressure of H_2O, mm Hg
4	6.1
6	7.0
8	8.0
10	9.2
12	10.5
14	12.0
16	13.6
18	15.5
20	17.5
22	19.8

TABLE 25C-1.—MOISTURE CORRECTION—Continued

Temperature, °C	Vapor pressure of H_2O, mm Hg
24	22.4
26	25.2
28	28.3
30	31.8

6.2 Water Correction. Use Table 25C-1, the LFG temperature, and barometric pressure at the sampling site to calculate B_w.

$$B_w = \frac{P_w}{P_b}$$

6.3 NMOC Concentration. Use the following equation to calculate the concentration of NMOC for each sample tank.

$$C_t = \left[\frac{\dfrac{P_{tf}}{T_{tf}}}{\dfrac{P_t}{T_t} - \dfrac{P_{ti}}{T_{ti}}}\right]\left[\frac{1}{(1-B_w)\,r}\sum_{j=1}^{r} C_{tm}(j)\right]$$

7. *Bibliography*

1. Salo, Albert E., Samuel Witz, and Robert D. MacPhee. Determination of Solvent Vapor Concentrations by Total Combustion Analysis: A Comparison of Infrared with Flame Ionization Detectors. Paper No. 75-33.2. (Presented at the 68th Annual Meeting of the Air Pollution Control Association. Boston, Massachusetts. June 15-20, 1975.) 14 p.

2. Salo, Albert E., William L. Oaks, and Robert D. MacPhee. Measuring the Organic Carbon Content of Source Emissions for Air Pollution Control, Paper No. 74-190. (Presented at the 67th Annual Meeting of the Air Pollution Control Association. Denver, Colorado. June 9-13, 1974.) 25 p.

[FR Doc. 91-12290 Filed 5-29-91; 8:45 am]
BILLING CODE 6560-50-M