EPA-453/R-94-021

AIR EMISSIONS FROM MUNICIPAL SOLID WASTE LANDFILLS - BACKGROUND INFORMATION FOR FINAL STANDARDS AND GUIDELINES

Emission Standards Division

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711
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ENVIRONMENTAL PROTECTION AGENCY

Air Emissions from Municipal Solid Waste Landfills--
Background Information for Final Standards and Guidelines

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____________________________________ ______________________

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1. The standards of performance and emission guidelines limit emissions from new and existing municipal solid waste landfills that emit over 50 Mg/yr of nonmethane organic compounds (NMOC). Section 111 of the Clean Air Act (42 U.S.C. 7411), as amended, directs the Administrator to establish standards of performance and emission guidelines for any category of source of air pollution that "... causes or contributes significantly to air pollution which may reasonably be anticipated to endanger public health or welfare."

2. Copies of this document have been sent to the following Federal Departments: Office of Management and Budget, Commerce, Interior, and Energy; the National Science Foundation; and the Council on Environmental Quality. Copies have also been sent to members of the State and Territorial Air Pollution Program Administrators; the Association of Local Air Pollution Control Officials; EPA Regional Administrators; and other interested parties.

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ACRONYMS, ABBREVIATIONS, AND MEASUREMENT UNITS

Acronyms

AEERL	The EPA Office of Research and Development's Air and Energy Engineering Research Laboratory
APCD	air pollution control device
AQRV	air quality related value
ASCE	American Society of Civil Engineers
BACT	best available control technology
BAT	best available technology
BDT	best demonstrated technology
BID	Background Information Document
BFI	Browning-Ferris Industries
CAA	Clean Air Act
CARB	California Air Resources Board
CEM	continuous emission monitor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
CH_4	Methane
C_{NMOC}	nonmethane organic compounds concentration
CO	carbon monoxide
CO_2	carbon dioxide
CTC	Control Technology Center

Acronyms

EG	emission guidelines
EIS	Environmental Impact Statement
EMB	Emission Measurement Branch
EMCON	(company name; not an acronym)
EPA	U. S. Environmental Protection Agency
ESD	Emission Standards Division
EXISCLOS	Data base of landfills opening in 1987 and closing in 1992
FLM	Federal land manager
FID	flame ionization detector
FR	Federal Register
GC	gas chromatograph
HAP	hazardous air pollutant
HDPE	high density polyethylene
HON	hazardous organic NESHAP
H_2O	water
I.C.	internal combustion
IGBP	International Geosphere-Biosphere Programme
ISO	Interim Standard Offer
k	methane generation rate constant, year^{-1}
LAEEM	Landfill Air Emissions Estimation Model
LAER	lowest achievable emission rate

LFG	landfill gas

ACRONYMS, ABBREVIATIONS, AND MEASUREMENT UNITS (CONTINUED)

Acronyms

LLRW	low level radioactive waste
L_o	methane generation potential, m^3/Mg
MACT	maximum achievable control technology
MIR	maximum individual lifetime risk
MSW	municipal solid waste
MWC	municipal waste combustor
N_2	nitrogen
NAAQS	national ambient air quality standard
NAPCTAC	national air pollution control techniques advisory committee
NESHAP	national emission standards for hazardous air pollutants
NIMBY	not in my backyard
NMOC	nonmethane organic compounds
NO_x	nitrogen oxides
NPL	National Priorities List
NPV	net present value (the value at one point in time of a flow of values across time)
NRC	Nuclear Regulatory Commission
NSPS	new source performance standards
NSR	new source review
NSWMA	National Solid Wastes Management Association
NTIS	National Technical Information Service

ACRONYMS, ABBREVIATIONS, AND MEASUREMENT UNITS (CONTINUED)

Acronyms

NYSDEC	New York State Department of Environmental Conservation
OAQPS	Office of Air Quality Planning and Standards
OMB	Office of Management and Budget
OSW	Office of Solid Waste
OVA	organic vapor analyzer
O_2	oxygen
PCB	polychlorinated biphenyls
PCDD	polychlorinated dibenzo-p-dioxins
PCDF	polychlorinated dibenzo furans
pH	hydrogen-ion concentration
PIC	products of incomplete combustion
PM	particulate matter
PM_{10}	particulate matter smaller than 10 microns
POHC	polycyclic organic hydrocarbon
PSD	prevention of significant deterioration
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RFA	Regulatory Flexibility Analysis
RIA	Regulatory Impact Analysis
RIP	refuse-in-place
ROD	Records of Decision
ROI	radius of influence

ACRONYMS, ABBREVIATIONS, AND MEASUREMENT UNITS (CONTINUED)

Acronyms

RRF	resource recovery facilities
SBA	Small Business Act
SCAQMD	South Coast Air Quality Management District
SDB	Standards Development Branch
SIP	State implementation plan
SO_2	sulfur dioxide
SO_x	sulfur oxides
SWANA	Solid Waste Association of North America
TAG	technical advisory group
TCD	thermal conductivity detector
TGNMO	total gaseous nonmethane organics
TOC	total organic carbon
TSDF	treatment, storage and disposal facility
VOC	volatile organic compound
WMA	Waste Management, Inc.
WCRP	World Climate Research Programme

Abbreviations and Measurements Units

Btu = British thermal unit

^oC = degrees Celsius

dscf = dry standard cubic foot (14.7 psi, 68 ^oF)

dscm = dry standard cubic meter (760 mmHg, 20 ^oC)

ACRONYMS, ABBREVIATIONS, AND MEASUREMENT UNITS (CONTINUED)

Abbreviations and Measurements Units

^oF = degrees Fahrenheit

ft = foot

ft^3 = cubic foot

in. = inch

J = joules

km = kilometers

ln = natural log

m = meter

mm = millimeter

MM = million

ml/min = milliliter per minute

Mg = megagram

MW = megawatt

m^3 = cubic meter

mg = milligram

ppm = parts per million

ppmv = parts per million by volume

ppmvd = parts per million by volume, dry

psi = pounds per square inch

tons/yr = tons per year

yr = year

$/Mg = dollars per megagram

$/ton = dollars per ton

1.0 SUMMARY

On May 30, 1991, the Environmental Protection Agency (EPA) proposed new source performance standards (NSPS) for new municipal solid waste (MSW) landfills and emission guidelines (EG) for existing MSW landfills (56 FR 24468) under the authority of sections 111(b) and (d) of the Clean Air Act (CAA). Public comments were requested on the proposed standards and guidelines. Comment letters were received from 60 commenters including industry representatives, governmental entities, environmental groups, and private citizens. A public hearing was held in Research Triangle Park, North Carolina, on July 2, 1991. This hearing was open to the public and five persons presented oral testimony on the proposed NSPS and EG.

On June 21, 1993, a supplemental notice of data availability to the May 30, 1991 proposal appeared in the Federal Register (58 FR 33790). The notice announced the availability of additional data and information on changes in the EPA's modelling methodology being used in the development of the final NSPS and EG for MSW landfills. Public comments were requested on the new data and comment letters were received from seven commenters.

Changes have been made to the NSPS and EG in response to comments and as a result of additional analyses completed since proposal. The final NSPS and EG are summarized in section 1.1. The major changes made to the proposed rules are summarized in section 1.2. A summary of the impacts of the

NSPS and EG is presented in section 1.3. All of the written and verbal comments that were submitted regarding the proposed rules and notice of data availability are summarized in chapter 2. The revised economic impacts analysis is presented in chapter 3. The summary of comments and responses and revised economic impacts serve as the basis for the revisions made to the NSPS and EG between proposal and promulgation.

1.1 SUMMARY OF STANDARDS, EMISSION GUIDELINES, AND METHODS

1.1.1 Listing Under Section 111 of the Clean Air Act

Section 111(b)(1)(A) of the CAA provides:

> The Administrator shall, within 90 days after [December 31, 1970], publish (and from time to time thereafter shall revise) a list of categories of stationary sources. He shall include a category of sources in such list if in his judgment it causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare.

Section 111(b)(1)(B) requires the Administrator to promulgate "standards of performance for new sources within such category."

Concurrently with promulgating the landfills NSPS and EG, the Administrator had added the source category MSW landfills to the priority list in 40 CFR 60.16 because in the judgment of the Administrator it contributes significantly to air pollution which may reasonably be anticipated to endanger public health and welfare.

MSW landfill emissions, commonly called landfill gas (LFG), are generated by naturally occurring methanogens that decompose complex organic materials into organic compounds of lower molecular weight. Landfill gas consists primarily of carbon dioxide (CO_2), methane, and non-methane organic compounds (NMOC). The methane strips or transports NMOC through the landfill to the atmosphere. Evidence from the EPA and State studies indicates that LFG released by MSW landfills has adverse effects on both public health and welfare.

The first specific health and welfare effect of concern is ozone formation. Ground level ozone is created by sunlight acting on nitrogen oxides (NO_X) and NMOC in ambient air. Ozone may lead to health effects such as alteration of pulmonary function, aggravation of preexisting respiratory disease, damage to lung structure, and adverse effects on blood enzymes, the central nervous system, and the endocrine system. Ozone also presents welfare effects such as reduced plant growth, reduced crop yield, necrosis of plant tissue, and deterioration of certain synthetic materials, such as rubber.

A second concern is the cancer and noncancer health effects of various NMOC. Many NMOC identified in LFG are either known or suspected carcinogens, and have the potential to produce noncancer health effects as well, such as adverse effects on the kidneys, liver, and central nervous system. Many of the NMOC are Hazardous Air Pollutants (HAP's) as defined under section 112(b) and listed by the Source Category List under section 112(c) of the CAA, as amended in 1990 (57 FR 31576, July 16, 1992). The EPA intends to evaluate MSW landfills as a source category under this section.

Additional public welfare concerns are odor nuisance from gaseous decomposition, and the potential for methane migration, both on-site and off-site, which may lead to explosions or fires. Explosive gas control is already addressed under § 258.23 of the Resource Conservation and Recovery Act (RCRA) Subtitle D rules (40 CFR part 258); however, a landfill gas control system will significantly reduce the explosion potential. These concerns are not only nuisances in and of themselves, but can adversely affect adjacent property values. And, as discussed in the preamble to the proposal, MSW emissions contribute to global methane emissions, a major greenhouse gas. These methane emissions also present a welfare concern.

Although one commenter suggested that LFG emissions should be regulated under RCRA authority, the EPA continues to consider Section 111 NSPS and EG to be the appropriate statutory approach for regulating these emissions because the adverse health and welfare effects of concern result from air emissions. Therefore, the final notice added MSW landfills as a source category for regulation under Section 111(b)(1)(A) of the CAA to the priority list in 40 CFR 60.16.

1.1.2 Applicability

The affected facility under the NSPS is each new MSW landfill. Municipal solid waste landfills are also subject to the requirements of RCRA (40 CFR part 258). A new MSW landfill is a landfill for which construction, modification, or reconstruction commences on or after the proposal date of May 30, 1991 or that began accepting waste on or after that date.

The emission guidelines require control for certain existing MSW landfills. An existing MSW landfill is a landfill for which construction commenced prior to May 30, 1991. 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 emission guidelines is each existing MSW landfill that has accepted waste since November 8, 1987.

Section 60.752 of the NSPS requires affected and designated MSW landfills having design capacities below 2.5 million megagrams (Mg) or 2.5 million cubic meters (m^3) to file a design capacity report. Affected and designated MSW landfills having design capacities greater than or equal to

2.5 million Mg or 2.5 million m^3 are subject to the additional provisions of the standards or guidelines.

Some changes have been made to the definitions in both subpart WWW and subpart Cc so that definitions in these subparts would be consistent with definitions in regulations of part 258 of title 40, Criteria for MSW Landfills Under RCRA.

MSW landfills are also listed under section 112(c) as a source category (57 FR 31576, July 16, 1992). Promulgation of section 112 emission standards for the MSW landfills source category is currently scheduled for not later than November 15, 2000 (58 FR 63941, 63954, Dec. 3, 1993).

Section 111(d)(1)(A) was twice amended by the 1990 Clean Air Act Amendments. Pub. L. 101-549, section 302(a), directed the substitution of "7412(b)" for "7412(b)(1)(A)," and Pub. L. 101-549, section 108(g), substituted "or emitted from a source category which is regulated under section 7412 of this title" for "or 7412(b)(1)(A)." Title 42 of the U.S. Code adopts the amendment of section 108(g) with the explanation that section 302(a) could not be executed because of the prior amendment by section 108(g). 42 U.S.C. section 7411 (Supp.IV 1993). The EPA also believes that section 108(g) is the correct amendment because the Clean Air Act Amendments revised section 112 to include regulation of source categories in addition to regulation of listed hazardous air pollutants, and section 108(g) thus conforms to other amendments of section 112. The section not adopted by title 42, 302(a), on the other hand, is a simple substitution of one subsection citation for another, without consideration of other amendments of the section in which it resides, section 112. Thus EPA agrees that CAA section 111(d)(1)(A) should read "[t]he Administrator shall prescribe regulations which . . . establish[] standards of performance for any existing source for any air pollutant . . . which is not . . . emitted from a source category which is regulated under section 112."

Thus, as amended by the 1990 Clean Air Act Amendments, section 111(d)(1)(A) allows EPA to establish NSPS without prescribing emission guidelines for existing sources if the designated air pollutant is 1) a pollutant for which air quality criteria have been issued, 2) included on a list published under section 108(a), or 3) emitted from a source category regulated under section 112. That is not the case here because landfill gas, the designated air pollutant for MSW landfills, is not a pollutant which satisfies any of these criteria. First, landfill gas is a composite of many compounds, including some compounds for which air quality criteria have been issued and which are included on a list published under section 108(a) (e.g. volatile organic compounds (VOC), which are ozone precursors), although other landfill gas components, such as methane and methylene chloride, are not compounds for which air quality criteria have been issued and are not included on a list published under section 108(a). Moreover, landfill gas itself is not an air pollutant for which air quality criteria have been issued, and landfill gas itself is not included on a list published under section 108(a).

Finally, landfill gas is not emitted from a source category that is actually being regulated under section 112. Although MSW landfills is a source category listed under section 112(c), existing MSW landfills will not actually be regulated under section 112 until an emission standard is proposed under section 112(d). Because a section 112 emission standard for MSW landfills is not scheduled for promulgation until the year 2000, MSW landfill emissions will not actually be regulated under section 112 until that time. In addition, some components of landfill gas are not hazardous air pollutants listed under section 112(b) and thus will not be regulated under a section 112(d) emission standard. Therefore, EPA is establishing emission guidelines under section 111(d)(1)(A) for sources of the designated pollutant landfill gas.

1.1.3 Standards for Air Emissions from Municipal Solid Waste Landfills

The final standards and EG for MSW landfill emissions require the periodic calculation of the annual NMOC emission rate at each affected or designated facility with a maximum design capacity greater than or equal to 2.5 million Mg or 2.5 million m^3.

The best demonstrated technology (BDT) (for both the NSPS and the EG) requires the reduction of MSW landfill emissions from new and existing MSW landfills emitting 50 Mg per year (Mg/yr) of NMOC or more with: (1) a well-designed and well-operated gas collection system and (2) a control device capable of reducing NMOC in the collected gas by 98 weight-percent.

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 BDT control device is a combustion device capable of reducing NMOC emissions by 98 weight-percent. While energy recovery is strongly recommended, the cost analysis is based on open flares because they are applicable to all affected and designated facilities regulated by the standards and emissions guidelines. If an owner or operator uses an enclosed combustion device, the device must demonstrate either the 98-percent reduction or reduction of the outlet NMOC concentration to 20 ppmvd as hexane at 3-percent oxygen as demonstrated by Method 25 or Method 18 of appendix A of 40 CFR part 60 (for the compounds listed in the most recent "Compilation of Air Pollutant Emission Factors" (AP-42)). Alternatively, the collected gas may be treated for subsequent sale or use, provided that all emissions from any atmospheric vent from the treatment system are routed to a control device meeting either specification above.

The standards require that three conditions be met prior to removal of the collection and control system: (1) the landfill must be permanently closed under the requirements of 40 CFR 258.60; (2) the collection and control system must have been in continuous operation a minimum of 15 years; and (3) the annual NMOC emission rate routed to the control device must be less than the emission rate cutoff of 50 Mg/yr on three successive dates, between 90 and 180 days apart, based upon the site-specific landfill gas flow rate and average NMOC concentration.

A new section of the regulation, § 60.753, contains provisions regarding the operational standards for collection and control systems. These provisions include: (1) collection of gas from each active area, cell, or group of cells in which non-asbestos degradable solid waste has been placed for a period of 5 years or more and from each closed area or area at final grade in which solid waste has been placed for at least 2 years; (2) operation of the collection system with each wellhead under negative pressure; (3) operation with a nitrogen level less than or equal to 20 percent or an oxygen level less than or equal to 5 percent; (4) operation with a landfill gas temperature less than 55 ^{o}C; (5) a requirement that the collection system be operated to limit the surface methane concentration to less than 500 ppm over the landfill; (6) venting of all collected gases to a treatment or control device; and (7) operation of the control device at all times when the collected gas is routed to the control device.

1.1.4 The Tier System Procedures

The tier system is used to determine if and when an affected or designated landfill needs to install a gas collection system. As an example, a relatively new landfill may produce landfill gas above the emission rate cutoff at some time in the future; the annual emission estimate in the tier calculations will indicate when this time has come. Section 60.754 of the NSPS provides the tier system for calculating whether the NMOC emission rate is less than 50 Mg/yr, using a first order decomposition rate equation. Section 60.34c of the EG also requires calculation of the NMOC emission rate using the tier system provided in the NSPS. Any owner or operator that already has or intends to install controls (to full compliance) without modeling the emissions does not need to use this tier system.

The final NSPS and EG allow the mass of segregated, non-degradable waste in a landfill to be subtracted from the total mass prior to the NMOC emission rate calculation, provided that the non-degradable nature of the waste, location, and mass are recorded and included with the emission rate report.

Tier 1--Under Tier 1, the landfill owner or operator combines readily available data such as landfill age and waste acceptance rate with default values of 0.05/yr for the methane generation rate constant (k), 170 m^3/Mg for the methane generation potential (L_o) and 4,000 parts per million by volume (ppmv) for the NMOC concentration. The default values for these parameters were changed between proposal and promulgation. The default values for k, L_o, and NMOC concentration are within an acceptable range and were selected to minimize the number of landfills that are actually emitting more than 50 Mg/yr of NMOC, but would be estimated, using the default values, to emit less than the cutoff. In selecting the default values in this way, Tier 1 estimates emissions from some landfills to be greater than the emission rate cutoff when in reality they are not. Therefore, the landfill can use site-specific information from Tier 2 and Tier 3 to show that the revised emission estimates are below the cutoff. For those landfills where the Tier 1 calculation results in an emission estimate below 50 Mg/yr of NMOC, the rules would not require collection and control systems, but would require periodic recalculation of emissions until closure. For those landfills whose Tier 1 calculations result in an NMOC emission rate equal to or greater than 50 Mg/yr, the owner or operator must either install collection and control systems or must perform the field measurement procedures detailed in Tier 2 to better estimate the site-specific NMOC emission rate for comparison with the 50 Mg/yr cutoff.

Tier 2--In Tier 2, the landfill owner or operator conducts sampling to determine a site-specific NMOC concentration to substitute for the default NMOC concentration of 4,000 ppmv in the Tier 1 equation. The standards provide sampling procedures for NMOC concentration, and the samples are to be analyzed using Method 25C. Unlike the proposal, the number of samples depends on the size of the landfill. Two samples must be taken from each hectare up to a maximum of 50 samples. More than 2 per hectare or more than 50 samples may be taken; however, all samples taken must be used in the analysis. If the NMOC emission rate calculated using the site-specific NMOC concentration is equal to or greater than 50 Mg/yr, the owner or operator must install controls or perform the field testing procedures detailed in Tier 3 to better estimate the NMOC emission rate for comparison with the 50 Mg/yr cutoff.

If the average NMOC concentration from the samples results in a calculated NMOC emission rate below the emission rate cutoff of 50 Mg/yr, the standards require retesting of

NMOC concentration levels for use in the tier calculations every 5 years. Due to the increase in the design capacity exemption and the decrease in the emission rate cutoff, the proposed provision for a statistical analysis to allow 10 years between retesting the NMOC concentration levels has been deleted from the final rule. These changes to the rule greatly reduce the number of landfills that would perform Tier 2 measurements. The lower emission rate cutoff will require controls to be applied sooner, and the change simplifies implementation of the rule.

<u>Tier 3</u>--Under Tier 3, a site-specific methane generation rate constant, k, is determined by gas flow testing to substitute for the default k value of 0.05/yr in the equation. Tier 3 distinguishes between MSW landfills with known histories of where and when MSW was deposited and those with little known history. Cluster wells are used when the history is known, and equal-volume wells when the 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, Method 2E provides guidance on where to locate cluster wells to provide good estimates of k. However, if landfill history is not known, the equal-volume well method produces estimates with greater statistical confidence than cluster wells. Tier 3 testing is performed using Method 2E, which is a final method promulgated in the rule. The NSPS requires that the NMOC concentration obtained in Tier 2 be used in all Tier 3 calculations.

Landfills where the NMOC emission rate calculated in Tier 3 is below 50 Mg/yr need not install collection and control systems, but must still retest the concentration of NMOC every 5 years as required in Tier 2. The value for k obtained in Tier 3 is to be used for all subsequent calculations.

Landfills with a calculated emission rate greater than 50 Mg/yr, after substituting both a site-specific NMOC concentration and a site-specific k, must install a collection and control system.

Calculation of NMOC and Flow for On-Line Collection Systems--For landfills which have a collection system already installed, the standards provide formulas and procedures for calculating NMOC emissions using samples and gas flow data obtained from an existing collection system. These formulas can be used by landfills that are presently collecting landfill gas to show that their NMOC emissions are less than the emission rate cutoff. These formulas and procedures can also be used by landfills that have installed collection and control systems to comply with the rule when the emissions have subsided to the extent that the owner or operator would like to determine if the NMOC emissions are now less than the emission rate cutoff. 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 no positive pressure at any wellhead when sampling and gas flow tests were performed. The landfill owner or operator must also document that the collection system is effectively collecting landfill gas from all gas producing areas of the landfill.

Using samples and gas flow data from an existing system is the only method allowed for determining that the NMOC emission rate is less than 50 Mg/yr when owners or operators want to remove control systems. The formula and procedures for sampling and determining the NMOC concentration and the gas flow directly from the system provided in § 60.754(b) of the final NSPS must be used when calculating the NMOC emission rate for the purpose of system removal. The tier approach is not permitted once a collection system has been installed, because direct sampling procedures provide the most accurate estimate of the NMOC emission rate and are readily available after system installation.

1.1.5 Compliance

Section 60.755 of the NSPS provides formula and/or procedures for determining compliance with the standards for collection systems and control devices provided in § § 60.752(b)(2)(ii) and 60.753.

To design the collection system to handle the maximum expected gas flow rate, the maximum expected gas generation rate is calculated using the default values for k and L_O; if Method 2E has been performed, the owner or operator must use the site-specific k. In § 60.755(a)(1) of the final standard, changes have been made to allow calculation of the maximum gas generation rate for sites with known and unknown year-to-year solid waste acceptance rates, and for a specific intended equipment use period, if the owner or operator intends to use the equipment for a period of time other than 15 years. Section 60.755(a)(2) was revised to allow the use of any collection system approved by the regulatory authority capable of controlling and extracting gas from all required portions of the landfill. The design plan must demonstrate that there is a sufficient density of gas collectors to meet all operational and performance standards.

Section 60.755(a)(3) requires that adjustments to the gas collection header and wellhead valves be made to maintain negative pressure. A time schedule was added to this section that requires an additional well to be installed if negative pressure cannot be achieved within a specified time period.

Several commenters maintained that 30 days was not adequate time to establish negative pressure at the wellhead after initial start-up of the collection and control system. Upon further evaluation, the rules were modified to allow 180 days to establish negative pressure at the wellhead after initial start-up of the collection and control system.

A new paragraph (a)(6) was added to § 60.755, requiring that owners and operators of MSW landfills seeking to demonstrate compliance with the standards for collection systems must demonstrate that off-site migration is being controlled.

As discussed later in the summary of major changes to the rule section, three additional compliance provisions were added to § 60.755. These provisions are: (1) a 60 day time limit for the extension of the collection system into solid waste that has reached an age of 5 years if active, 2 years if closed or at final grade [in § 60.755(b)]; (2) procedures and instrument specifications for monitoring surface concentrations of methane, including the installation of additional wells, if necessary; and (3) allowable downtime for start-up, shutdown and malfunction of collection or control equipment. The reader is directed to sections 1.2.3.4 through 1.2.3.6 of this BID for a discussion of these provisions.

Owners and operators seeking to demonstrate compliance with § 60.752(b)(2)(iii) are required to use open flares operated in compliance with 40 CFR 60.18, or to conduct an initial performance test using Method 25 or Method 18 (speciated for compounds listed in AP-42) to demonstrate either 98 percent NMOC emission reduction or, for enclosed combustors, a concentration of 20 ppmvd NMOC as hexane at 3 percent oxygen at the outlet.

1.1.6 Monitoring

Each MSW landfill installing a collection system must monitor the nitrogen or oxygen concentration and the temperature of the LFG at each well on a monthly basis. Also, the owner or operator can propose and use an alternative method for detecting infiltration (such as monitoring for carbon monoxide, the methane to carbon dioxide ratio, or the composting ratio) provided that the method is approved by the permitting authority.

When an enclosed combustion device is used for control, the temperature and the gas flow to (or bypass of) the control device must be monitored. When an open flare is used for gas control, the pilot flame (or flare flame itself) must be monitored using a heat sensing device to demonstrate the continuous presence of a flame, and the gas flow to (or bypass of) the control device must be monitored.

Sections 60.756(d) and (e) provide that for each collection system and for any control device other than an open flare or an enclosed combustion device used, the owner or operator must provide to the regulatory authority information describing the operation of the system and/or device, parameters that would indicate proper performance and monitoring procedures.

1.1.7 Reporting and Recordkeeping

The final standards require owners and operators of all affected facilities to submit notifications of construction, modification, or reconstruction as required under the General Provisions (40 CFR 60.7). This notification must include the maximum design capacity of the landfill, date of anticipated initial waste acceptance, and the anticipated solid waste acceptance rate. The EPA expects that the design capacity calculation required in the notification of construction report will exclude a large majority of all landfills from the further provisions of the 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.

Notification of construction from MSW landfills with initial design capacities less than 2.5 million Mg or 2.5 million m^3 fulfills all of the recordkeeping and reporting requirements for these landfills unless the design capacity is revised above the limit in the future.

Each owner or operator of an MSW landfill with a design capacity equal to or greater than 2.5 million Mg or 2.5 million m^3 must install a collection and control system or submit an annual calculation demonstrating that the NMOC emission rate is less than 50 Mg/yr. 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 equations provided in § 60.754 and an estimate of the solid waste acceptance rate for each of the 5 years, provided that the estimated NMOC emission rate does not exceed 50 Mg/yr in any of the 5 years reported. The initial annual NMOC emission rate report or 5-year estimate must be submitted within 90 days of start-up, i.e., solid waste acceptance.

The owner or operator must also update and re-submit the 5-year estimate within at least 5 years of submittal of the first 5-year estimate. Additionally, 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 when the new report is submitted.

After the NMOC emission rate calculated using Tier 1 equals or exceeds 50 Mg/yr, § 60.757(c) of the final standards requires the submission of a collection and control system design plan for approval within a year. A landfill owner or operator may elect to perform the Tier 2 sampling or Tier 3 testing to generate a site-specific NMOC concentration or gas generation rate to use for the calculation of a more accurate NMOC emission rate. In either case, 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 50 Mg/yr, the collection system design plan must also be submitted within the same 1-year time period in which the Tier 1 calculation equaled or exceeded 50 Mg/yr.

After the 1-year described above, a landfill will have 18 months to install an approved collection system. Collection system design plans should require 180 days for review and revision; therefore, 1 year is allowed for installation of the collection system. As discussed in the proposal preamble, the EPA believes this approach to be fair for either design approach (see proposal preamble section III.H). An owner or operator using an approved design is allowed an additional 180 days to submit the initial performance test.

After the collection and control system has been installed and the initial performance test has been completed and submitted, § 60.757(f) of the NSPS and § 60.35c of the EG require the submission of annual compliance reports which include: (1) any period in which the value of any of the monitored operating parameters falls outside the acceptable ranges; (2) all periods when the gas stream was diverted from the control device; (3) periods when collection or control equipment was not operating; (4) the location of all exceedances of the 500 ppm methane limit during the quarterly surface monitoring and the highest level recorded at that location in the subsequent monitoring period; and (5) the date of installation and location of each well added to the system during the period.

The NSPS and EG also require that certain types of records be maintained. Records of the accumulated solid waste in place, collection system design (including planned as well as current well or trench layout), control device vendor specifications, the initial and most recent performance test results, and the monitoring parameters established during the initial performance test must be maintained 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 to demonstrate 98 percent NMOC destruction efficiency must be entered into this permanent record, and reported in the next annual compliance report. Monitoring records and all data and calculations from each annual compliance report must be maintained for at least 5 years following the date of such reports.

1.1.8 Design Specifications for Active Vertical Collection Systems

In the final standards, provisions are given that design plans must specify methods for siting active vertical collection wells throughout the landfill, but does not contain prescriptive design plans. Instead, all site-specific design plans must be approved by the Administrator (in most cases the State or local regulatory agency will be delegated authority to implement the NSPS and EG, including the approval of design plans). Wells must be placed so that gas is collected from all active areas of the landfill that have contained solid waste for at least 5 years and all closed areas or areas at final grade that have contained solid waste for at least 2 years.

The final standards have been changed to allow the owner or operator to consider the site-specific equipment life when sizing the collection system blower. In this way, blowers may be used over shorter periods of time or exchanged to more closely track gas flow rate without being out of compliance. The formula for determining maximum flow rate has been revised to accommodate both active and closed landfill conditions.

The final NSPS distinguishes between areas that are nonproductive because of the age of the solid waste and those that are non-degradable due to the inorganic nature of the solid waste when allowing such areas to be excluded from the collection system. Nonproductive areas are excluded due to low NMOC emissions, and all such excluded areas must collectively contribute less than 1 percent of total NMOC emissions. Non-degradable areas are excluded because they have no emission potential, and only if (1) such materials are deposited in a segregated area not overlying productive solid waste, and (2) the location, volume, mass and nature of the excluded materials are documented and reported.

The final EG requires that existing landfills subject to control must install collection systems that meet the NSPS standards for collection systems. The collection system must satisfy all the criteria provided in § 60.752(b)(2) and be approved by the Administrator.

1.1.9 Additional Information Specific to the Emission Guidelines

Under the final EG, States are required to submit plans for existing sources and to provide for implementation and enforcement of emission standards for existing MSW landfills. The EPA has determined that these are health-based guidelines, meaning that State plans must be at least as stringent as the EG. The final EG have been modified to reference the provisions of the NSPS for the specification of approved design plans for the gas collection and control system.

The final emission guidelines stipulate that the existing MSW landfills emitting NMOC of 50 Mg/yr or greater when the State plan is approved must achieve compliance with the guidelines for collection and control systems within 3 years from the time of promulgation of the State regulations. This time period allows 2.5 years for further site-specific testing (if elected by the owner or operator), preparation and review of a collection system design plan, and installation of the collection and control system; and 180 days for a performance test.

In the case of existing MSW landfills whose NMOC emission rates reach the emission rate cutoff of 50 Mg/yr sometime after the initial calculation, 3 years is allowed to achieve compliance and conduct a performance test from the date of the first periodic report documenting NMOC emissions of 50 Mg/yr or greater.

1.1.10 Method 2E

In Tier 3, the landfill owner or operator may determine the landfill gas flow rate with Method 2E by installing a single cluster of three extraction wells or five extraction wells equally spaced over the landfill. The cluster wells are preferred, but may be used only if the composition, age of the solid waste, and the landfill depth of the test area can be determined. The construction of the extraction well is the same regardless of the pattern, and is specified in the method.

Pressure probes are located along three radial arms 120 degrees apart at distances of 3, 15, 30, and 45 m from each extraction well. The probes 15, 30, and 45 m from each well are called deep probes and extend to a depth equal to the top of the perforated section of the extraction wells. The three probes located 3 m from the well are called shallow probes and extend to half the depth of the deep probes. The method has been revised to require the pressure probes to be capped or the probe hole to be refilled with cover material after testing is complete.

After the wells have been installed and the static flow rate 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.

A leak check is required to ensure accurate flow rate and safety, using Method 3C. Maximum blower vacuum is determined by increasing the vacuum and testing for infiltration of air into the landfill. Method 2E has been changed to specify the use of a blower with a capacity of at least 8.5 m^3 per minute. Infiltration of air into the landfill is considered to have occurred if any of the following conditions are met: the temperature of the LFG at the wellhead is more than 55 ^oC or above the maximum temperature established during the static testing, the concentration of nitrogen in the LFG exceeds 20 percent, or 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 at the wellhead until the nitrogen concentration is less than 20 percent, the gauge pressures of the shallow probes are positive, and the temperature of the landfill gas at the wellhead is less than 55 ^oC or below the maximum temperature established during the static testing.

The temperature check is required to monitor for subsurface fires and aerobic conditions. If infiltration does occur, oxygen is brought into the anaerobic environment beneath the cover. Therefore, the temperature must be recorded during the static test. This temperature is used to determine the maximum allowable temperature during the pumping test. The pumping test temperature should not rise above 55 ^oC or above the maximum temperature established during the static testing.

The maximum radius of influence (ROI) is the radial distance from the extraction well that is affected by the maximum blower vacuum. This distance is determined by comparing the initial average pressure for each deep pressure probe distance for the static portion of the test with the final average pressures for each distance from the short term pumping portion of the test. The farthest distance where the final average pressure is less than the initial average pressure is the maximum ROI. The maximum ROI may be determined by plotting the pressure differentials (initial pressure minus final pressure) versus the natural log of the distance from the wellhead. Extrapolation is used to calculate the distance at which the pressure differential is zero. This distance is the maximum ROI. Method 2E has also been revised to allow the use of a semi-log plot of pressure differentials versus distance from the wellhead for determining ROI.

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 flow rate is established and used to determine k, the methane generation rate constant. This site-specific k is used along with the site-specific landfill NMOC concentration (determined using Method 25C or Method 18) to recalculate the NMOC mass emission rate by using equations in Method 2E.

1.1.11 Method 3C

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

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 nitrogen concentrations of greater than 20 percent in the sample indicate improper sampling probe installation or sampling technique, and the sample must be rejected.

In Tier 3, when Method 2E is used to determine the flow rate of landfill gas from the landfill, Method 3C is used to determine the presence of nitrogen concentrations exceeding 20 percent in a landfill gas sample, which is an indication of infiltration of air into the landfill.

Method 3C is prescribed for the option of monthly monitoring of nitrogen concentration for air infiltration. (Alternatively, the rule allows monthly monitoring of oxygen instead of nitrogen.) Method 3C may also be used to leak check the above ground extraction well apparatus. The landfill gas is extracted from the landfill by a blower and the flow rate is measured by a gas flow measurement device. Leaks in the well piping may affect the flow rate measured by the device significantly. Therefore, Method 3C is used during Method 2E testing. The concentration of N_2 is measured at the wellhead sample port and at a point downstream of the flow rate measuring device, and a difference of greater than 10,000 ppmv indicates a leak. In this case, the owner or operator must locate and repair the leaks to the system and repeat the sampling and analysis.

1.1.12 Method 25C

Method 25C is used to determine the concentration of NMOC in landfill gas. A sampling probe is perforated at one end and driven or augured to a depth of at least 1 m below the bottom of the landfill cover. The sample probe depth requirement in Method 25C has been changed to read "extend no less than 1 m below the cover" to increase flexibility in sampling. Additionally, a requirement has been added to both Methods 25C and 2E to cap or refill the probe holes with cover material once sampling or pressure testing has taken place. The owner or operator may choose to leave the probe in place and simply plug the sampling probe or remove the probe and refill the hole with cover material.

Landfill gas is extracted from the probe with an evacuated cylinder at the rate of 500 ml/min (30.5 ± 3.1 in^3/min), and the carrier gas bypass valve is used to pressurize the cylinder with helium to approximately 1,060 mm mercury absolute pressure. The landfill gas will not condense when it mixes with the dry gas. This approach provides a method of addressing the small amounts of condensate without requiring a condensate trap, which would make the test more expensive and complicated.

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 carbon monoxide (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 method for determining the number of samples has changed from the proposal. Instead of using statistics based on the scatter in the individual measured NMOC concentrations to determine the required number, the landfill must install a minimum of two probes per hectare. For landfills greater than 25 hectares, a minimum of 50 probes are required, but the owner or operator may use more if desired. Additional probes must be evenly distributed as well (i.e., 3 probes per hectare), and all of the samples must be used in the analysis.

1.2 SUMMARY OF MAJOR COMMENTS AND RESPONSES ON THE PROPOSED STANDARDS AND EMISSION GUIDELINES

In the proposal Federal Register notice, the EPA requested comment on four issues, (1) the use of an alternative format for the regulatory cutoff, (2) the inclusion of materials separation requirements in the NSPS and EG, (3) the establishment of a separate BDT for methane, and (4) the inclusion of specific energy recovery requirements within the NSPS and EG. In addition to discussing comments received on these topics, this section summarizes comments on the selection and implementation of BDT, and provides the rationale for changes made to the regulations since proposal.

1.2.1 Response to EPA Solicitation of Comments

1.2.1.1 Alternative Regulatory Cutoff Format. In the preamble to the proposed regulations, the EPA requested comment on its decision to use the same format for the removal of control equipment as was used for the installation of the control equipment. However, no comments pertaining to the alternative regulatory cutoff format were received. Therefore, the format for equipment removal has not changed since proposal.

1.2.1.2 Material Separation Requirements. Two commenters supported including material separation requirements within the proposed rules under Section 111 of the CAA, while seven favored leaving such requirements to be decided under RCRA. After considering these comments, the EPA decided not to include materials separation requirements within the final rules because the EPA continues to believe RCRA and local regulations are the most appropriate vehicle to address wide-ranging issues associated with solid waste management for landfills.

The final RCRA subtitle D preamble identified an array of initiatives designed to expand recycling efforts (56 FR 50980; October 9, 1991). Under section II-D of that preamble, "EPA's Solid Waste Agenda for Action," the EPA explained the current strategy and stressed three national goals for MSW management. These goals were: (1) to increase source reduction and recycling; (2) to increase disposal capacity and improve secondary materials markets; and (3) to improve the safety of solid waste management facilities. The EPA strategy was composed of numerous initiatives, including market studies, federal recycling procurement guidelines, the development of training materials for State, local, and Tribal recycling coordinators, publications, and the establishment of a national recycling institute.

More recently, the EPA is considering similar initiatives as part of its effort to encourage recycling through education and voluntary programs.

1.2.1.3 A Separate Best Demonstrated Technology for Methane. Under the proposed regulations, MSW landfill emissions, or LFG, was selected as the pollutant to be regulated. Landfill gas is composed of various air pollutants including CO_2, methane, and NMOC. Nonmethane organic compounds were specified as a surrogate for MSW landfill emissions for measurement purposes. The proposed regulations required that air emissions from new and existing MSW landfills emitting 150 Mg/yr of NMOC or more be reduced using a gas collection and control system as part of BDT.

While some commenters to the proposed standards supported the use of NMOC as a surrogate for MSW landfill emissions, other commenters considered VOC, total organic carbon (TOC), and methane to be more appropriate surrogates. Some of these commenters asserted that methane deserved a separate standard of its own. Other commenters concurred with the EPA's proposal decision to consider only the ancillary benefits of methane when setting the standard based on NMOC emission potential. These commenters asserted that additional consideration of methane was unwarranted, since significant methane reductions would occur indirectly from the regulation of NMOC.

Two commenters wanted a separate methane standard to be developed to more completely address the health and environmental effects of methane, including the role of methane in global warming and the formation of ozone in the troposphere, and the ability of methane to cause explosions and transport toxics. Another commenter stated that methane reductions should be considered directly in the selection of

BDT because of the serious health and welfare effects, including global climate change impacts, of methane emissions.

One commenter suggested that current and ongoing methane studies be evaluated to determine whether additional regulation of methane is warranted. Another commenter said the regulation should place more emphasis on reducing methane through such measures as source reduction and recycling, especially at small facilities.

In setting standards and EG which reflect BDT under Section 111 of the CAA, the EPA considered reductions of NMOC directly and methane reductions as an ancillary benefit. Methane reductions were quantified and considered in selecting the stringency level of the rule. However, NMOC was selected as a surrogate for MSW landfill emissions because NMOC contains the landfill air pollutants posing more concern, due to their adverse health and welfare effects. In addition, the EPA agrees with the commenters who considered separate methane controls as unnecessary because reducing NMOC concentrations in LFG will significantly reduce the amounts of methane emitted in LFG. Specifically, the methane produced by existing landfills will be reduced by 39 percent due to the 50 Mg/yr NMOC cutoff.

The U.S. Climate Change Action Plan, released in October 1993, contains a series of actions to reduce emissions of methane from landfills and other sources. The Climate Change Action Plan forms the cornerstone of the U.S. National Action Plan required by the Framework Convention on Climate Change, which the U.S. signed in 1992. The EPA actions to reduce emissions of methane and other greenhouse gases will be guided by the directives contained in the Action Plan. Therefore, the EPA maintains that no separate BDT for methane is needed at this time.

1.2.1.4 Energy Recovery Requirements. Several commenters wanted energy recovery to be promoted through this

NSPS. Some recommendations for promoting energy recovery included: discussion in the preamble, relaxed regulations for sources implementing energy recovery, and economic incentives. Many commenters also supported the consideration of energy recovery in the cost-benefit analysis, and some commenters indicated a site-specific feasibility analysis for energy recovery should be required by the regulation. However, only one commenter supported including provisions within these rules that would <u>require</u> the use of energy recovery devices for some affected and designated sources. One commenter suggested that energy recovery technologies also be defined as BDT, and further suggested that the cost effectiveness analysis be revised to incorporate the role of energy recovery.

The EPA decided to incorporate energy recovery in the nationwide impacts analysis by adding an energy recovery scenario to the original flare analysis upon which the selection of BDT is based. As mentioned in section 1.3.2.1, a conservative assumption was made addressing this issue. The analysis assumes that the 138 most profitable landfills are the 138 landfills that operate annually in the U.S. Therefore, these top landfills were removed from the analysis. Primarily due to this reason, the energy recovery analysis did not predict any lower costs than did the original methodology in which all landfills are assumed to use flares.

The revised nationwide impacts analysis was modified to select the least-cost of three control options for each model landfill: the use of flares, I.C. engines, or turbines for the full control period. In some cases, use of an I.C. engine or turbine results in a net profit because the energy recovery profits outweigh the control costs.

Additional cost data were gathered for turbines and I.C. engines for use in the revised analysis. The sources of data and costs derived from them are presented in "Changes to the Municipal Solid Waste Landfills Nationwide Impacts Program Since Proposal" (Docket No. A-88-09, Item No. IV-M-3). As discussed in section 1.3.2.1, the EPA performed analysis which concluded that approximately 138 landfills would recover energy annually in the absence of the regulation.

After considering these comments and adding an energy recovery scenario to the analysis, the EPA continues to believe that the use of energy recovery should be a site-specific decision. Such a decision should be made after the landfill owner or operator considers the potential for income from energy utilization given the uncertainty in the amount of gas produced. Many other variables come into play when considering energy recovery, such as gas market fluctuations, gas production rates, ability to market or distribute electricity produced, and the quality of the gas. Not all energy recovery ventures from landfill gas have been successful in the past. Technical difficulties vary from site to site and may include such barriers as the gas being unfit for recovery because of non-combustible components or an insufficient flow rate to maintain dependable operation of equipment. On the other hand, some landfills may generate adequate volumes of clean burning gas that would make energy recovery profitable. For these reasons, the EPA is strongly encouraging, but not mandating, energy recovery within these standards.

The EPA's Office of Research and Development has developed several technology transfer tools to help encourage energy recovery from landfills. One tool is a software model and user's manual for estimating landfill air emissions using the equation and defaults specified in the rule. The Landfill Air Emissions Estimation Model (version 2.0) and user's manual can be obtained from NTIS or the EPA Control Technology Center at the phone numbers listed below. The model also contains

AP-42 emission factors for developing estimates for State inventories.

Another aid to the regulatory work sponsored by the EPA is a report entitled, "Landfill Gas Energy Utilization: Technology Options and Case Studies," EPA-600/R-92-116, June 1992. This report includes detailed case studies of six sites for the range of every recovery option in use, data on over 50 projects, and information on the capital and operating costs.

The EPA has also developed a report on the technical and nontechnical factors to consider including a discussion of different philosophies of major operators of landfill gas recovery projects regarding gas cleanup and operation. The report is entitled "Landfill Gas Energy Utilization Experience: Discussion of Technical and Nontechnical Issues, Solutions and Trends", EPA-600/R-95-035. Two other reports developed by the EPA's Office of Research and Development in 1995 are: "Emerging Technologies for Landfill Gas Utilization" and "Methodologies for Quantifying Pollution Prevention Benefits from Landfill Gas Control and Utilization". These documents and the ones discussed above are available through the National Technical Information System at (703) 487-4650 (phone) or (703) 321-8547 (fax) or the EPA Control Technology Center Hotline at (919) 541-0800 (phone) or (919) 541-2157 (fax). Technical assistance regarding the CAA regulation, estimating landfill emissions, and evaluating control and landfill gas utilization options can also be obtained by calling the Control Technology Center.

The EPA has also developed a Landfill Methane Outreach Program to assist owners and operators interested in landfill gas energy recovery and to encourage more widespread utilization of landfill gas as an energy source. Information regarding the Program can be obtained by calling the Landfill Methane Outreach Program Hotline at (202) 233-9042.

1.2.2 Rationale for Significant Changes to Regulation

1.2.2.1 Selection of Design Capacity Exemption Level. The proposed rule included a design capacity exemption to reduce the burden on small landfills. Several commenters discussed the proposed design capacity exemption level of 100,000 Mg. Several comments were submitted requesting an increase in the exemption level. An increase would relieve additional owners and operators of small landfills from the emission estimation and control requirements. Two commenters recommended a specific higher exemption level. One of the commenters contended that no additional MSW landfills having design capacities less than 100,000 Mg will be built and recommended an exemption level of 1.0 million Mg. The second commenter suggested an exemption level of 550,000 Mg, noting that landfills smaller than this would not emit more than 150 Mg/yr NMOC, and arguing that the lower exemption level unnecessarily increased the regulatory burden of the standard. In addition, representatives of State and local governmental agencies who were consulted under Executive Order 12875 recommended higher exemption levels to relieve small entities of regulatory burden.

One industry commenter approved of the design capacity exemption of 100,000 Mg, but also noted that there would still remain considerable burden for small landfills that would be exempted at Tier 1. However, the commenter, along with two other commenters, recommended that all MSW landfills be evaluated for NMOC emission rates, not only those above the design capacity exemption level.

The design capacity cutoff of 100,000 Mg of waste was chosen at proposal so that no landfill would be exempted by size and have actual emissions above the emission rate cutoff. In addition to the comments, changes to the data base and the emission modeling values prompted a reevaluation of the design capacity exemption level.

The new design capacity exemption analysis evaluated a range of options from 500,000 Mg to 4.0 million Mg of waste. Two important considerations in the selection are the number of landfills exempted and the amount of potential NMOC emission reduction lost from the exempted landfills. The 2.5 million Mg exemption level would exempt 90 percent of the existing landfills while losing only 15 percent of the total NMOC emission reduction. Therefore, 2.5 million Mg was chosen since losing 15 percent of the potential emission reduction is a reasonable tradeoff to relieve as many small businesses and municipalities as possible from the regulatory requirements, while still maintaining significant emission reduction. The lowest value considered, 500,000 Mg, only allows slightly more than 1 percent of the total emission reduction potential to go unregulated; however, only 62 percent of the landfills are exempted so the regulatory burden is higher than under the chosen option. Exemption levels higher than 2.5 million Mg resulted in less emission reduction.

The 2.5 million Mg design capacity exemption level excludes those landfills, both public and private, who would be least able to afford the costs of landfill gas collection and control systems. Also, smaller landfills are less likely to have successful energy recovery projects.

Since some landfills record waste by volume and have their design capacities calculated in volume, the EPA also established an equivalent design capacity exemption of 2.5 million cubic meters of waste. The density of landfilled solid waste varies from landfill to landfill depending on several factors, including the compaction practices. Any landfill that reports waste by volume and wishes to establish a mass design capacity must document the basis for their density calculation.

1.2.2.2 Selection of the Regulatory Stringency Level. Several commenters requested a more stringent emission rate cutoff, while others favored the 150 Mg/yr rate proposed, and some favored a less stringent standard. One of the commenters asserted that the NMOC data provided by the EPA at proposal supports a more stringent level. Other commenters stated that adding the benefits of energy recovery and abatement of global warming to the economic analysis would support a more stringent standard. Two commenters supported a cutoff level of 25 Mg/yr because of the additional methane reductions that would result. Another commenter favored a more stringent standard because the commenter believed that health risks posed by landfills between a cutoff of 25 Mg/yr and 150 Mg/yr may be significant.

One commenter supported an emission rate cutoff of 250 megagrams per year. This commenter stated that the BID and regulatory impact analysis (RIA) for the proposal did not provide a clear rationale or cost effectiveness for the selection of a 150 Mg/yr cutoff and that actual health and environmental benefits are uncertain.

The Climate Change Action Plan, signed by the President in October, 1993, calls for EPA to promulgate a "tough" landfill gas rule as soon as possible. This initiative also supports a more stringent emission rate cutoff that will achieve greater emission reduction.

Due to the small-size exemption, only landfills with design capacities greater than 2.5 million Mg of waste or 2.5 million cubic meters of waste will be affected by this rule. It is estimated that a landfill of 2.5 million Mg design capacity corresponds to cities greater than 100,000 people. On the whole, large landfills service areas with large population. A reasonable assumption is that many of these large landfills are in the 400 counties that have been designated as urban ozone nonattainment areas and are developing plans to address ozone nonattainment.

Finally, the new data and modeling methodologies, which were published in the notice of data availability on June 21, 1993, significantly reduced the estimated emission reduction and corresponding effectiveness of the rule. Therefore, a more stringent emission rate cutoff would achieve similar emission reductions at similar cost effectiveness to the proposed rule.

Based on all of these reasons, the EPA reevaluated the stringency level and chose an emission rate cutoff of 50 Mg/yr of NMOC for the final rules. This revision would affect more landfills than the proposal value of 150 Mg/yr of NMOC; however, the 50 Mg/yr of NMOC will only affect less than 5 percent of all landfills and is estimated to reduce NMOC emissions by approximately 53 percent and methane emissions by 39 percent. The 150 Mg/yr emission rate cutoff would have reduced NMOC emissions by 45 percent and methane emissions by 24 percent. The incremental cost effectiveness of control of going from a 150 Mg/yr cutoff level to a 50 Mg/yr cutoff level is $2,900/Mg NMOC reduction for new landfills and $3,300/Mg for existing landfills.

The values for NMOC cost effectiveness do not include any credit for the benefits for toxics, odor, explosion control, or the indirect benefit of methane control. A revised cost effectiveness could be calculated with an assumed credit value for one or more of the other benefits. As an example, assuming a $20/Mg credit for the methane emission reduction, the incremental cost effectiveness from the proposal cutoff of 150 Mg/yr to the final cutoff of 50 Mg/yr would be reduced to $1,300/Mg NMOC.

1.2.2.3 <u>Gas Collection System Design Specifications</u>. Many commenters wanted the proposed standards to allow more design flexibility, some wanted the EPA to encourage States to allow alternative designs and some commenters requested that the designs be <u>required</u> to be site-specific.

Some commenters noted that the design specifications in chapter 9 of the proposal BID were too rigid, while one commenter suggested that to foster development of new designs, the design specifications in § 60.758 of the proposed NSPS be removed from the regulation and used only as guidance rather than as required design specifications. Some commenters stated that the collection and control design criteria were based on unproven and invalid theories and models, resulting in over designed systems.

Other commenters recommended that the regulations designate an alternative collection system design based on the South Coast Air Quality Management District (SCAQMD) rule, which uses integrated surface sampling of total organic carbon (TOC) to determine if additional gas control is needed. One commenter noted that such surface sampling encourages system maintenance.

The design specifications proposed in § 60.758 were included in the proposed rule to provide a straightforward basis for system design. However, because of the many site-specific factors involved in landfill design, alternative systems may be necessary. To provide design flexibility, the final regulations no longer contain specific designs, but require all designs to be prepared by a professional engineer and submitted to the permitting authority for approval. All designs must satisfy the criteria for an effective collection system provided in § 60.759. The removal of specific gas collection system design plans from the rules will encourage technological innovation by allowing sources to design their own gas collection systems to meet specific needs. The enabling document will contain the specific design information removed from the regulation, so that if landfills wish to use the design specifications, they will be available.

1.2.2.4 Operational Standards for Collection and Control Systems. Several commenters identified a variety of operational considerations that may affect the installation and operation of collection and control systems, and they suggested that these considerations should be addressed by the standards. Some of these considerations related to the landfill environment, such as: settlement or movement of landfill or cover surfaces; changing topography, weather, and barometric pressure; presence of on-site structures; gas generation rate; and existing passive venting systems. Other considerations focused on management practices or operation of the collection and control system, such as: equipment traffic; the effect of bailing waste; equipment leaks; maintenance and repair practices; treatment of leachate and/or condensate; provisions for flame-outs, downtime, malfunctions or pipe leaks; air injection; and the effects of sampling ports.

The EPA agrees that these considerations will have an effect on the installation and operation of collection and control systems. All of these considerations, however, vary from site to site, and the EPA judged that, in general, most of these concerns are best addressed by the local operator.

The treatment of leachate and condensate is already addressed under RCRA (subtitle D).

The operational specifications provided in the proposal are not intended to replace the operator's knowledge of, and response to, the situations discussed above. However, well-operated and well-maintained equipment should be used to comply with these rules, which should keep air emissions through leaks in equipment at a minimum.

In addition to the removal of the prescriptive design criteria for gas collection systems, the EPA made several logical changes to the proposed rules on issues raised by commenters. Two of these changes are significant. The first change was to aggregate the various operational provisions that had been located at different points throughout the proposed regulation in a new § 60.753, "Operational standards for collection and control systems." Second, as suggested in the proposal preamble, to ensure that the integrity of the landfill cover is adequately maintained, a requirement to operate the collection system so that surface methane concentration is less than 500 ppm has also been included.

In summary, new § 60.753 addresses the following areas: (1) collection of gas from active areas containing solid waste older than 5 years, and 2 years for areas closed or at final grade; (2) operation of the collection system with negative pressure at each wellhead (with exceptions added since proposal); (3) operation of the collection system with a landfill temperature less than 55 ^{o}C (or a higher established temperature) and either a nitrogen level less than or equal to 20 percent or an oxygen level less than or equal to 5 percent; (4) operation of the collection system with a surface methane concentration less than 500 ppm; (5) venting all collected gases to a treatment or control device; and (6) operation of the treatment or control device at all times when the collected gas is routed to the control device.

The requirement to collect gas from areas containing solid waste was changed from 2 years at proposal for all areas, to 5 years for active areas and 2 years for closed or final grade areas. A summary of comments on this requirement and rationale for the change is contained in section 1.2.2.7 on "System Expansion."

The proposed requirement to maintain negative pressure at wellheads was not changed. The EPA has, however, provided for three exceptions when it may not be possible for sources to maintain negative pressure at wellheads. These exceptions are also discussed in section 1.2.2.7.

The proposed requirement for operation of the collection system with nitrogen levels less than or equal to 1 percent was revised to 20 percent based on new information received since proposal. An alternative provision for maintaining an oxygen level less than or equal to 5 percent, and an additional provision maintaining a temperature of less than 55 ^{o}C (or a higher established temperature) were added. The rationale for these changes is provided in section 1.2.2.6 on "Monitoring of Operations."

A significant new requirement to operate the gas collection system with a surface methane concentration less than 500 ppm (along with monitoring provisions to ensure maintenance of this concentration) was added after proposal. This surface emission limit was included under the operational standards, because the EPA is using it to verify that the system is adequately operated and maintained and not to ensure an emission limit, surface or otherwise, as normally constructed under Section 111. The rationale for this requirement is also provided in section 1.2.2.6.

The requirements to vent all emissions to a treatment or control device and to operate the device at all times when the emissions are being routed to the device have not changed since proposal. Provisions for downtime and malfunction are described in section 1.2.2.5.

In conjunction with the new operational provisions, the compliance, testing, and monitoring sections were revised to reference and support these new or relocated provisions.

1.2.2.5 Start-up, Shutdown, and Malfunction Provisions. In response to the comments regarding system start-up, shutdown, and malfunction, the EPA has added provisions in § 60.755 of the final NSPS as follows:

> "(e) The provisions of this subpart apply at all times, except during periods of start-up, shutdown, or malfunction, provided that the duration of start-up, shutdown, or malfunction shall not exceed 5 days for collection systems, and 1 hour for treatment or control devices."

When considering the various provisions for start-up, shutdown or malfunction conditions recommended by the commenters, the EPA has chosen to include provisions that are linked to compliance for ease of implementation.

The 5-day exemption period for collection systems was selected in recognition that a major problem with a collection system will likely take some time to locate and solve but also that the landfill is not going to stop generating LFG. In the design and operational standards of these rules, compliance with the standards is meeting the requirements for the installation and operation of a properly-designed system. The EPA recognizes that a shut down system cannot possibly meet a standard requiring that a collection system be actively collecting LFG. In recognition that flame-outs and problems with the collection system do occur, the EPA did not want to render owners and operators of well-designed and operated systems out of compliance with the standards under normal operating circumstances. Therefore, a reasonable exception to the compliance provisions was sought.

The EPA has decided to include a 1-hour repair window for control devices within the final NSPS and EG. The 1-hour period was selected for control devices because, in practice, most sites currently collecting landfill gas have multiple control devices, whether multiple flares, boilers, I.C. engines, turbines, fuel cells, or combinations of the above. Therefore, only a short period of time would be necessary to relight a flare or reroute the collected gas to an alternative device.

While all periods when collection or control equipment are not operating must be recorded, only periods in excess of 5 days for collection systems and 1 hour for control devices must be reported in the annual excess emission report. And, as required in § 60.11(d), the collection and control system must be maintained and operated at all times, including periods of start-up, shutdown or malfunction, in a manner consistent with good air pollution control practice for minimizing emissions.

Localized problems with crushed pipes, etc., may be resolved through adjustments to the draw from other wells in the vicinity until repair is effected. If the blowers need to be repaired or replaced, the collection/control system may be able to function temporarily as a passive system while repairs are effected. However, the EPA has no data upon which to base how long such an arrangement would be feasible. Therefore, owners and operators should take care to plan for such contingencies. Whether the owner or operator has arranged with vendors for quick turnaround on replacement parts, has spare system components on site, or has multiple devices on line so that the flow may be distributed among them, compliance can be maintained in a number of ways. Therefore, the EPA has elected to specify a downtime that is acceptable under these rules, and leave the actual repair strategy to the owners and operators.

1.2.2.6 <u>Monitoring of Operations</u>.

<u>Control Device Monitoring</u>--Two commenters questioned how the residence time during the initial performance test of a flare could be monitored and suggested perhaps the requirements intended to require calculation of the residence time. One of the commenters also suggested a monitoring schedule be added.

The monitoring provisions of the MSW landfill NSPS are based on typical Section 111 provisions for open flares and enclosed combustion devices. New provisions allow sources to monitor the use of bypass systems using car seal or lock and key type configurations instead of monitoring flow to the control device. These provisions were added to reduce the burden imposed by monitoring requirements.

The intent of this section of the regulation is to require that residence time be determined during the initial performance test for enclosed combustors. Flares are open combustors which have no "residence time" associated with the combustion. The final regulation was changed to reflect that residence time should be determined in conjunction with gas flow measurements rather than "monitored." After the initial performance test, the NSPS only requires that temperature and flow (or bypass) be recorded with equipment calibrated, maintained, and operated according to the manufacturer's specification.

Two commenters recommended that the flare flame, rather than the pilot flame, be monitored to verify that the flare is operating at all times. The monitoring provisions have been changed to allow monitoring of either the pilot flame or the flare flame itself to determine if the flare is operating. Pilot flare monitoring is allowed because the temperature of the flare flame is high and may cause the thermocouple to burn out more quickly. The requirement to monitor flow to the flare or other control device every 15 minutes, or to prevent bypass of the control device using a car seal or lock and key type system, is to ensure that the collected landfill gas is being conveyed to a flare or other suitable control device rather than being discharged to the atmosphere.

Surface Monitoring--Some commenters recommended that the regulations incorporate an alternative collection system design provision, which would establish a performance standard based on the SCAQMD rule. The SCAQMD rule uses integrated surface sampling of TOC to determine the need for additional gas control. This would allow more flexibility for the gas collection designs. One commenter noted that their State regulation requires that gas collection systems be designed so that surface concentrations of methane do not occur above certain levels. The commenter asserted that a surface test encourages system maintenance. Commenters also asserted that a surface emission standard which landfill operators must maintain would allow maximum design flexibility and encouraging more cost effective innovations.

One commenter was concerned about the integrity of the landfill cover and that cracks in the cover could allow emissions to the atmosphere even when an effective collection system has been installed. As mentioned in the proposal preamble, surface emission monitoring as used in the SCAQMD seems appropriate for determining that closer well spacing is in fact needed. As mentioned in the proposal preamble, the EPA was already considering what role the California test might reasonably fill in these regulations (see 56 FR 24492-24493).

The EPA considers surface emission monitoring to be an appropriate tool for monitoring both cover integrity and the effectiveness of well spacing. Therefore, some aspects of the surface emission monitoring test have been incorporated in the new § 60.753, where all of the operational provisions for the collection system have been brought together.

After initial installation of the collection system, owners and operators will be required to operate the collection system with a methane concentration less than 500 ppm at all points around the perimeter of the collection area and along a serpentine pattern across the entire surface of the landfill. Compliance with this operational standard is to be demonstrated by monitoring surface concentrations on a quarterly basis using an organic vapor analyzer, flame ionization detector, or other portable hydrocarbon monitor. If an instrument reading of 500 ppm or greater is produced, the location of the exceedance must be recorded, and cover maintenance or adjustment to the vacuum at adjacent wellheads must be made within 10 calendar days. The 10-day schedule was selected to allow the personnel to continue monitoring without stopping to make adjustments, but to assure that conditions at the locale of the exceedance are attended to quickly.

A second measurement must be taken within 10 days. If a second exceedance is recorded at the same location, additional adjustments shall be attempted <u>and</u> additional monitoring performed within 10 days. If a third exceedance is recorded at that location, an additional well must be installed within 120 days of the first exceedance.

The methane concentration level of 500 ppm was chosen based on data received from numerous sources, including: (1) information provided by the SCAQMD stating that this was an appropriate level and the level used at landfills in that district; (2) information indicating that some leak detection programs for other industries currently use 500 ppm and analyzers are capable of detecting this level; (3) instrumentation specifications citing this as an appropriate number and that familiarity with this level is broad; and (4) site visits conducted by the EPA indicating that 500 ppm is an acceptable detection level.

Surface monitoring will provide a safeguard against uncertainties in well density determination, no matter what collection method is used. The new surface monitoring provisions include requirements for increased monitoring and corrective actions upon exceedance of 500 ppm.

<u>Nitrogen Monitoring</u>--Many commenters stated that the 1 percent nitrogen limit in the proposed standard for infiltration detection was unrealistic and reported typical levels of 5 to 11 percent. Some commenters stated that nitrogen measurements are expensive and that other methods, such as well temperature or percent methane should be allowed as indicators of excess air infiltration.

In Method 2E as well as daily operation, the nitrogen concentration in the extracted LFG is important because it indicates if the maximum vacuum achievable without air infiltration is being obtained from the landfill. The EPA set the nitrogen limit as a safety measure to avoid fires and explosions that may result from pulling too much air into the landfill and to avoid altering the anaerobic state of the landfill. For compliance purposes, the main concern is that the system is pulling at maximum capacity up to the point of infiltration.

The monitoring provisions of the final NSPS have been revised after consideration of the comments. The nitrogen limit during operation of the collection system at the wellhead has been increased to 20 percent based on the evaluation of numerous comments on this subject.

The nitrogen limit in Methods 2E and 25C has also been increased to 20 percent. In Method 2E, a sample found to contain more than 20 percent nitrogen indicates infiltration. If a sample is found to contain more than 20 percent nitrogen in Method 25C, then that sample should be removed from the collection. The equation for calculating the NMOC concentration in Method 25C has also been revised to correct the NMOC concentration in the LFG sample to zero percent nitrogen.

Because commenters indicated that nitrogen measurement via Method 3C is impractical, provisions have also been added that allow for the monitoring of oxygen using Method 3A. The measurement of oxygen via portable monitoring devices is already being done in the field, and an oxygen threshold of 5 percent would correlate to an nitrogen value of 20 percent.

Temperature Monitoring--A provision requiring the temperature to be maintained below a set limit has also been added. This temperature limit is 55 ^{o}C, or a higher temperature at each well that the owner or operator can document will not cause fires or inhibit anaerobic decomposition. If the LFG temperature at the wellhead increases above the temperature threshold, the new provisions require an adjustment of the vacuum to reduce the temperature. The value of 55 ^{o}C was cited by industry experts as an alert temperature that may indicate a problem. Since temperature variability exists between landfills and between wells within a landfill, the provision to establish higher operating temperatures at individual wells has been added. A higher temperature limit will be allowed, however, only if the owner or operator can demonstrate with supporting data that the higher temperature does not cause fires or adversely affect the anaerobic decomposition of the waste.

As with nitrogen monitoring, an alternative method for measuring temperature may be used if it is documented and maintained with the landfill records. The EPA realizes many owner or operators presently extracting gas use other compounds, conditions, and theoretical ratios to monitor for air infiltration. Therefore, this flexibility allows them to use these methods for demonstrating compliance with the regulation.

1.2.2.7 System Expansion. Commenters expressed two primary concerns dealing with system expansion. The first concern centered around the requirement to expand extraction systems into each area after 2 years of waste deposition. Some commenters suggested that such a timeframe is unreasonable and does not coincide with common operation practices. Commenters suggested that other means, such as emission potential, be used to determine when wells should be placed rather than a time requirement or site-specific data. The second concern was the requirement to install an additional well in the vicinity of a well where negative pressure cannot be achieved through valve adjustment at the wellhead. Commenters indicated the provisions were vague and that a time schedule should be added to the provisions.

The EPA has reanalyzed the provisions of these rules in response to public comment regarding both maintenance of negative pressure at the wellhead and the addition or replacement of wells. These changes to the rule were placed in § 60.753, "Operational Standards for Collection and Control Systems," and § 60.755, "Compliance Provisions."

The provision requiring maintenance of negative pressure at wellheads has not been changed. However, exceptions to negative pressure at wellheads have been added to the rules. The exceptions are as follows: (1) If there is a significant increase in temperature (or fire), in which case the source may need to reduce the vacuum or go to positive pressure. If this occurs, the owner or operator must record and report the event; (2) If the source is using a synthetic cover or geomembrane. In this case the owner or operator must establish the maximum positive pressure allowable in the design plan and have it approved. If this is not in the original design plan, the plan must be updated to include positive pressure limits; and (3) In an area of declining gas flow, wells that are shut off to allow higher flows at adjacent wells may experience static positive pressure. The owner or operator must update the design plan and have it approved before shutting off wells in declining areas.

After initial installation of the collection system, owners and operators will be expanding the collection system over time to provide adequate coverage for all active areas in which waste has been deposited for 5 years. The 5 year period is believed to be more reasonable and consistent with common landfill practices than the proposed 2-year period for active areas of the landfill. A given area is typically active for more than 2 years. If collection system wells are required to be installed within 2 years, they will likely get covered over, decreasing their operational life. This scenario would increase costs and be inefficient. Thus, a 5-year period is allowed. A period longer than 5 years is not allowed because emissions from a given block of waste will decline over time, so it is important to install collection and control systems as soon as reasonably practical. For areas that are closed or at final grade, collection system wells must be installed within 2 years.

There are also two cases in which wells must be added unexpectedly--when negative pressure cannot be achieved at a given wellhead within a 15 days (except as noted in the three exceptions above) and when surface methane levels cannot be reduced below 500 ppm after three attempts in 30 days.

In the first case, 15 days are allowed to restore negative pressure at the wellhead and thereby avoid installation of an additional well. The principal reason positive pressure is likely to occur is that the collection system capacity in the locale of the well is less than the production in the area. Either collection capacity can be increased through adjustments to the vacuum, or system expansion is warranted.

The 15 days allows time for a surge in generation after significant rainfall to subside or for the operator to make all attempts to restore negative pressure through other means. Any operational adjustments the operator can make to restore the well to proper function within this timeframe are not precluded by these rules. If negative pressure cannot be restored within this 15-day period, however, the area is producing more gas than the wells in that area are able to handle, and the installation of an additional well is warranted. If rainfall results in increased generation on a regular basis, an additional well is also warranted to accommodate this regular increase in gas production.

In the case when methane concentrations are monitored at 500 ppm or more, two 10-day periods are allowed after initial measurement to reduce surface methane concentrations below 500 ppm. There are two reasons likely to contribute to excessive methane levels--cover failure or insufficient density of wells. When excessive methane concentrations are recorded, 10 days are allowed for personnel to evaluate the problem. If the cover has been disturbed, maintenance will likely reduce surface levels. On the other hand, if the density is insufficient for the gas production level in the vicinity, adjustment of the vacuum may extend the effective area and methane concentrations also decrease. An increase in vacuum cannot always be used, however, because there is a trade-off in increasing the vacuum and avoiding excessive air infiltration. Therefore, if the vacuum is increased as much as possible without excessive infiltration and the surface methane concentrations still reach or exceed 500 ppm, installation of an additional well is warranted.

Because disturbance of the cover can coincide with an ineffective area of influence, the EPA has allowed an additional 10 days after a subsequent exceedance. It is expected that methane concentrations will usually subside after cover maintenance or vacuum adjustments are made. The EPA believes, however, it would be possible for landfill personnel to locate and repair cracks or other flaws in the landfill cover, thinking that the repairs would address excessive methane levels that result, at least in part, from an ineffective area of influence. However, if the area is highly productive, excessive methane concentrations might still be monitored in the subsequent 10-day period in spite of the repairs to the cover. In this case, an adjustment to the vacuum at adjacent wells may still restore surface methane concentrations to acceptable levels, even though a second exceedance was recorded. Rather than requiring that owners and operators remonitor at the location of every exceedance, the EPA elected to require remonitoring only when the initial attempt to reduce surface concentrations has been unsuccessful. Therefore, varying durations are allowed to attempt to reduce surface methane concentration to below 500 ppm before the installation of an additional well would be required.

In both cases of unscheduled system expansion, 120 days after initial exceedance are allowed for the installation of the required well. The 60 days beyond that allowed for scheduled expansion is reasonable because the availability of materials, drilling rigs or contract personnel for an unscheduled installation, although anticipated in a general sense, make the installation of these wells in the 60 day time period less feasible.

1.2.2.8 Revision of Tier Defaults. Several commenters challenged the default values for NMOC concentration, C_{NMOC}, methane generation rate constant, k, and methane generation potential, L_o. Most of the commenters argued that the values used were overly conservative and that inadequate technical justification was provided for the values used.

The EPA believes some of the commenters may have been confused by the nationwide impacts modeling. The values chosen for the tier defaults were not used to model nationwide emissions. A more sophisticated analysis was used in the modeling to select the standard involving ranges of values. The tier default values were chosen after the nationwide modeling was complete.

As explained in the preamble to the proposal, the selection of the default values provided in the tier calculation was not based on test data alone (56 FR 24489; May 30, 1991). Rather, the default values were selected after development of the nationwide impacts analysis to obtain a balance between lost emission reduction potential and cost of performing the field tests in Tiers 2 and 3 on a nationwide basis, as described in the memorandum entitled "Documentation of Small Size Exemption Cutoff Level and Tier 1 Default Values (Revised)" (Docket No. A-88-09, Item No. IV-B-6). Lost emission reduction potential is the loss of emission reduction due to exempting landfills through the tier calculations when the landfills are actually greater than the emission rate cutoff. The values for k, L_o, and $C_{NM}OC$ are within an accepted range and were selected to minimize those landfills that actually emit more than 50 Mg/yr of NMOC but could calculate emissions below the cutoff using the defaults. The three defaults comprise a combination that best achieved the balance between lost emission reductions and the cost of site-specific testing to replace the default C_{NMOC} and k values in the tier system.

The new default values of 0.05/year for k, 170 m^3/Mg for L_o, and 4,000 ppmv for $C_{NM}OC$ are for use in the Tier analysis. The memorandum "Methodology for Revising the Model Inputs in the Municipal Solid Waste Landfills Input Data Bases

(Revised)" (Docket No. A-88-09, Item No. IV-M-4) discusses the approach used to reevaluate and select these default values.

1.2.2.9 Revision of Method 25C

Method 25C--A few commenters stated that Method 25C needs to take the gas condensate into account. Method 25C was revised to include evacuation before and pressurization afterwards with helium. The landfill gas will not condense when it mixes with the dry gas. This approach provides a method of addressing the small amounts of condensate without requiring a condensate trap, which would make the test more expensive and complicated.

Implementation of Method 25C--Tier 2 requires performing Method 25C at a number of surface locations to determine a site-specific landfill gas concentration. Many commenters stated that the statistical approach to calculate the number of samples and the confidence level is not supportable. Others stated that thorough sampling across the whole surface would give a better average due to the extreme variability in waste composition.

In an effort to simplify the Tier 2 process and address many of the comments, the number and location of Method 25C sampling probes were revised. Each landfill will take two samples per hectare of surface area up to 50 samples. Therefore, any landfill greater than 25 hectares may take a minimum of 50 samples. Since the confidence level calculation was abandoned, only one time period is needed for recalculation of the gas concentration. An active landfill that calculates the annual emission rate to be below 50 Mg NMOC/yr in Tier 2 will need to retest the gas concentration every 5 years.

1.3 SUMMARY OF IMPACTS OF PROMULGATED ACTION AND ALTERNATIVES

Environmental, energy, and economic impacts of NSPS or EG are normally expressed as incremental differences between facilities complying with the final standards or guidelines and those same facilities if no NSPS or guidelines were in effect. At present, very few State or Tribal agencies have landfill regulations that address complete landfill gas control, and few new or existing landfills would be affected by these State, local, or Tribal regulations.

For most NSPS and EG, emission reductions and costs are expressed in annual terms. In the case of the NSPS and guidelines for landfills, the final regulations require controls at a given landfill only after the increasing NMOC emission rate reaches the level of the regulatory cutoff. The controls are applied when the emissions exceed the threshold, and they must remain in place until the emissions drop below the cutoff. However, this process could take as long as 50 to 100 years for some landfills. During the control period, costs and emission reductions will vary from year to year. Therefore, the annualized numbers for any impact will change from year to year.

Because of the variability of emission reductions and costs of the final standards and guidelines over time, the EPA judged that the net present value (NPV) of an impact is a more valuable tool in the decision process for landfills and has used NPV in the development of both the proposal and final nationwide impacts. The NPV is computed by discounting the capital and operating costs and emission reductions that will be incurred throughout the control periods to arrive at a measure of their current value. In this way, the NPV accounts for the unique emission patterns of landfills when evaluating nationwide costs and benefits over different discrete time periods for individual sources. Thus, the impacts presented include both fifth year annualized estimates and estimates expressed in terms of NPV in 1992.

1.3.1 Revisions to the Data Base

During the period between proposal and promulgation, all the data bases of landfills and modeling values used to estimate emissions were reevaluated in response to public comments. After review of the data bases, the following aspects of the modeling were revised as discussed below: (1) scale factors; (2) NMOC concentrations; and (3) methane generation rate constant (k) and methane generation potential (L_o) pairs.

The Office of Solid Waste (OSW) data base used at proposal included 931 landfills that were identified as either small or large landfills by a scale factor assignment. The OSW defined small landfills as those landfills accepting less than 500 tons/day of waste, while large landfills are those landfills accepting 500 tons/day or more of waste. A scale factor was applied to each landfill in the data base, which resulted in a scaled-up total number of landfills to reflect the true population. The scale factor assignments were later reviewed to ensure consistency with the OSW criteria for small and large landfills. Based on the OSW tons/day criteria, some scale factor assignments were then revised and the primary scale factors for large and small landfills were adjusted to yield the corrected number and proportion of small and large landfills. These adjustments result in a lower annual waste acceptance rate than the proposal level. This in turn results in a somewhat lower NMOC baseline emission rate. Compared to the nationwide impacts analysis at proposal, fewer landfills would be expected to emit above any given stringency level as a result of this change in scale factor.

The values for C_{NMOC} used for the proposal, which are used as an input parameter in the model, were also reviewed and revised in response to public comment. The new data base values result in a lower average NMOC concentration than was reflected in the proposal nationwide impacts analysis.

The values for k and L_O were also reviewed and regenerated. The result of the recalculation of k, L_O pairs was a lower estimated overall landfill gas flow rate on a nationwide basis.

The reanalysis consisted of a closer look at each value previously included in the nationwide impacts analysis as well as the inclusion of additional values obtained from ongoing studies. The notice of data availability placed in the Federal Register (58 FR 33790; June 21, 1993) outlined the new data and reanalysis occurring between proposal and promulgation.

In the reanalysis, for data to be used to obtain k values, the following had to be available: test year, year landfill opened, year landfill closed (if closed), amount of solid waste "in-place" in the test year, solid waste acceptance rate, and the actual methane flow rate. For data to be used to obtain NMOC concentrations, the following had to be available: the total NMOC concentration and associated units (e.g., ppmv as hexane, ppmv as methane), the methane and CO_2 concentration (to correct for air infiltration since landfill gas is primarily methane and CO_2), and the test method used. Also, the test method had to be comparable to the EPA Method 25C.

As a result of these revisions to flow rate and concentration, both the MSW landfill emissions and NMOC emissions are less than earlier estimates. Therefore, the NMOC and methane baseline emissions are lower, and it is estimated that control would be required at fewer landfills at any given stringency level, in comparison with the proposal.

1.3.2 Revisions to the Modeling Methodology

Considering public comment, the EPA revised the methods for assessing nationwide impacts. Some landfills presently choose to employ energy recovery systems independent of any regulatory requirements because energy recovery is a profitable operation. These profitable landfills are removed from the cost analysis because the cost analysis evaluates the potential impact of regulatory requirements on landfills that have not yet chosen to install recovery systems. The EPA also added a least cost modeling scenario to supplement the proposal costing methodology. The least cost scenario estimates impacts if all landfills used energy recovery whenever the situation was economically more attractive than simply flaring the gas.

1.3.2.1 Profitable Landfills. As reflected in the proposal BID and preamble, and stated by some commenters, there are market impediments that discourage landfill systems developers from taking a risk on energy recovery systems even though the standard would provide additional incentive to install energy recovery systems by requiring landfill gas to be controlled. In contrast, there is also some incentive to install energy recovery devices to reduce dependence on fossil fuels. The EPA has determined that some landfills that could achieve a profit by installing an energy recovery device would do so even in the absence of a regulation. In cases where landfills would combust the gas in the absence of the regulation, the estimate of nationwide impacts of the regulation should not include the emission reductions and the negative control costs for these landfills because installation of controls is not a result of the regulation. Not all landfills that could make a profit from energy recovery, however, would install energy recovery devices unless required to apply control by the regulation. As discussed below, the impacts of the final rule have been calculated to exclude credit for those landfills that would control in the absence of the rule.

The EPA prepared a study (Docket No. A-88-09, Item No. IV-M-2) that concluded that, on average, for each year between 1992 and 2002, 138 landfills would be expected to use energy recovery, whether or not a regulation was in place. These landfills would most likely use energy recovery in absence of the NSPS and EG and would be the landfills that would make the most profit by using energy recovery. Therefore, the EPA decided to remove the 138 most profitable landfills from the data base used to calculate nationwide impacts for existing sources.

The costs and profits of energy recovery at a given landfill vary depending on when the controls are installed and removed. This time period varies depending on the stringency of the regulatory alternative because it will take a longer period of time for the emissions at a given landfill to drop below a more stringent cutoff level. Using the nationwide impacts program from the proposal, the control period of each landfill was varied and total costs were determined for each period. The control period was varied for each landfill by running the nationwide impacts program at various stringency levels which corresponded to different control periods (from a minimum control period of 15 years to a maximum that varied with each landfill). A list was generated that contained all the landfills that were profitable for any control period.

Once the list of profitable landfills was generated, the most profitable ones were identified and then deleted from the landfill data base until a number representing 138 after scaling were removed. Since these landfills represent voluntary control in the absence of the standard, their emission reductions do not result from the NSPS and EG. Therefore, they were removed entirely from the analysis (including the baseline). Since the most profitable landfills, rather than the ones that would actually control in the absence of the regulation, were removed, the analysis assumes the maximum lost emission reduction and corresponding lost profit. In reality, not all of the most profitable landfills are recovering due to other barriers.

For the NSPS, a comparable number of landfills were removed from the data base of new sources since this data base effectively replaces the data base of existing sources over time.

1.3.2.2 Least Cost Modeling. A least cost scenario was added to the nationwide impacts program to reflect the use of energy recovery devices in cases where these cost less than flares. In the least cost scenario portion of the program, the least cost of the flare, turbine, or internal combustion (I.C.) engine options was chosen for each landfill. The least cost decision was made by comparing the costs of using each control device throughout the entire control period. The costs for I.C. engines and turbines included revenue from the sale of the electricity generated. The modeling program then chose the option that had the least net cost. The results of the least-cost control option at each landfill are included in the final nationwide impacts analysis.

Due to the deletion of the most profitable landfills and the selection of conservative discount rates in the analysis, the least cost option did not provide lower cost numbers. The total cost estimates for the two methods were very similar. Therefore, the chosen options were based on the flare-only analysis as was done at proposal.

1.3.3 Alternatives to Promulgated Action

The regulatory alternatives are discussed in the preamble for the proposed standards and guidelines (56 FR 24468; May 30, 1991) and in chapter 5 of the proposal BID (EPA-450/3-90-011a). These regulatory alternatives reflect the different levels of emission control. The regulatory alternative selected was based on the BDT, considering costs, nonair quality health, and environmental and economic impacts for MSW landfills.

The impacts of the proposed regulatory alternatives and additional alternatives were reevaluated based on the new data described in the Federal Register supplemental notice of data availability (58 FR 33790; June 21, 1993) and in response to public comments. The alternatives reflect different emission rate cutoffs. The final standard requires control of landfills with NMOC emissions above 50 megagrams per year. Other alternatives included the baseline (no NSPS or EG), the proposed emission rate cutoff (150 Mg/yr), and an alternative with no emission rate cutoff. Tables

TABLE 1-1. SUMMARY OF COST IMPACTS AND EMISSIONS REDUCTIONS OF REGULATORY ALTERNATIVES OF THE NSPS

Regulatory alternative (Mg NMOC/yr)	Cost for flares (Millions $-NPV)	NMOC emissions reductions (Mg-NPV)	Methane emissions reductions (Millions Mg-NPV)	Cost for flares (Millions $--fifth-year annualized)	NMOC emissions reductions (Mg--fifth year annualized)	Methane emissions reductions (Mg--fifth year annualized)
Baseline[a]	--	--	--	--	--	--
150[b]	54	64,500	2.46	4	4,510	187,000
50[b]	97	79,300	3.89	4	4,860	193,000
No cutoff[c]	956	157,000	10.4	66	11,100	736,000

[a] In the absence of an NSPS.

[b] Includes a design capacity exemption level of 2.5 million Mg.

[c] No emission rate cutoff and no design capacity exemption level.

1-1 and 1-2 present the emissions and cost impacts of the

TABLE 1-2. SUMMARY OF COST IMPACTS AND EMISSIONS REDUCTIONS OF REGULATORY ALTERNATIVES OF THE EG

Regulatory alternative (Mg NMOC/yr)	Cost for flares (Millions $-NPV)	NMOC emissions reductions (Millions Mg-NPV)	Methane emissions reductions (Millions Mg-NPV)	Cost for flares (Millions $--fifth-year annualized)	NMOC emissions reductions (Mg--fifth year annualized)	Methane emissions reductions (Millions Mg--fifth year annualized)
Baseline[a]	--	--	--	--	--	--
150[b]	696	0.93	29.7	51	66,600	2.21
50[b]	1,278	1.10	47.0	90	77,600	3.37
No cutoff[c]	10,271	2.03	118	719	142,000	8.30

[a] In the absence of an NSPS.

[b] Includes a design capacity exemption level of 2.5 million Mg.

[c] No emission rate cutoff and no design capacity exemption level.

regulatory alternatives for the NSPS and EG expressed as NPV and annualized values.

1.3.4 Air Impacts

The analysis of the impacts of the NSPS are based on the landfills projected to begin accepting waste over the first 5 years of the standard. For these landfills, the NPV of the baseline NMOC emissions are 160,000 Mg, and the NPV of the baseline methane emissions are 10.6 million Mg. Of the roughly 900 landfills estimated to open during the first 5 years, controls will be required at approximately 5 percent of the facilities. The estimated NPV of the emission reductions are 79,000 Mg (50 percent) and 3.9 million Mg (37 percent) for NMOC and methane, respectively. For existing landfills affected by the EG, the NPV of the baseline NMOC emissions are 2.1 million Mg. The NPV baseline methane

emissions are 120 million Mg. Of the 7,300 existing landfills, controls would be required at roughly 4 percent. The estimated NPV of the emission reductions are 1.1 million Mg (53 percent) and 47 million Mg (39 percent) for NMOC and methane, respectively.

The NSPS and EG are based on reductions of NMOC emissions; however, landfill gas primarily consists of methane and carbon dioxide. Although the methane reductions achieved by these rules were considered as ancillary benefits in the analysis, these reductions do have positive global climate change impacts. A potent greenhouse gas, methane is about 20 times more effective at trapping heat in the atmosphere than carbon dioxide (over a 100 year time horizon). Landfills are the largest anthropogenic source of methane emissions in the U.S., constituting about 40 percent of total emissions. President Clinton has committed to reducing emissions of greenhouse gases to 1990 levels by the year 2000 and, in October 1993, released the "U.S. Climate Change Action Plan" for achieving that goal. The MSW landfills NSPS and EG are an important component of the Climate Change Action Plan because of the significant greenhouse gas reductions they provide. Other relevant components of the Climate Change Action Plan include the EPA Landfill Methane Outreach Program (hotline phone (202) 233-9042) to encourage more widespread utilization of landfill gas as an energy source, and the Department of Energy's Landfill Methane Research Development and Demonstration (RD&D) Program. Taken together, the goal of these Climate Change Action Plan actions will lead to methane reductions equivalent to over 6 million metric tons of carbon in the year 2000.

Many constituents of NMOC in MSW landfill emissions are carcinogenic or can cause other adverse health effects as discussed in chapter 2 of the Background Information Document for the proposed standards (EPA-450/3-90-011(a), March 1991).

The reduction in landfill emissions may result in a reduction of the risks from potential exposure to these constituents in the vicinity of the regulated landfills.

The use of energy recovery devices for the control of MSW landfill emissions has the potential to reduce secondary air impacts from electric utility plants by reducing the energy requirements for these plants. This is because the air impacts of electric energy generation from coal and oil-fired units are larger than those of LFG-fired energy generation. Landfill gas-to-energy projects are regarded as pollution prevention because energy is being recovered from a nonfossil fuel source while reducing the emissions of toxics, NMOC, and methane. The EPA prepared an analysis (Docket No. A-88-09, Item No. IV-B-5) that looks at the secondary air impacts and electricity generation due to the NSPS and EG. If all landfills affected by the rule used energy recovery, the energy value available for electricity generation would be 0.18 quadrillion BTU's (quads) in 2000 and 0.20 quads in 2010. To illustrate the significance of these potential energy values, comparisons were made using recent DOE statistics (i.e., Annual Energy Outlook with Projections to 2010, 1/93). The potential energy of landfill methane for sites affected by this rule is equal to 1.1 percent in 2000 and 1.2 percent in 2010 of the annual consumption of coal by U.S. electric utilities (i.e., 16.2 quads of coal were consumed by electric utilities in 1990). The potential methane to be reduced from this rule compared to the annual consumption of petroleum by U.S. electric utilities is 15 percent in 2000 and 16 percent in 2010 (i.e., 1.23 quads of petroleum were consumed by electric utilities in 1990).

There are additional benefits associated with use of this nonfossil fuel source such as the potential offsets from electric power plants. The estimate of electricity production for the sites predicted to use energy recovery (not including those sites determined to be profitable or already utilizing energy recovery) is 2.7 kWh x 10^9 for the year 2000 and 2010. This would result in a reduction in emissions from electric power plants of greenhouse gases such as carbon dioxide (CO_2) and tropospheric ozone precursors, criteria pollutants including sulfur dioxide (SO_2), nitrous oxides (NO_x), and carbon monoxide, and toxics such as mercury. Assuming recovery of all the gas that is available, there is potentially a savings of 1.7 million tons of CO_2 in 2000 and 2010. There is also a potential reduction of 0.5 thousand tons of SO_2 from landfills. These reductions may be used by electric utilities in reducing the compliance cost to meet the CAA requirements for SO_2 emissions. There is also a potential savings of 5 thousand tons of NO_x although these emissions may be partially offset by emissions of NO_x resulting from the combustion of landfill gas. Currently, data are insufficient to calculate the net reductions. The EPA has research underway through the Office of Research and Development (ORD) to develop a methodology for use by States in considering the offset in emissions associated with landfill gas utilization projects so that the overall environmental benefits of these projects are considered in permitting applications.

Certain by-product emissions, such as NO_x, CO, 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 proposal BID (EPA-450/3-90-011a, March, 1991) present additional information about the magnitude of potential secondary air impacts.

1.3.5 Other Environmental Impacts

1.3.5.1 Water. Landfill leachate is the primary potential source of water pollution from an uncontrolled landfill. Although there is not sufficient field test data to quantify the effect of gas collection on leachate composition, the amount of water pollutants present as NMOC in the leachate may be reduced under these standards and guidelines.

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

1.3.5.2 Solid Waste. The final NSPS and EG 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 control requirements may cause greater use of waste recycling and other alternatives to landfill disposal, leading to a decrease in landfill use. However, is not possible to quantify such and impact at this time.

1.3.5.3 Implications of the Rulemaking for Superfund. Municipal solid waste landfill sites comprise approximately 20 percent of the sites placed by the 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 final NSPS and EG may affect remedial actions under Superfund for MSW landfills. Section 121(d)(2) of Comprehensive Environmental Response, Compensation, and

Liability Act (CERCLA) requires that remedies comply with the substantive standards of applicable and "relevant and appropriate" requirements (ARAR's) of other environmental laws. "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 requirements, but may address problems or situations sufficiently similar to those encountered at the Superfund site so that their use is well suited to a particular site. See 40 CFR 300.5 (55 FR 8666, 8814, 8817, March 8, 1990).

These air emission regulations will apply to new MSW landfills, as well as to those landfills that have accepted waste since November 8, 1987. This date in 1987 is the date on which permit programs were established under the Hazardous and Solid Waste Amendments of RCRA. For CERCLA municipal landfill remediations, the substantive requirements of these regulations may be considered potential ARAR's based on site-specific factors. These NSPS and EG may be applicable for those MSW landfill sites on the NPL that accepted waste on or after November 8, 1987, or that are operating and have capacity for future use.

1.3.5.4 Energy. Affected and designated landfills with NMOC emission rates of 50 Mg/yr or more are 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 LFG, commonly 1.86×10^7 J/scm (500 Btu/scf) or more. If a recovery device such as an I.C. engine, boiler, or gas turbine is used, an energy savings would result.

1.3.5.5 Control Costs and Economic Impacts. Nationwide annualized costs for collection and control of air emissions from new MSW landfills constructed in the first 5 years of the standards are estimated to be $4 million. The nationwide annualized cost of the EG would be approximately $90 million. In comparison to other solid waste-related regulations, the nationwide costs of the recently promulgated RCRA subtitle D rule are estimated to be $300 million per year and the estimated nationwide costs of the MWC rules promulgated in 1991 are estimated to be $170 million per year for new combustors and $302 million per year for existing combustors.

For NMOC, the average cost effectiveness is $1,200/Mg and the incremental cost effectiveness of going from a 150 Mg/yr emission rate cutoff to a 50 Mg/yr cutoff is $2,900/Mg for new landfills. For existing landfills, the average cost effectiveness is $1,200/Mg NMOC and the incremental cost effectiveness is $3,300/Mg NMOC.

Preliminary economic analysis indicates that the annual cost of waste disposal may increase by an average of approximately $0.60 per Mg for the NSPS and $1.30 per Mg for the EG. Annual costs per household would increase approximately $2.50 to $5.00 on average, 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 $15 or more per household as a result of the final EG. However, the EPA anticipates that many landfills will elect to use 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. IV-A-7) and chapter 3.0 of this document.

2.0 SUMMARY AND RESPONSE TO PUBLIC COMMENTS RECEIVED ON THE PROPOSED STANDARDS AND GUIDELINES

2.1 INTRODUCTION

The public comment period for the proposed NSPS and EG was from May 30, 1991, to August 1, 1991. A total of 60 letters commenting on the proposed standards and guidelines were received. Comments were provided by industry representatives, governmental entities, environmental groups, and private citizens. These comments have been recorded and placed in the docket for these rulemakings (Docket No. A-88-09, categories IV-D and IV-G). Category IV-G differs from category IV-D in that it documents correspondence received after the close of the comment period. Table 2-1 presents a listing of all persons submitting written comments, their affiliation, and the recorded Docket Item No. assigned to each comment letter.

In addition, five persons presented oral comments on the proposed standards and guidelines at a public hearing held in Research Triangle Park on July 2, 1991. A verbatim transcript of the comments on the public hearing has been prepared and placed in Docket No. A-88-09, Item No. IV-F-1. Category IV-F contains public comments pertaining to the public hearing. Table 2-2 presents a listing of all persons presenting comments at the public hearing, their affiliation, and the docket item number assigned to each speaker.

Comments made at the public hearing or submitted in writing are summarized and responses are provided in sections 2.2 through 2.19 of this chapter. The comments are grouped by subject areas, and the organization of topics is similar to the organization of the proposal preamble for the new source performance standards and guidelines (56 FR 24468; May 30, 1991).

TABLE 2-1. LIST OF WRITTEN COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS

Docket item number[a]	Commenter and affiliation
IV-D-1	Mr. Edward W. Repa, Ph.D. National Solid Wastes Management Association 1730 Rhode Island Avenue, NW Washington, D.C. 20036
IV-D-2	Mr. David Armstrong 6544 Whispering Pines Drive San Jose, California 95120
IV-D-3	Mr. Gregory W. Burrows, M.S. Laboratory Director FLI Environmental Services 446 Broad Street Waverly, New York 14892-1445
IV-D-4	Mr. Christopher Frank Resource Management Agency Government Center Administration Building, L #1710 800 South Victoria Avenue Ventura, California 93009
IV-D-5	Mr. Charles Collins Administrator, Air Quality Division Department of Environmental Quality Herschler Building 122 West 25th Street Cheyenne, Wyoming 82002
IV-D-6	Mr. Mark H. Bobman Assistant Director Bristol Resource Recovery Facility Operating Committee 75 Twining Street Bristol, Connecticut 06010
IV-D-7	Mr. Gary L. Smith, P.E. Vice President Cummings and Smith, Incorporated Post Office Box 43073 Upper Montclair, New Jersey 07043

TABLE 2-1. LIST OF WRITTEN COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS (CONTINUED)

Docket item number[a]	Commenter and affiliation
IV-D-8	Mr. Dale K. Phenicie Manager of Environmental Affairs-North Georgia-Pacific Corporation Post Office Box 105605 Atlanta, Georgia 30348-5605
IV-D-9	Mr. Bob Van Deman, P.E. Department of Solid Waste Management Pinellas County Board of County Commissioners Post Office Box 21623 St. Petersburg, Florida 33742-1623
IV-D-10	Mr. John W. LaFond President Quadrel Services, Incorporated 10075 Tyler Place #9 Ijamsville, Maryland 21754
IV-D-11	Mr. Fred S. Kemp Program Manager International Fuel Cells Post Office Box 739 South Windsor, Connecticut 06074
IV-D-12	Mr. Edwin H. Seeger Michael A. Poling Prather Seeger Doolittle & Farmer 1600 M Street, NW, 7th Floor Washington, D.C. 20036
IV-D-13	Mr. William Juris Division of Air Pollution Control State of Ohio Environmental Protection Agency Post Office Box 1049 Columbus, Ohio 43266-0149
IV-D-14	Mr. James H. McCoy Total Petroleum, Incorporated Denver Place North Tower 999 18th Street, Suite 2201

Denver, Colorado 80202-2492

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TABLE 2-1. LIST OF WRITTEN COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS (CONTINUED)

Docket item number[a]	Commenter and affiliation
IV-D-15	Mr. Lynne A. Plambeck Co-Secretary Laser Coalition Landfill Alternatives Save Environmental Resources 23942 Lyons Avenue, Suite 103-353 Newhall, California 91321-2444
IV-D-16	Mr. Jerry T. Joseph Senior Environmental Engineer Westinghouse Electric Corporation Resource Energy Systems Division 2400 Ardmore Boulevard Pittsburgh, Pennsylvania 15221
IV-D-17	Mr. R. Darryl Banks Deputy Commissioner New York State Department of Environmental Conservation 50 Wolf Road Albany, New York 12233
IV-D-18	Mr. Rufus C. Young, Jr. Burke, Williams & Sorensen 611 West Sixth Street, Suite 2500 Los Angeles, California 90017
IV-D-19	Mr. Michael J. Barboza, P.E. Chairman ASCE Task Committee on Air Toxics Emissions 1015 15th Street, NW, Suite 600 Washington, D.C. 20005
IV-D-20	Mr. Patrick Kirsop, P.E. Plan Review Unit Leader State of Wisconsin Department of Natural Resources Post Office Box 7921 Madison, Wisconsin 53707-7921

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TABLE 2-1. LIST OF WRITTEN COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS (CONTINUED)

Docket item number[a]	Commenter and affiliation
IV-D-21	Mr. Michael Baly, III President American Gas Association 1515 Wilson Boulevard Arlington, Virginia 22209
IV-D-22	Mr. Charles K. Weiss, Chief Bureau of Sanitation Baltimore County Government Department of Public Works 111 West Chesapeake Avenue Towson, Maryland 21204
IV-D-23	Mr. Raymond F. Pelletier Director Office of Environmental Guidance Department of Energy Washington, D.C. 20585
IV-D-24	Mr. David R. Wooley Executive Director Pace University School of Law Center for Environmental Legal Studies 78 North Broadway White Plains, New York 10603
IV-D-25	Mr. H. Lanier Hickman, Jr., P.E. Mr. Donald J. Borut Mr. Larry E. Naake Local Government Solid Waste Action Coalition Post Office Box 7219 Silver Spring, Maryland 20910
IV-D-26	Mr. Richard L. Echols Director of Operations, Gas Systems Browning-Ferris Industries Post Office Box 3151 Houston, Texas 77253

TABLE 2-1. LIST OF WRITTEN COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS (CONTINUED)

Docket item number[a]	Commenter and affiliation
IV-D-27	Ms. Sue M. Briggum Director of Governmental Affairs Waste Management of North America, Incorporated 3003 Butterfield Road Oakbrook, Illinois 60521
IV-D-28	Mr. Thomas L. Connelly, P.E. 121 Orange Ridge Drive Longwood, Florida 32779
IV-D-29	Mr. James K. Hambright Bureau of Air Quality Control Commonwealth of Pennsylvania Department of Environmental Resources Post Office Box 2357 Harrisburg, Pennsylvania 17105-2357
IV-D-30	Mr. Thomas A. Kraemer, P.E. CH2M Hill Seattle Office 777 108th Avenue, NE Bellevue, Washington 98004
IV-D-31	Mr. Mark B. Beizer, P.E. Vice President SCS Engineers 3711 Long Beach Boulevard Ninth Floor Long Beach, California 90807
IV-D-32	Mr. Ralph E. Chandler Executive Director California Integrated Waste Management Board 1020 Ninth Street, Suite 100 Sacramento, California 95814

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TABLE 2-1. LIST OF WRITTEN COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS (CONTINUED)

Docket item number[a]	Commenter and affiliation
IV-D-33	Ms. Deborah A. Sheiman Resource Specialist Ms. Marika Tatsutani Research Associate Natural Resources Defense Council 1350 New York Avenue, NW Washington, D.C. 20005
IV-D-34	Mr. John H. Gulledge Solid Waste Management Department County Sanitation Districts of Los Angeles County Post Office Box 4998 Whittier, California 90607-4998
IV-D-35	Mr. Peter R. Karasik, P.E. DEP/DSWM 101 Monroe Street, 6th Floor Rockville, Maryland 20850-2589
IV-D-36	Mr. Dan B. Magoun Vice President Environmental Affairs 6231 McBeth Road Fort Wayne, Indiana 46809
IV-D-37	Mr. Peter D. Venturini Stationary Source Division Air Resources Board 1102 Q Street Post Office Box 2815 Sacramento, California 95812
IV-D-38	Mr. Mohsen Nazemi, P.E. Senior Engineering Manager South Coast Air Quality Management District 9150 Flair Drive El Monte, California 91731

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TABLE 2-1. LIST OF WRITTEN COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS (CONTINUED)

Docket item number[a]	Commenter and affiliation
IV-D-39	Mr. Edward W. Repa, Ph.D. National Solid Wastes Management Association 1730 Rhode Island Avenue, NW Washington, D.C. 20036
IV-D-40	Mr. Larry D. Henry, P.E. Maintenance Engineer The City of Wichita Department of Public Works 455 North Main Street Wichita, Kansas 67202
IV-D-41	Mr. James C. Franklin Manager, Flare Systems IT McGill Pollution Control Systems 2700 East 51st Street Tulsa, Oklahoma 74105
IV-D-42	Mr. Marvin Hempleman Mr. Darrel A. Heider Twin Falls County Board of County Commission 425 Shoshone Street, North Twin Falls, Idaho 83303-0126
IV-D-43	Ms. Jane Levine Deputy Commissioner for Legal Affairs The City of New York Department of Sanitation 125 Worth Street, Suite 728 New York, New York 10013
IV-D-44	Mr. Francis J. Schwindt State Department of Health and Consolidated Laboratories Post Office Box 5520 Bismarck, North Dakota 58502-5520

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TABLE 2-1. LIST OF WRITTEN COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS (CONTINUED)

Docket item number[a]	Commenter and affiliation
IV-D-45	Ms. Marsha McLean President S.C.V. Canyons Preservation Committee 24519 Breckenridge Place Newhall, California 91321
IV-D-46	Mr. James C. Street Commissioner of Public Works Lexington-Fayette Government Building 200 East Main Street Lexington, Kentucky 40507
IV-D-47	Ms. Jane Levine Deputy Commissioner for Legal Affairs The City of New York Department of Sanitation 125 Worth Street, Suite 728 New York, New York 10013
IV-D-48	Mr. Edward Peterson Environmental Activities Staff General Motors Corporation General Motors Technical Center 30400 Mound Road Warren, Michigan 48090-9015
IV-D-49	Mr. Edward W. Elam City Manager Manager Lucas Monroe County Landfill City of Chariton 115 South Main Street Chariton, Iowa 50049
IV-D-50	Ms. Linda G. Stuntz Deputy Under Secretary Policy, Planning and Analysis Department of Energy Washington, D.C. 20585

TABLE 2-1. LIST OF WRITTEN COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS (CONTINUED)

Docket item number[a]	Commenter and affiliation
IV-D-51	Mr. William Juris Division of Air Pollution Control State of Ohio Environmental Protection Agency Post Office Box 1049 Columbus, Ohio 43266-0149
IV-D-52	Mr. Brad Jones Saguache County Administrator Saguache County Land Use Department Post Office Box 326 Saguache, Colorado 81149
IV-D-53	Mr. Michael E. McDaniel, R.S. Rockingham County Department of Public Health Rockingham County Governmental Center Route 8, Box 701-J Reidsville, North Carolina 27320
IV-D-54	Mr. Leonard D. Verrelli State of Alaska Department of Environmental Conservation Division of Environmental Quality Post Office Box O Juneau, Alaska 99811-1800
IV-D-55	Mr. Michael R. Lake Chief of Engineering Air Pollution Control District 9150 Chesapeake Drive San Diego, California 92123-1095
IV-D-56	Mr. George N. Kaya Director of Public Works County of Maui Department of Public Works 200 South High Street Wailuku, Maui, Hawaii 96793

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TABLE 2-1. LIST OF WRITTEN COMMENTERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS (CONCLUDED)

Docket item number[a]	Commenter and affiliation
IV-D-57	Mr. Jonathan Greenberg Browning-Ferris Industries, Incorporated 1150 Connecticut Avenue, N.W. Suite 500 Washington, D.C. 20036
IV-G-1	Ms. Dawn M. Campbell The Solid Waste Association of North America Post Office Box 7219 Silver Spring, Maryland 20910
IV-G-2	Senator Joseph I. Lieberman Senate Office Building Washington, D.C. 20510
IV-G-3	Mr. Lanier Hickman, Jr., P.E., D.E.E. Executive Director The Solid Waste Association of North America Post Office Box 7219 Silver Spring, Maryland 20910

TABLE 2-2. LIST OF PUBLIC HEARING SPEAKERS ON THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS

Docket item number[a]	Commenter and affiliation
IV-F-3	Mr. Edward W. Repa, Ph.D. National Solid Wastes Management Association 1730 Rhode Island Avenue, NW Washington, D.C. 20036
IV-F-4	Mr. Robert Peters The Solid Waste Association of North America Post Office Box 7219 Silver Spring, Maryland 20910
IV-F-5	Mr. Jeff Douglas Waste Management, Incorporated 1155 Connecticut Avenue, N.W. Suite 800 Washington, D.C. 20036
IV-F-6	Mr. Rick Oakley Mr. Richard Echols Browning-Ferris Industries, Incorporated 1150 Connecticut Avenue, N.W. Suite 500 Washington, D.C. 20036

[a]The docket number for this project is A-88-09. Dockets are on file at the EPA Headquarters in Washington, D.C.

On June 21, 1993, the EPA published a notice in the Federal Register (58 FR 33791) providing information on additional data being used in the development of the final NSPS and EG for MSW landfills. The additional data that were made available for public comment included: (1) An updated data base of site-specific landfill information from which k, L_o pairs are calculated and $C_{NM}OC$ values are selected (the k, L_o data base); (2) revised modeling methodologies used to calculate k values which are then used to estimate nationwide impacts; and (3) the incorporation of energy recovery in the modeling of nationwide impacts. The public comment period for this notice was from June 21, 1993, to July 21, 1993. A total of seven letters commenting on the additional data were received from industry representatives, governmental entities, academia, and a private citizen. These comment letters have been recorded and placed in the docket for these rule makings (Docket No. A-88-09, Category IV-L). Table 2-3 presents a listing of all persons submitting written comments, their affiliation, and the recorded docket item number assigned to each comment letter. The comments that were submitted are integrated with the comments and responses to the proposed NSPA and EG provided under sections 2.3 through 2.19 of this chapter.

2.2 GENERAL COMMENTS

2.2.1 Definitions

Comment: Two commenters requested that definitions of the terms "enclosed combustor" and "sufficient extraction rate" be included in the definitions section, § 60.751.

Response: After considering the commenters' suggestions, the EPA added definitions in § 60.751 for the terms "enclosed combustor" and "sufficient extraction rate."

Comment: One industry commenter (IV-D-27) recommended changing the following definitions in the proposed regulations to make them consistent with existing solid waste (RCRA) definitions: "commercial solid waste"; "controlled landfill";

TABLE 2-3. LIST OF WRITTEN COMMENTERS ON THE NOTICE OF AVAILABILITY FOR THE PROPOSED STANDARDS OF PERFORMANCE FOR MUNICIPAL SOLID WASTE LANDFILLS

Docket item number[a]	Commenter and affiliation
IV-L-01	Mr. Kurt W. Rieke Assistant General Counsel Ogden Projects, Incorporated Post Office Box 2615 Fairfield, New Jersey 07007-2615
IV-L-02	Mr. H. Lanier Hickman, Jr. Executive Director The Solid Waste Association of North America Post Office Box 7219 Silver Spring, Maryland 20910-7219
IV-L-03	Mr. Kurt W. Rieke Assistant General Counsel Ogden Projects, Incorporated Post Office Box 2615 Fairfield, New Jersey 07007-2615
IV-L-04	Mr. Thomas L. Connelly 121 Orange Ridge Drive Longwood, Florida 32779
IV-L-05	Dr. Ramana K. Rao Senior Engineer Montgomery County, Department of Environmental Protection 101 Monroe Street Rockville, Maryland 20850
IV-L-06	Mr. Bharat Mathur Chief, Bureau of Air State of Illinois Environmental Protection Agency 2200 Churchill Road Springfield, Illinois 62794-9276
IV-L-07	Mr. David R. Wooley Executive Director Pace University School of Law Center for Environmental Legal Studies 78 North Broadway

White Plains, New York 10603

4444444444444444444444444444444444444444444444444444444444444444444444 "design capacity"; "industrial solid waste"; "municipal solid waste landfill"; and, "sludge."

Another commenter (IV-D-32) indicated that the definition of "controlled landfill" is not clear and should be restated to say that "controlled landfills" are those landfills with operating collection and control systems in place. Furthermore the commenter requested the term "construction permit" in the definition for design capacity be changed to "operating permit."

Response: The terms applicable to this regulation are defined in § 60.751. The definitions for "commercial solid waste", "industrial solid waste", and "sludge" are identical to the definitions contained in the RCRA regulations. The terms "controlled landfill" and "design capacity" are defined in this MSW landfill NSPS regulation, but not under RCRA. The term "municipal solid waste landfill" is defined within these regulations to assist in determining applicability with the NSPS; RCRA defines the term "municipal solid waste landfill unit" for applicability under RCRA.

As for the definition of "controlled landfill," a landfill is considered controlled at the time a collection and control system design plan is submitted. Thus, a collection and control system does not have to be operational for a landfill to be controlled under this definition. The definition of design capacity has been revised to state that the design capacity will be specified in the construction or operating permit. If the maximum design capacity is not specified in the permit, the reporting requirements now allow it to be calculated using good engineering judgment.

Comment: One commenter (IV-D-27) suggested that the EPA eliminate the use of the term "permanently closed landfill" within the preamble discussion since the definition of "closed landfill" means essentially the same thing. Another commenter (IV-D-32) indicated that the definition of "closed landfill" in the proposed regulation differs from their State's definition of "landfill closure," and also does not address the common practice of closing discrete sections of the landfill as they become full. The commenter noted that these units are typically closed according to an approved plan and are no longer subject to new regulations in his State. The commenter requested clarification of this issue and suggested that certification by a knowledgeable engineer or geologist occur prior to considering a landfill closed.

<u>Response</u>: The definition of "closed landfill" contained in the final regulation means a landfill in which no additional solid wastes will be placed in the future. If additional solid wastes need to be placed in the landfill, a notification of modification [§ 60.7(a)(4)] must be filed and the landfill will no longer be considered a closed landfill. In order to be considered closed, a landfill must also meet the criteria of 40 CFR 258.60. The term "permanently closed landfill" is not contained in the preamble to the final regulation.

Although discrete sections of a landfill may be certified as closed for purposes of RCRA, these sections are contributing to the overall NMOC emission rate of the entire landfill and remain potentially affected by this regulation because the overall NMOC emission rate is the basis for applicability under these regulations.

<u>Comment</u>: One commenter (IV-D-39) requested that the term "readily accessible" records be defined.

<u>Response</u>: Records in § 60.758 of the final NSPS can be either paper or electronic records. Most records must be kept for 5 years. The final rule specifies that these records may be kept either on-site or off-site if they are retrievable within 4 hours. A few types of records must be kept readily accessible for the life of the landfill or equipment. These records may also be maintained either on-site or off-site.

2.2.2 Wording of the Standards

Comment: Several commenters (IV-D-23, IV-D-25, IV-D-27, IV-D-32, IV-D-34) noted places within the Federal Register notice that appeared to contain typographical errors or erroneous cross references. Two commenters (IV-D-23, IV-F-6) noted that § 60.753 of the proposed NSPS refers to the methane generation rate constant as 0.02/yr and § 60.758 refers to the methane generative rate as 0.2/yr.

Response: The final regulations were reviewed and typographical errors and erroneous cross references were corrected.

Comment: Two commenters (IV-D-22, IV-D-32) asked for clarification about the term "D" in § 60.753(a)(3)(ii)(A), Tier 2, of the proposed NSPS, wondering if it is the same D defined in Method 2E.

Response: The commenter was referring to an equation contained in Tier 2 at proposal. This equation was removed from Tier 2, in an effort to simplify the Tier 2 requirements. In the final regulation, Tier 2 requires the owner or operator to determine the NMOC concentration using a specified sampling procedure. The regulation requires at least 2 sample probes to be installed per hectare of landfill surface that has retained waste for at least 2 years. Areas of nondegradable solid waste should be avoided when installing the sample probes. No more than 50 sample probes are required, regardless of the size of the landfill. If more than 50 samples are taken, then all samples must be used in determining the NMOC emission rate. The landfill owner or operator will collect and analyze one sample of landfill gas from each probe to determine the NMOC concentration using Method 25C.

Comment: One commenter (IV-D-4) indicated that the nomenclature for C_{NMOC} should be referred to in a more consistent manner throughout the proposed regulation. The commenter further maintained that references to NMOC concentrations and nomenclature be stated as ppmC (carbon equivalent) as in Method 25C. The commenter asserted that if the conversion factors are changed to consistently reflect the carbon equivalent (instead of hexane as it is stated) then changes within the regulation will need to be made to reflect this.

Response: The EPA has reviewed the regulation between proposal and promulgation to remove any ambiguity regarding the use of the term C_{NMOC}. The conversion factors in the final regulation for NMOC consistently reflect the hexane equivalent.

Comment: One commenter (IV-D-38) suggested that "or within 1 year after necessary State and local permits are issued, whichever is later" be added to § 60.752(b)(2)(ii). This paragraph requires the installation of LFG collection and control systems within 1-1/2 years of design plan submittal or notification of intent to install a collection and control system. The commenter stated that the permit process is very time consuming.

Response: The EPA considers the timeframes provided in the final NSPS and EG to be reasonable, based on section 111 concerns. As stated in the preamble to the proposed regulations, the time allowed between submittal of the design plan and installation of the collection and control system takes into consideration necessary lead time for obtaining and installing the system components. Whether or not a particular landfill must also go through a permitting process and how time consuming that process may be will vary from State to State, and this is best dealt with at the State level when the plans for implementing the NSPS and EG are developed. Section 2.14.1 contains additional information on compliance times.

Comment: One commenter (IV-D-19) indicated the regulation should clearly state that 98 percent emission reduction refers to reduction of NMOC collected by the gas collection system, not 98 percent of all landfill-generated gases.

Response: All references to 98 percent emission reduction within the NSPS and EG refer to reduction of NMOC in the collected gas.

Comment: One commenter (IV-D-26) indicated that the RIA should be revised for the final rule. The commenter stated that the conclusions in the RIA are sometimes not referenced and that the document contains some careless and biased text. The commenter also suggested that the revised edition should disclaim the first edition.

Response: The RIA has been reviewed and revised in conjunction with the final rule. The final RIA is included in Docket A-88-09 as Item No. IV-A-7. The EPA has made every effort to address pertinent issues in a fair and unbiased manner.

2.3 SELECTION OF THE SOURCE CATEGORY

2.3.1 Statutory Authority to Regulate

Comment: One commenter (IV-D-06) contended that RCRA subtitle D is the proper arena for addressing MSW landfill emissions and that this standard should not come under section 111 of the CAA. A second commenter (IV-D-18), however, expressed agreement with the EPA in listing MSW landfills as a source category under Act section 111(b)(1)(A). The second commenter (IV-D-18) agreed with the proposed regulation that for the purposes of ascertaining the NMOC emission rate and design capacity, the entire landfill and all its emissions should be considered one landfill, i.e, the affected facility.

Two commenters (IV-D-5, IV-D-55) argued that MSW landfills should be regulated under section 112, the NESHAP program, rather than under section 111. One commenter (IV-D-55) contended that air emission regulations in that State were the result of concern for toxic air impacts, health concerns and fire hazards that had no particular correlation to landfill size. The commenter (IV-D-55) cited an example of a school playground built on top of a closed landfill, where students and teachers had reported illnesses correlating with emission episodes. The commenter (IV-D-55) noted a variety of section 112 HAP's that are often found in LFG.

Two commenters (IV-D-5, IV-D-44) stated that because NMOC exist in relatively insignificant amounts in their States, the proposed regulation would be an unnecessary burden and strain on scarce resources. One of these commenters (IV-D-44) maintained that landfill regulations should fall under the control of State and local air pollution agencies. Another commenter (IV-D-42) stated that methane gas and/or leachate has never been produced in significant amounts in their area, and did not appreciate a mandatory "methane gas regulation."

Response: 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 Clean Air Act. After further consideration, the EPA announced in the Federal Register on August 30, 1988 (53 FR 33314) their decision to regulate MSW landfill emissions under section 111 of the CAA.

As discussed in the proposal preamble, section 111 NSPS and EG 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 (56 FR 24468; May 30, 1991). Evidence from the EPA and State studies show that MSW landfills release air pollutants that have adverse effects on both public health and welfare. For this reason, the EPA chose to regulate MSW landfill emissions under section 111.

The RCRA subtitle D establishes a framework for controlling the management of nonhazardous solid waste. Because the intent of this rule is to regulate emissions of landfill gas, and not solid waste, this regulation has been developed under the CAA instead of under RCRA. Some requirements in the RCRA subtitle D regulation are referenced within the NSPS and EG and are necessary to achieve compliance with these regulations.

The CAA as amended (1990 Amendments) revised the approach for regulating HAP emissions under section 112 and requires that the EPA publish a list of categories of sources having the potential to emit 10 or 25 tons/yr in the aggregate of any HAP listed in section 112. MSW landfills are a source of such HAPs and therefore were included on the source category list. MSW landfills not emitting above the regulatory cutoff under the NSPS and guidelines may still meet the section 112 criteria. Thus, the HAP emission potential of such landfills and the need for control of HAP's from municipal landfills will be evaluated in the future as part of that program. Additionally, State and local governments may address site-specific issues under their own air toxics programs.

Despite the listing under section 112, it was decided to continue with the section 111 regulations because they address the range of health and welfare concerns related to landfill gas emissions. Furthermore, because they have already been proposed, section 111 regulations can be promulgated more quickly than section 112 regulations thereby achieving benefits of earlier control at landfills with NMOC emissions above the cutoffs. In response to commenters who are concerned about the burden of the regulation, the final regulation includes both a design capacity exemption and an emission rate cutoff to determine if controls are required thereby focusing control efforts on those landfills where the greatest emission reductions can be achieved and control is most reasonable. This will greatly reduce the burden on small landfills who would incur high costs if they were required to apply controls, but would see only small emission reductions.

The proposed regulations are not methane gas regulations. The designated pollutant of concern is MSW landfill emissions because it has been determined to be a threat to the environment and public health. The group of compounds, NMOC, was chosen as the surrogate pollutant for landfill emissions because NMOC includes those LFG constituents of most concern to the environment and public health. Only landfills emitting NMOC greater than the regulatory cutoff are required to install controls.

2.3.2 Health and Welfare Concerns

Comment: A number of commenters addressed the EPA's consideration of the five areas of concern regarding potential adverse health and welfare effects of air emissions from MSW landfills. The five major effects of MSW landfill air emissions are: (1) human health and vegetation effects caused by ozone formed from nonmethane organic compound emissions, (2) carcinogenicity and other possible noncancer health effects associated with specific MSW landfill emission constituents, (3) green house effects from methane emissions, (4) explosion hazards, and (5) odor nuisance.

Three commenters (IV-D-26, IV-D-39 and IV-F-3, IV-F-4) stated that the five concerns have not been quantified or properly justified in the EPA's analysis. Two commenters (IV-D-26, IV-F-4) stated that these five concerns can better be addressed using a performance standard.

Several commenters (IV-D-2, IV-D-17, IV-D-18, IV-D-45, IV-D-55, IV-L-1) expressed concern for the effects MSW emissions can have on public health. One commenter (IV-L-1) contended that the proposed NSPS was insufficiently inclusive and stringent to protect public health and the environment. The commenter (IV-L-1) requested that the EPA reconsider whether the CAA compliance and health risk implications have been addressed by the proposed NSPS. Two of the commenters (IV-D-18, IV-D-45) argued that LAER and not BDT should be used in nonattainment areas to better protect public health. Another commenter (IV-D-55) was concerned that the proposed regulations would divert funding from small, more hazardous landfills to larger, remote landfills which are less hazardous to public health. A third commenter (IV-D-2) suggested increasing the stringency of standards for landfills located 3 or fewer miles from a residence.

One commenter (IV-D-19) requested that basic information regarding the magnitude of effects a landfill and its emissions may have on the surrounding land area be considered in the final regulation because it could either justify additional controls or justify the reduction of controls. Another commenter (IV-D-39) added that the proposal BID provides information on the effects of ozone on laboratory animals and vegetation, but does not quantify the role landfill air emissions play in endangering public health or welfare. Therefore, the contribution of landfill air emissions to ozone formation and its resulting impact on the environment and human health cannot be determined. Also, the commenter argued that existing studies have shown that the carcinogenic risks associated with landfill emissions are actually very low (1×10^{-6} to 1×10^{-8}) and that such low risk sources are not typically regulated.

The commenter (IV-D-39) stated that no data are presented on the contribution and effects that landfill-derived methane plays in the alleged "global warming" process. The commenter stated that the existing data suggest that landfills as a methane source are a small component of the total methane generated and released into the atmosphere.

Another commenter (IV-D-17) was concerned with the danger imposed on nearby residential areas by the existence of toxic organic compounds in LFG and the threat of explosion due to volatile gases.

The commenter (IV-D-39) stated that although the explosive hazard of methane migration into on-site and off-site buildings is well documented, the control of methane for explosive hazards is already addressed in subtitle D of RCRA. Therefore, this regulation will do little to reduce the potential of such hazards since appropriate controls are already mandated under existing law.

The commenter (IV-D-39) stated that odor control practices are presently being addressed in the revisions to RCRA subtitle D. The commenter also asserted that the technical data presented and the analysis performed do not clearly justify the regulation. Also, the commenter critiqued the five areas of concern identified by the EPA as justification for the standard.

The commenter (IV-D-39) stated that the courts have rightfully insisted that a variety of factors, such as costs, health and environmental impacts, nonair quality impacts, and energy requirements be evaluated in formulating new source standards pursuant to section 111. The commenter asserted that the proposed standards are inconsistent, both with the expressed terms of section 111 and the regulations promulgated thereunder.

Response: The EPA is regulating MSW landfill emissions to address threats to public health and welfare posed by landfill emissions on a nationwide basis. Recognizing that individual MSW landfills contribute to these nationwide health and welfare concerns, the EPA has fully considered these issues for this section 111 rulemaking. The EPA addressed the five areas of concern to public health and welfare to the extent possible using the available sources of information at proposal. The proposal preamble, BID, and RIA provided the basis for addressing these concerns as well as discussions on cost benefit analysis.

As stated in the proposal preamble (see 56 FR 24469; May 30, 1991), NSPS 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. In addition, an NSPS requires these sources to control emissions to the level achievable by BDT considering costs and any nonair quality health and environmental impacts and energy requirements. As such, the proposed standards conform to section 111 of the CAA. All of the relevant factors were considered and the EPA's decisions regarding these factors were summarized in the preamble to the proposed NSPS (56 FR 24468; May 30, 1991).

Section 111 standards deal with emissions of concern through establishing technology-based, not risk-based, standards. The level of control required under the section 111 NSPS program is BDT. The NSPS may assist States in achieving the NAAQS, but this is not the focus of the NSPS. States can institute more stringent requirements for any source to address State or local issues, including provisions requiring the use of LAER. Under the NSR program, either BACT in attainment areas or LAER in nonattainment areas are determined on a site-specific basis. The BACT or LAER must, at a minimum, be equivalent to the BDT under any applicable NSPS, but may also be more stringent.

The commenter concerned about smaller, more hazardous landfills focussed on air toxics. As discussed in the previous paragraph, air toxics at landfills emitting above the regulatory cutoff will be reduced by these regulations, and the EPA also intends to address HAP emissions at MSW landfills specifically under section 112. Additionally, the inclusion of MSW landfill emissions on the PSD significance list and the promulgation of these NSPS and guidelines should provide funding relief to State air program boards. Title V of the CAA required that States collect fees from all sources subject to regulation under the CAA, and the EPA promulgated this operating permit program on July 21, 1992 (57 FR 32250).

As stated in the preamble to the proposed regulations, landfills emit methane, which has been identified as a greenhouse gas contributing to global climate change. Because the rate and magnitude of these changes are uncertain, a quantitative assessment of climate change impacts was not performed. However, methane reductions were quantified, and the NSPS and guidelines together will reduce methane emissions by over 47 million Mg (expressed as NPV). The President's 1993 Climate Change Action Plan calls for the promulgation of the landfill gas rule.

Explosion hazards for methane at the boundary of the landfill are addressed directly under RCRA. This regulation would supplement RCRA and reduce the threat of explosions all over the landfill site, as well as offsite at controlled landfills through the destruction of LFG. Hazardous air pollutants from landfills would also be reduced through these regulations, and municipal landfills have also been listed for future regulatory development under section 112 of the CAA (see 57 FR 31576; July 16, 1992).

Because of the difficulty in describing MSW landfill emission levels that can be causally linked to the risk of fire or explosion, the EPA did not attempt to quantify these effects. Chapter 2 of the proposal BID describes these effects in greater detail. Although RCRA addresses explosion hazards, not all landfills will be subject to RCRA. Explosion potential will be reduced at all landfills that must install collection and control systems as a result of these regulations. All of these concerns, whether addressed qualitatively or quantitatively, contributed to the EPA's decision to regulate MSW landfills under section 111 of the CAA.

Because odor perception and impact is subjective, it is difficult to quantify the degree of unpleasantness of odor. Therefore, the EPA has addressed the adverse effects of odors qualitatively in its analysis. Because NMOC are a precursor to ozone, the NSPS and EG should provide a reduction in ozone formation. However, the effect of NMOC on ozone formation has not been accurately quantified and has only been addressed qualitatively.

The commenter asked that the effects one particular existing MSW landfill has on surrounding areas be considered in the regulation. However, NSPS under section 111 of the CAA must require the application of BDT that addresses public health and welfare concerns at all affected landfills. The BDT established for this rulemaking requires all affected landfills to install collection and control systems if their calculated NMOC emission rates exceed the emission rate cutoff. Also, State and local agencies have the flexibility to consider any site-specific public health and welfare concerns in developing their own regulatory and permitting programs and establishing additional control requirements.

Comment: One commenter (IV-L-1) encouraged the EPA to immediately begin to conduct studies in preparation for the 8-year review. The commenter discussed pollutant-specific cancer risks of benzene and vinyl chloride.

Response: The section 111 standards are technology based standards and as such do not address specific health risk. While section 111 requires periodic review of standards, that review does not include health risk estimation; rather, it addresses whether the standards reflect BDT, considering technology advances and other factors. The commenter may be confusing the section 111 (NSPS) and section 112 (NESHAP) programs. The CAA requires a review of residual risk 8 years after NESHAP are promulgated under section 112. This provision does not apply to NSPS. Municipal landfills are listed as a source category that emits hazardous air pollutants and NESHAP will be developed in the future.

2.4 SELECTION OF THE AFFECTED AND DESIGNATED FACILITIES

Comment: Three commenters (IV-D-17, IV-D-39, IV-D-48) cautioned the EPA that controlling landfills which have accepted waste after November 8, 1987 and which may have closed prior to May 30, 1991 is unfair, and would pose an economic burden, because these landfills will have no means to raise the funds needed for installation of collection and control systems. One of the commenters (IV-D-17) suggested that a requirement be included in the final rule for an economic and fiscal analysis to determine the feasibility of applying the emission guidelines "retroactively." Given that a retroactive cutoff date was set, the commenter suggested that an alternative cutoff date, ranging from 1965 to 1970, might be appropriate for landfills large enough to warrant regulation, because such landfills might still be producing NMOC.

Two commenters (IV-D-26, IV-D-39) recommended that an existing facility be defined as a facility that had received waste on or after May 30, 1991, the date of proposal, instead of November 8, 1987. One of the commenters (IV-D-26) stated that the costs for compliance with the November 8, 1987 cutoff date are significant. One of the commenters (IV-D-39) argued that owners of closed facilities historically have not been required by the EPA to implement controls and that the environmental benefit gained by the inclusion of older landfills would be much less than the benefit of controlling open landfills because older closed landfills typically have emission levels that are much lower than newer sites.

The commenter (IV-D-39) asserted that locational data for these facilities is not readily available and would be difficult to obtain because most States did not maintain such records despite the requirement of the 1984 RCRA amendments. Additionally, the commenter reported that a comparison of recent surveys shows that States were not capable of reporting the same data consistently and that differences between data sets were sometimes as great as 100 facilities.

Response: As discussed in section IV.D of the proposal preamble under "Selection of the Affected and Designated Facilities," the EPA requested 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. However, during the development of these standards and guidelines, the 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.

A significant number of landfills have closed after November 8, 1987, prior to 1991, and may still have emissions above the regulatory cutoff that pose a risk to public health and welfare. For this reason, the EPA considers it appropriate to regulate these landfills under section 111(d) of the CAA.

Faced with the administrative and policy complexities of regulating closed facilities, the 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 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. The EPA views this permit program as a readily available resource for States to use in implementing today's guidelines and judged States would be able to identify active facilities as of this date. For these reasons, the EPA has defined 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.

With regard to the suggested cutoff dates of 1965 to 1970, many States lack the information necessary to identify all landfills that closed that long ago.

Section 111 of the CAA defines a new source as one commencing construction on or after the date of proposal (May 30, 1991) of the applicable standard. Therefore, the distinction between new and existing MSW landfills was not determined as a part of this rulemaking, but was set at the date of proposal, as mandated by the CAA.

The focus of the rulemaking is control of the designated pollutant, MSW landfill emissions, at new and existing MSW landfills. Any landfill subject to the emission guidelines accepting waste or having capacity available for future waste acceptance between November 8, 1987, and the proposal date would have to exceed the regulatory cutoff before installation of collection and control systems would be required.

Even though the actual decline in the emission rate varies from landfill to landfill, in general landfills closing prior to 1987 emit at declining rates, while landfills closing after the 1987 cutoff date may warrant control. However, as stated in the proposal preamble, the model and information presented in the proposal preamble and BID are appropriate for application to older landfills, and States are encouraged to use them to assess the emission potential of any closed landfills of concern under the emission guidelines.

The EPA found that the majority of landfills are either part of a municipal system or else corporately owned. There are few independently owned and operated landfills. If an individual landfill does not have adequate resources, a State may consider making a case-by-case showing for the landfill, or a group or class of landfills, that a less stringent emission guideline is warranted. Under 40 CFR 60.25(f), a State may apply a less stringent standard based on unreasonable cost, physical impossibility, or other factors specific to the landfill or class of landfills that make application of a less stringent standard significantly more reasonable. States may submit such case-by-case determinations to the EPA for review as part of the submittal of their plan to implement the EG.

Comment: One commenter (IV-L-1) recommended that all design and construction plans for new landfills, or expansions of existing landfills, contain active landfill gas collection and control systems, regardless of the anticipated disposal capacity.

Response: The final rule requires only those landfills that exceed the emission rate cutoff of 50 Mg/yr to install a collection and control system to control emissions of NMOC. The EPA encourages owners or operators of new landfills or existing landfills that are in the process of expanding to begin planning for collection and control systems if they anticipate ever having a design capacity that would exceed 2.5 million Mg or 2.5 million m^3 and an emission rate of 50 Mg/yr. The EPA has included a design capacity exemption of 2.5 million Mg or 2.5 million m^3 in the final rule and estimates that this will exempt approximately 90 percent of affected landfills from the recordkeeping and reporting requirements of the rule. These landfills are excluded for reasons described in section 2.4.1.1. The final rule focuses on control of larger landfills where there is the greatest emission reduction potential and reduces the regulatory burden on small entities. The EPA will not require an owner or operator to include active landfill gas collection and control systems in their design plans if they do not anticipate exceeding the design capacity exemption and the 50 Mg/yr control applicability cutoff. The MACT standard that must be promulgated in the future for municipal landfills will examine whether smaller landfills have significant hazardous air pollutant emissions.

2.4.1 Exemptions from Control

Comment: One commenter (IV-D-8) requested exemption from these regulations, based on the administrative and cost burdens, for all industrial/municipal solid waste disposal facilities where less than 15 percent of waste is MSW.

A second commenter (IV-D-6) stressed that landfills that accept large amounts of MWC ash should be regulated under RCRA subtitle D rather than under the CAA, and that landfills accepting only MSW should be regulated by the proposed standards.

A third commenter (IV-D-27) recommended that the regulation allow owners and operators to demonstrate that some older portions of the landfill may be virtually nonproductive and, therefore, not warrant the placement of collection wells. The commenter suggested that exclusion provisions similar to those established for asbestos deposition be crafted. Additionally, the commenter proposed that gas generation rate calculations should not be required for areas excluded from the system since the rates could only be determined from an active collection system.

In addition, the commenter (IV-D-27) proposed that the provisions for exempting areas of asbestos deposition in the guidelines be extended to the NSPS, noting that asbestos will continue to be disposed of in MSW landfills. The commenter further noted that documentation of the deposition area may not be available, and warned that erroneous drilling through asbestos may occur if the owner is required to keep the excluded areas below 1 percent emission potential. The commenter recommended greater flexibility in excluding areas of asbestos deposition.

Another commenter (IV-D-39), however, recommended the elimination of the exclusion for areas of a landfill based on the presence of asbestos and nondegradable materials. The commenter asserted that these exclusions will lead to unequal enforcement of the regulations and not provide the level of environmental protection that the EPA seeks. The commenter argued that an operator hypothetically could, through the acceptance of very small quantities of asbestos, landfill the waste so that most of the landfill's area is excluded from the requirements pertaining to the installation of gas recovery wells. Also, since many landfills have disposed of nondegradable material as the landfilling operations progressed and few have records of disposal location, regulatory enforcement of this section would be difficult.

Response: While it is true that many MSW landfills have accepted non-MSW in some quantity, the regulations do not exempt these landfills from the standard because the LFG emissions depend on the organic material in the waste, not on the origin of the waste. The emissions of concern, LFG emissions, result primarily from degradation of organic material, which may result from deposition and degradation of MSW, industrial solid waste, commercial solid waste, conditionally exempt small quantity generator waste or nonhazardous sludge. All of these wastes may contribute to LFG emissions. Therefore, the MSW landfill definition must include all of these constituents, and does not include a percentage MSW cutoff.

The final regulations are structured to require collection and control based on NMOC emission potential, and the emission rate calculations are based on the amount and age of the waste, regardless of its origin. As provided in § 60.754 of the NSPS, the emission rate calculations include summing the individual emission rates from each yearly submass of waste material. Areas may be excluded from the collection system only through three mechanisms: documentation must be provided for nonproductivity due to age, nonproductivity due to nondegradable nature (e.g., cement, MWC ash), and the presence of asbestos.

Older "nonproductive" organic waste will likely be emitting at some low rate, and the regulation would exempt such an area from control provided that its calculated emission potential can be shown to be less than 1 percent of the overall emission potential of the landfill. If the age and mass of an older area is known, the current emission rate for that submass can be calculated and compared to the overall emission rate. Since emissions from each yearly submass decline with age, the actual ages of these submasses will govern how many of these submasses may be excluded from control before the 1-percent limit is reached. The data and calculations that provide the basis for excluding such areas must be documented and provided to the Administrator upon request.

Landfills receiving wastes other than, or in addition to, MSW may, however, be able to demonstrate an emission rate below the regulatory level, via the provisions for the exclusion of nondegradable areas of the landfill. These provisions would likely exempt dedicated landfills receiving only demolition waste or MWC ash because such landfills may not emit above the emission rate cutoff. Nondegradable waste, such as cement or MWC ash, is exempted because it is not contributing to the LFG emission rate, and these provisions specify that the mass of nondegradable refuse is not to be included when estimating emissions. In the final NSPS, the 1-percent condition is not required of asbestos or nondegradable material, provided that documentation is provided on the nature, date of deposition, location, and amount of material deposited. This approach is preferable to excluding landfills that accept a certain percent of MWC ash from the NSPS and EG because landfills that accept a mixture of MWC ash and MSW may still emit significant amounts of landfill gas from the MSW and may warrant control. Regulating such landfills only under RCRA instead of the NSPS and EG would not necessarily address the air pollution concerns.

The intent of the exclusion for asbestos was to avoid a known, documented hazard, rather than to permit circumvention of the regulations based on either a hunch about the presence of asbestos or poor management practices. The EPA will allow exclusions based on asbestos deposition only for those cases where such deposition is managed and fully documented.

As discussed in the previous response, a State may make a case-by-case showing for the landfill, or a group or class of landfills, such as a landfill where a very small percent of the waste is MSW, that a less stringent emission guideline is warranted if the criteria in 40 CFR 60.25(f) are met.

Comment: One commenter (IV-D-54) stated that alternative standards should be proposed for facilities in cold regions that have reduced their LFG emissions by using designs that freeze the waste. The commenter suggested that if a temperature monitoring system can assure that the waste is stored at a temperature below freezing, then a gas collection and control system should not be required.

Response: The regulation provides for a situation such as this. A low NMOC emission rate can be verified through sampling and analysis using Method 25C. If the NMOC emission rate is below 50 Mg/yr, installation of a gas collection and control system is not required. However, if the NMOC concentration is high enough to result in a calculated NMOC emission rate above the emission rate cutoff, the landfill would warrant control under these regulations. For existing landfills, a State could establish an alterative emission rate cutoff based on the criteria provided in 40 CFR 60.24(f).

<u>Comment</u>: After the notice of data availability (58 FR 33790, June 21, 1993), one commenter (IV-L-5) inquired as to what types of materials other than nonprocessible materials (white goods), could be excluded from consideration as MSW for modelling air emissions for use in determining whether collection and control systems should be installed.

<u>Response</u>: The EPA did not request comment on materials exempted from control in the notice of data availability. The EPA assumes that by the term nonprocessible materials (white goods) the commenter is referring to either nondegradable materials or nonproductive areas. Under § 60.759(a)(3)(i) of the final rule, segregated areas of asbestos or nondegradable materials may be excluded from control if documentation is kept on the nature, date of deposition, amount and, location of the waste. Nondegradable waste, such as demolition waste or MWC ash, is exempted because it does not contribute to LFG emissions. Under § 60.759(a)(3)(ii) of the final rule, older, nonproductive areas of the landfill may be excluded from control, if the total of all excluded areas contributes less than 1 percent of the total amount of emissions from the landfill and they are documented.

2.4.1.1 <u>Design Capacity Exemption</u>

<u>Comment</u>: Several commenters (listed below) discussed the proposed design capacity exemption of 100,000 Mg. One commenter (IV-D-7) contended that because of the current costs associated with the siting, permitting, and development of landfills, no additional MSW landfills having design capacities less than 100,000 Mg will be built. The commenter

said that the exemption level should be raised to 1.0 million Mg because the calculation method used in the regulation overestimates NMOC emissions. Two commenters (IV-D-20, IV-D-54), suggested an exemption level of 550,000 Mg because they reasoned that landfills smaller than this would not emit more than 150 Mg/yr anyway. The commenters contended that the lower exemption level would unnecessarily increase the regulatory burden of the standard, and will burden small landfills and State regulatory agencies. Another commenter (IV-D-51) also argued that the proposed design capacity exemption level was too low.

One industry commenter (IV-D-27) approved of a design capacity exemption level of 100,000 Mg, but also noted that there would still remain considerable burden for small landfills that would be exempted at Tier 1, noting that about 35 percent of Tier 1 MSW landfills are never required to install controls. The commenter applauded the conservative basis for review of MSW landfills to identify those warranting gas control and praised EPA's effort to obtain information from the regulated community. The commenter recommended, however, that all MSW landfills be evaluated for NMOC emission rates, instead of only those above the design capacity exemption level.

Another commenter (IV-D-36) agreed, suggesting that if LFG is an environmental concern, then all landfills, regardless of size, should be regulated, or at least monitored to determine if control is necessary.

Another commenter (IV-D-39) asserted that the 100,000 Mg cutoff is not based on technical justification or cost/benefit analyses using NMOC emission data. The commenter stated that small landfills that are poorly designed and operated may have emission levels that exceed levels found at large, properly designed and operated landfills. The commenter asserted that all owners or operators should be required to report emission levels that have been certified by an appropriate professional, such as a professional engineer.

Response: These regulations, including the design capacity exemption level, are based on NMOC emission potential. After BDT was determined, the design capacity exemption was selected to reduce the paperwork burden on landfills that typically would not have a calculated NMOC emission rate large enough that controls would be required. The design capacity exemption was re-evaluated in the interim between proposal and promulgation, and has been revised to 2.5 million Mg or 2.5 million m^3.

The proposed design capacity cutoff of 100,000 Mg of waste was chosen so that no landfill would be exempted and have actual emissions above the emission rate cutoff. Several comments were submitted requesting an increase in the exemption level. An increase would relieve additional owners and operators of small landfills from the emission estimation and control requirements. In addition to the comments, changes to the data base and the emission modeling values prompted the design capacity exemption level reevaluation. The new design capacity analysis evaluated a range of options from 500,000 Mg to 4.0 million Mg of waste. Two important considerations in the selection are the number of landfills exempted and the amount of potential NMOC emission reduction lost from the exempted landfills.

The 2.5 million Mg exemption level would exempt 90 percent of the existing landfills while only losing 15 percent of the total NMOC emission reduction. Therefore, 2.5 million Mg was chosen since losing 15 percent of the emission reduction is a reasonable tradeoff to relieve as many small business and municipalities as possible from the regulatory requirements while still maintaining significant national emission reduction. The 2.5 million Mg exemption level excludes those landfills, both public and private, would be at least able to afford the costs of collection and control systems. The lowest value considered, 500,000 Mg, only allows slightly more than 1 percent of the total emission reduction potential to go unregulated; however, only 62 percent of the landfills are exempted. Under this option, a large proportion of landfills would be required to perform annual emission calculations and would experience significant recordkeeping and reporting burdens, even though they would never reach 50 Mg/yr and would never be required to install controls. The highest capacity value considered, 4.0 million Mg, would allow over 20 percent of the potential emission reduction to go unregulated.

Since some landfills record waste by volume and have their design capacities calculated in volume, EPA also established an equivalent design capacity exemption of 2.5 million m^3 of waste. The density of landfilled solid waste varies from landfill to landfill depending on several factors, including the compaction practices. Any landfill that reports waste by volume and wishes to establish a mass design capacity must document the basis for their density calculation.

All MSW landfills above the design capacity exemption level (maximum design capacity) must periodically calculate their annual NMOC emission rate to determine if controls are warranted. See responses in section 2.15, "Reporting and Recordkeeping", for consideration of the resulting paperwork burden. The EPA remains convinced that control of landfills smaller than the design capacity exemption is a reasonable tradeoff to focus effort on those landfills with the highest potential for emission reductions. However, States have the freedom to require additional monitoring, LFG collection, or control to address State concerns. At the time MACT standards are developed for landfills under section 112 of the CAA, EPA will assess the HAP emission potential from landfills and decide whether smaller landfills warrant control for HAP emissions.

2.4.1.2 Co-combustion of Landfill Gas

Comment: One commenter (IV-D-16) suggested that the proposed regulations do not account for the possibility that some enclosed combustors could be used for combusting fuels other than LFG. In particular, the commenter was concerned about MWC's subject to the NSPS for MWC's that also combust LFG. The commenter recommended that the standards be changed to exclude facilities which are already regulated by other standards of performance and/or emissions guidelines promulgated under the CAA from the requirements of these regulations. The commenter also suggested the regulations should provide a different emission limit for facilities burning LFG along with other fuels. The commenter requested that the compliance test method be appropriate for use with LFG and LFG mixed with other fuels, and noted that co-combustion may affect the test methods provided in these regulations.

Response: The EPA does not consider it difficult to demonstrate either a 98-percent reduction in NMOC or a 20 ppmv TOC concentration when LFG is combusted in an MWC. Because the format of the MWC NSPS is a set of emission limits for individual pollutants, while the format for this NSPS is a performance standard for total NMOC, the performance tests in the NSPS for MWC's differ from the performance test provided in these regulations. When only LFG is fired in a combustor, it will be subject only to the control requirements of this NSPS and EG.

In addressing the commenter's concern, the EPA looked for ways to relieve undue regulatory overlap while still ensuring that BDT is not compromised. The final regulation clarifies that alternative methods of compliance demonstration can be used if approved by the Administrator. For example, for a situation when both LFG and refuse is combusted in an MWC simultaneously, a design analysis and any other information demonstrating that the standards can be continuously achieved must be submitted to and approved by the Administrator.

In the development of the Hazardous Organics NESHAP (HON) and previous NSPS for process vents that may be controlled by routing organic-containing gases to boilers, the EPA determined that a performance test would not be required for boilers or process heaters with a design heat input capacity of 44 MW or greater. Analysis shows that when vent streams are introduced into the flame zone of these boilers and process heaters, over 98 percent reduction or an outlet concentration of 20 ppmv is achieved. Therefore, a performance test is not necessary. If, however, the gas stream is combusted in a boiler or process heater with a design heat input capacity of less than 44 MW, a performance test to demonstrate 98 percent NMOC reduction or 20 ppmv is still required. The final NSPS has been amended to incorporate these provisions.

2.4.2 Selection of the Tier Default Values

Comment: Three commenters (IV-D-4, IV-D-7, IV-D-26 and IV-F-6) contended that the NMOC default concentration of 8,000 ppmv is overly conservative and recommended alternative concentrations as more representative. One of the commenters (IV-D-7) referred to tests conducted in humid climates yielding NMOC concentrations of 200 to 500 ppmv.

Another commenter (IV-D-39) asserted that the default NMOC concentration value of 8,000 ppmv as hexane is not justified in the proposal BID, and questioned how it was derived. The commenter stated that this value should be re-examined and that the analysis should address differences in NMOC concentration based on the waste types received at the landfills.

Another commenter (IV-D-28) alleged that there is no established technical basis for the refuse decay rate value (k) of 0.02/yr or the refuse methane generation potential (L_o) of 230 m^3/Mg and, therefore, these values should be excluded from the regulation until adequate technical justification exists. A second commenter (IV-F-6) stated that the k value of 0.02 is too conservative and overstates gas production rate. A third commenter (IV-D-17) listed the range of variation for these two defaults and stated that the EPA should fund contracts to study the variability of the LFG generation constant, k, and the methane generation potential, L_o, to see if the variations can be reduced. Another commenter (IV-D-26) argued that the default k and L_o values overpredict production of gas, thereby requiring collection when "real" emissions levels may be very low. The commenter asserted that the default L_o is the most critical value and that the proposed regulation does not allow a calculated value to be substituted in the estimation.

Response: The default values for use in the tier calculations were not chosen to be average values. Owners or operators wanting average values for use in system design or inventory should use the values published in the latest version of EPA's AP-42 document. Selection of the default NMOC concentration provided in the tier calculation was not based on test data alone. Rather, it was chosen in concert with the defaults for the methane generation potential (L_o) and the refuse decay rate constant (k). The objective of the defaults selection process was to obtain a balance between lost emission reduction potential and cost of performing the field tests in Tiers 2 and 3 on a nationwide level as described in the memorandum entitled "Rationale for Selecting Tier 1 Default Values" (Docket No. A-88-09, Item No. II-B-33). More specifically, the default values were selected such that there is low potential that they will significantly underestimate emissions for individual landfills (resulting in less emission control); yet the defaults will not overestimate emissions by such an extent that a large number of landfills would be over 50 Mg/yr according to Tier 1 and would undergo the expense of Tiers 2 and 3 and show that they are actually below 50 Mg/yr.

It should be noted that the default NMOC concentration reflects some existing landfills that may have a history of codisposal of hazardous waste. Data received from codisposal landfills indicates that the NMOC concentrations from codisposal sites are typically higher than NMOC concentrations from nonhazardous MSW landfills. However, because of RCRA regulations preventing disposal of hazardous waste in MSW landfills, only NMOC concentrations from landfills that never accepted hazardous waste were used to characterize landfills opening after 1987. The NMOC concentrations from landfills that accepted hazardous waste as well as landfills that never accepted hazardous waste were both used to characterize landfills opening through 1987. The memorandum "Methodology used to Revise the Model Inputs in the Municipal Solid Waste Landfills Input Data Bases (Revised)" (Docket No. A-88-09, Item No. IV-M-4) discusses the rationale used to calculate and select values for k, L_O, and $C_{NM}OC$. As discussed in later comments in this section, the default values have been revised since proposal.

For data to be used to obtain default k values, the following had to be available: test year, year landfill opened, year landfill closed (if closed), amount of refuse-in-place in the test year, refuse acceptance rate, and the actual methane flow rate. For data to be used to obtain default NMOC concentrations, the following had to be available: the total NMOC concentration and associated units (e.g., ppmv as hexane, ppmv as methane), the methane concentration and the CO_2 concentration (to correct for air infiltration since landfill gas is primarily methane and CO_2), and the test method used. Also, the test method used had to be comparable to EPA Method 25C.

Comment: One commenter (IV-L-2) contended that the k, L_O, and $C_{NM}OC$ values will vary based on more than just geographic location, which the commenter stated was a surrogate for precipitation. Other factors the commenter (IV-L-2) mentioned that could influence the values included: the categories and relative quantities of waste produced according to the local economic conditions and emphasis, the amount and types of materials diverted from the waste stream by recycling, and other physical characteristics of the region where the subject landfill is located and their influence on the design of the landfill. The commenter (IV-L-2) noted that all or most of the landfills added to the database are from arid regions.

Response: The commenter is correct in noting that there are many factors that influence k, L_O, and $C_{NM}OC$ values at each landfill. The purpose of the MSW landfills data base is to reasonably represent the variability among landfills in the U.S. While the EPA agrees that its approach cannot accurately estimate emissions at a given landfill without additional site-specific information, the EPA supports the methodology for emissions estimates on a nationwide basis. All of the randomly assigned factors were determined from data on existing landfills, and available literature was reviewed to establish reasonableness criteria for using this information in the model.

While it would be infeasible to factor every variable into the emissions estimation model, the model does account for the percentage of landfills in arid versus moist regions. This was a way to factor the influence of moisture into the analysis. In order to factor other influences into the analysis, a large amount of resources and time would need to be spent and the outcome is questionable. The data on precipitation and location, however, were readily available. For further information on arid versus moist k and L_o values used in the landfills data base, see section 6.0 of the memorandum "Methodology Used to Revise the Model Inputs in the Municipal Solid Waste Landfills Input Data Bases (Revised)," April 28, 1993 (Docket No. A-88-09, Item No. IV-M-4).

Comment: One commenter (IV-L-4) alleged that there is no established technical basis for the "revised" k value of 0.03 yr^{-1} or the L_o value of 140 m^3/Mg. The commenter (IV-L-4) cited as reasons: the enactment of Federal final cover standards which should cause landfills to be "extra arid," resulting in a decreased k, and the enactment of State recycling programs, which remove paper and landscaping waste, resulting in reduced L_o values. The commenter (IV-L-4) recommended not using the revised k and L_o values in the rule, but offered no alternative values or methodology.

Response: The k and L_o values are used as input parameters in the model equation for estimating NMOC emissions from each landfill in the input data bases. The revised k and L_o values were derived from known landfill-specific data obtained from SCAQMD test reports, section 114 letter responses, ORD studies, and landfill gas to energy data updated by SWANA. A description of the methodology used to calculate new k and L_o values can be found in the memorandum entitled "Methodology Used to Revise the Model Inputs in the Municipal Solid Waste Landfills Input Data Base (Revised)," April 28, 1993, (Docket No. A-88-09, Item No. IV-M-4).

The k value of 0.02 yr^{-1} and L_o value of 230 m^3/Mg were the proposed default values for use in Tier 1 of the rule where an owner or operator will estimate the annual NMOC generation for a landfill. The k and L_o values of 0.03 yr^{-1} and 140 m^3/Mg are the average k and L_o values in the input data bases and do not correspond to the default values to be applied in the rule. Default values were not chosen to be average values. Owners or operators wanting average values for use in system design or inventory should use the most current values published in AP-42.

Default values for the tier calculations are determined by an optimization analysis between estimated nationwide costs of performing the tier analyses and total nationwide emissions reduction of the rule. Defaults that result in greatly overestimated emissions would result in more landfills exceeding the 50 Mg/yr applicability level under Tier 1. An increased number of landfills would then undergo the expense of Tier 2 and 3 testing. If Tier 1 greatly overestimated emissions, many of the landfills that did Tier 2 and 3 testing would find they emit below 50 Mg/yr and are not required to apply controls; thus, they would incur high test costs and no emission reduction benefits. On the other hand, if the defaults underestimate emissions, landfills that actually have emissions over 50 Mg/yr would escape control. This would result in less emission reduction than intended. The default values selected were considered to achieve the best balance between resulting in control of those landfills that emit over 50 Mg/yr without resulting in overly burdensome national costs for tier analysis.

For the final rule, the default values were revised to $k = 0.05\ yr^{-1}$; $L_o = 170\ m^3/Mg$; $C_{NMOC} = 4{,}000$ ppmv as hexane. More information on this subject may be found in the memorandum "Documentation of Small-Size Exemption Cutoff Level and Tier 1 Default Values (Revised)," April 27, 1995 (Docket No. A-88-09, Item No. IV-B-10).

The average k and L_o values of 0.03 yr^{-1} and 140 m^3/Mg in the input data bases were representative of currently existing landfills. As discussed in the methodology memorandum listed above, (Docket No. A-88-09, Item No. IV-M-4), the gas generation from arid versus moist landfills was considered in the development of the k and L_O values for each landfill in the input data bases. Also, the rule allows site-specific k values to be determined for each landfill if the landfill chooses to perform a Tier 3 analysis.

The primary criteria effecting L_O of a landfill is the cellulose content of the refuse. State recycling programs that remove paper and landscaping waste may effect L_O of landfills; however, the extent to which these programs will effect L_O cannot be accurately quantified and currently available data must be used. However, under § 60.759(a)(3)(i) of the final rule, segregated areas of asbestos or nondegradable materials may be excluded from control if documentation is kept on the nature, date of deposition, amount, and location of the waste.

Comment: One commenter (IV-L-7) supported the use of the maximum L_O at each landfill, instead of the average in calculating potential landfill emissions. Another commenter (IV-L-2) objected to limiting the maximum L_O for an individual landfill that could be greater than 7,000 ft^3 methane/Mg of refuse. The commenter (IV-L-2) also expressed concern because the data used to determine the range of possible L_O values was compiled from one source. The commenter (IV-L-7) who supported the use of the maximum L_O stated that the net result of the changes to the methodology for calculating generation potential is a decrease in the total potential gas emissions nationwide and results in fewer landfills requiring controls. The commenter (IV-L-7) contended that the same was true for the results of the revised inputs to the concentration of NMOC. The commenter (IV-L-7) stated that this was a departure from the traditional EPA practice of assuming a worst case scenario in protecting the environment.

Response: The revisions to the methodology for determining L_O values and $C_{NM}OC$ values used in the input data bases provide estimates of methane and NMOC emissions that are lower than the proposal estimates. The revisions are based on additional information that was obtained since proposal, and the EPA believes that the revised estimates more accurately represent nationwide landfill emissions.

The EPA used the L_o range of 2,000 to 7,000 ft^3 methane/Mg refuse to define the minimum and maximum L_o values that can be assigned to any landfill in the input data bases. This L_o range, taken from "Methane Gas in Landfills: Liability or Asset?" presented at the Fourth National Congress of the Waste Management Technology and Resource and Energy Recovery, was chosen because it falls within the total range of L_o values reported in the numerous references reviewed by the EPA. Therefore, the commenter is incorrect in suggesting that the range of L_o values came from one source.

Based on a literature review and available data, the EPA has determined that an L_o range of 2,000 to 7,000 ft^3 methane/Mg refuse is appropriate. The literature review revealed that 7,000 is the upper end of the range that is typical, and values exceeding this would be unlikely due to the amount of methane producing material that could be realistically placed in a landfill and eventually converted to methane.

Comment: One commenter (IV-L-3) contended that an L_o of 1,700 to 3,500 ft^3 methane/Mg wet waste is more appropriate than the higher L_o of 4,913 ft^3 methane/Mg proposed by the EPA. The commenter noted a 1991 paper by Augenstein and Pacey that presents an L_o of 1 to 2 ft^3 methane/dry pound of waste. The commenter stated that assuming a waste moisture of 20 to 25 percent, translates to an L_o value of 1,700 to 3,500 ft^3 methane/Mg wet waste.

The commenter (IV-L-3) mentioned work of Augenstein (1976a,b), and Chynoweth and Legrand (1991) that have shown an L_o value on the order of 3 ft^3 methane/pound of dry volatile solids under lab conditions. The commenter (IV-L-3) contended that with waste at 20 to 25 percent moisture, 25 percent ash, and the balance volatile organics, the upper limit of L_o can be calculated based on these lab results to be about 3,500 ft^3 methane/Mg.

The commenter (IV-L-3) stated that dry landfill methane fermentation conditions are more typical and methane conversion will consequently be less than the potential maximum. The commenter (IV-L-3) stated that this is supported by the findings of apparently unaltered material even after many decades of burial, in several articles by Rathje. In addition, the commenter (IV-L-3) asserted that shallower landfills as well as those with more porous covers may be partly aerobic, reducing methane yield.

The commenter (IV-L-3) acknowledged that there are numerous projections and calculations by the EPA and their contractors of methane yields much higher than 3,500 ft^3 methane/Mg. However, the commenter (IV-L-3) contended that these higher yield projections are stoichiometric calculations rather than laboratory results with representative solid waste. The commenter (IV-L-3) stated that actual biological methane production will be substantially lower than stoichiometric estimates because much organic material is undecomposable and much of the degradable fraction is shielded by lignin. The commenter (IV-L-3) stated that similar points have been made by Professor Morton Barlaz (Barlaz 1991).

Response: Numerous references were reviewed that identified values for L_o. These items are summarized in the memorandum "Methodology Used to Revise the Model Inputs in the Municipal Solid Waste Landfills Input Data Bases (Revised)," April 28, 1993, (Docket No. A-88-09, Item No. IV-M-4). It was determined that L_o values are highly variable and difficult to quantify on a landfill-specific basis.

The range of L_o values recommended by the commenter (1,700 to 3,500 ft^3 methane/Mg) falls mostly within the range used by EPA (2,000 to 7,000). Also, applying the range of L_o values to the actual emissions data from the 44 landfills presented in the memorandum indicates that 25 percent of the landfills would not have a solvable k value at an L_o of 3,500 ft^3 methane/Mg, indicating that actual L_o values may be greater that 3,500. This indicates that the larger range of 2,000 to 7,000 ft^3 methane/Mg would be more appropriate.

Comment: One commenter (IV-L-2) requested clarification on the methodology used to calculate k values using the L_o values, and contended that this process appears to produce k and L_o values that are proportional to each other.

Another commenter (IV-L-3) noted that the use of lower L_o values implies higher k values. The commenter acknowledged that k is back calculated from L_o. The commenter stated that k and L_o are approximately reciprocal and that the effect of higher k values and lower L_o values would shorten the projected term of methane generation, as well as the cumulative NMOC emission over the long term.

Response: The k and L_o values determined for each landfill in the data base are based on measured landfill gas emissions and waste acceptance rate data for existing landfills. Based on this data, for a given L_o value, a k value was calculated using the model equation. This gives a k and L_o value that, when the model equation is used, yields a gas generation rate equivalent to the measured flow rate. While these values are related exponentially due to the model equation, they are not directly proportional or linear to one another. See "Methodology Used to Revise the Model Inputs in the Municipal Solid Waste Landfills Input Data Bases (Revised)," April 28, 1993, (Docket No. A-88-09, Item No. IV-M-4) for more information on this topic.

Comment: One commenter (IV-L-2) suggested that the upper limit of the 80th percentile confidence interval on the mean, and not the median, be chosen for the expected k and L_o values.

Response: In the period between proposal and promulgation, the EPA decided that determining a site-specific potential L_o range for each of the 44 landfills and then using the median L_o for each landfill would be more representative of reasonable gas generation potential than using the 20th and 80th percentiles equally with the median value, as was done in the proposal analysis. Using a median L_o value reduces the potential error in estimating emissions from individual landfills using the model equation. This eliminates the possibility of assigning high L_o values to landfills that may actually have low values, and vice versa. In order to calculate the upper limit of the 80th percentile confidence interval on the mean, a distribution of L_o values is necessary. The L_o value will vary depending upon the characteristics of the refuse disposed at individual landfills.

The data available only provided a range of L_o values that are most likely to exist at landfills. A distribution of the range of L_o values at landfills in the U.S. was unavailable and would require a great deal of additional resources and time to obtain.

Comment: One commenter (IV-L-5) requested clarification on the input parameters for estimating air emissions from existing MSW landfills using the model "Landfill Air Emissions Estimation Model, Version 1.1" obtained from the EPA's CTC. The commenter (IV-L-5) inquired whether the CTC's version 1.1 model is identical to the model used to develop the data in the EXISCLOS data base.

Response: The CTC's Landfill Air Emissions Estimation Model (version 2.0, which is the most recent version) uses the same equation that is used to derive the landfill gas generation rate for the final rule. Version 2.0 of the CTC model has been revised to include the default values for k, L_o, and $C_{NM}OC$ used in the final rule. A copy of the air emissions estimation model (version 2.0) is available from the Control Technology Center.

2.4.3 Removal of Controls

Comment: One industry commenter (IV-D-27) disapproved of the proposed 3-step removal criteria for control systems. The commenter recommended the use of a single criteria for the removal of controls: a calculated NMOC emission rate less than the stringency level of 150 Mg/yr demonstrated two times within a 2-year period, not closer together than 12-months. Other commenters (IV-D-39, IV-D-48, IV-F-6) disapproved of the 15-year time limit for removal of collection and control systems. One commenter (IV-F-6) recommended that removal of controls be allowed as soon as the emission level falls below the designated rate.

One commenter (IV-D-48) disapproved of the 15-year time limit for operation of the gas collection and control system at Superfund sites. The commenter asserted that MSW Superfund sites have often been closed for 20 to 30 years before site investigation begins and a need for emission controls is discovered. The commenter contended that because of the relatively old age of Superfund sites, 15 years of gas collection would not give the marginal benefit to substantiate the operational costs. The commenter also argued that the operation and maintenance costs generally exceed capital costs, especially at Superfund sites, because the Btu content of the gas is often insufficient without the aid of costly auxiliary fuels. The commenter recommended that the removal of controls be determined on a site-by-site basis.

Another commenter (IV-D-39) asserted that data justifying the 15-year minimum operation time of a collection and control system is not provided and that the 15-year time period appears to be based on a perceived useful life for the LFG equipment. The commenter contended that their experience indicates that the useful life of gas collection equipment should be based on site specific conditions and attainment of the emission limitations. The commenter recommended that the proposed regulation be modified so that adjustments can be made to the gas collection system based on site-specific conditions, including cycling the system's operation, or closing the system down prior to 15 years of operation, as long as the facility does not exceed the "performance standard" (i.e., the regulatory cutoff).

Another commenter (IV-D-32), however, disagreed with the proposed provisions for the removal of controls after as few as 15 years of operation. The commenter supported a 30-year period instead, because the 15-year period was inconsistent with their State's post closure maintenance period for landfills.

Response: The 3-step removal criteria were selected to assure that all necessary requirements are met before collection equipment is removed. First, the landfill must no longer be accepting waste. This is necessary because landfill emissions continue to rise until after closure when waste is no longer being accepted. Second, testing in three successive periods must demonstrate that NMOC emissions are below the stringency level of 50 Mg per year. This will require testing at different times of the year, giving a more realistic representation of the NMOC emission rate. Moreover, testing LFG samples taken directly from the collection system is relatively inexpensive. Two testing periods would not as clearly describe the NMOC emission rate. Third, the collection and control system must have been in operation a minimum of 15 years. The 15-year control period was selected based on the expected equipment life of the major system components. It was determined that once the capital costs were paid and the emission rate fell below the regulatory emission rate cutoff, the cost of reducing emissions would be significantly lower relative to the cost for controlling emissions including capital costs. The SWANA submitted a survey of LFG collection systems (Docket No. A-88-09, Items No. IV-G-01, IV-G-03), indicating that equipment replacement varied from 5 to 30 years, with vertical well replacement ranging from 10 to 20 years, and a 30-year life span for overall recovery systems. Therefore, the EPA continues to consider the 15-year control period reasonable, given the additional emission reduction achieved for basic operating costs only.

Superfund sites, however, are typically not actively receiving waste. To be subject to either the NSPS or the EG, a Superfund site would have to have accepted MSW since November 8, 1987 and emit above the emission rate cutoff. Any landfill accepting waste since November 8, 1987, that continues to generate NMOC at 50 Mg/yr or greater will require a gas collection system under these regulations. In cases where a gas collection system is required under these regulations, emission rates are such that the marginal benefit of gas collection for 15 years would be similar to younger, closed landfills requiring gas collection. However, special situations at any site, Superfund or not, can be given special attention by the State in which the landfill is located.

Any State may require 30 years of gas collection instead of 15 years, independent of these regulations. The post-closure maintenance period mentioned by the commenter is a RCRA provision and the basis for the control period was determined under a separate program. It should be noted that MSW landfills are subject to any applicable requirements contained in rules developed under RCRA as well as the landfills NSPS and EG developed under the CAA.

2.5 SELECTION OF THE POLLUTANT TO BE REGULATED

Comment: Two commenters (IV-D-3, IV-D-6) argued that NMOC should not be classified as a surrogate for MSW landfill emissions because of insufficient data in characterizing NMOC (IV-D-6) and because NMOC should only be considered as a substitute for MSW landfill emissions and not as a surrogate (IV-D-3).

Response: The pollutant to be regulated, MSW landfill emissions, or LFG, is composed of methane, CO_2, and NMOC. The EPA selected NMOC as a surrogate for determination of control because NMOC includes those LFG constituents of most concern. The nature of the individual compounds commonly found in LFG and the health concerns they present are discussed in chapter 2 of the proposal BID. By controlling NMOC emissions, the non-NMOC constituents in LFG would also be controlled. By basing control on NMOC emission rates, the EPA is controlling the subset of landfills having MSW landfill emissions of greater concern. The EPA, therefore, considers the use of NMOC as a surrogate for MSW landfill emissions to be effective and appropriate.

Comment: Four commenters (IV-D-19, IV-D-27, IV-D-29, IV-D-33) addressed the pros and cons of methane as the designated pollutant. One commenter (IV-D-19) stated that methane should be the surrogate for LFG because control of methane would likely result in the control of NMOC as well. In addition, methane is easier than NMOC to test and monitor. Another commenter (IV-D-27) asserted that NMOC also contributes to ozone nonattainment and the greenhouse effect. The commenter suggested performing a complete evaluation of ongoing methane studies, such as those being done by AEERL, WCRP, and IGBP, prior to subjecting MSW landfills to any additional requirements.

An environmental group (IV-D-33) recommended that a separate standard be developed for methane. One commenter

(IV-D-27) noted that some of the arguments made in the preamble for not regulating methane could also be used as reasons not to regulate NMOC.

Two commenters (IV-D-25 and IV-F-4, IV-D-34) recommended that TOC be used as a surrogate instead of NMOC, since it would include NMOC as well as other MSW emissions, and would address the global warming, explosion, and fire hazard aspects of MSW emissions. Additionally, the commenters asserted that TOC is less variable, and sampling and analysis is much less costly. The commenters suggested that the EPA's sensitivity analysis be repeated to select TOC limits. Another commenter (IV-D-54) recommended that VOC be used as the surrogate for MSW landfill emissions instead of NMOC. Other commenters (IV-D-26, IV-D-27) also suggested adoption of an alternative method for determining applicability of controls and well-spacing using TOC as a methane surrogate. The commenters preferred this method because it will be easy to enforce.

Response: The EPA designated MSW landfill emissions as the pollutant to be regulated because it contains the various landfill air pollutants, including methane and NMOC, posing concern due to adverse health and welfare effects. The NMOC may contribute to ozone formation and odor problems. Some NMOC are known or suspected carcinogens, while other NMOC are known to cause noncancer health effects. Methane was also a concern, due to the potential it poses for explosions and fire and global climate change impacts.

The EPA decided not to determine control requirements based on the methane fraction of MSW landfill emissions because the NMOC surrogate is more effective than methane in addressing the broad range of concerns posed by MSW landfill emissions. The reduction of methane will, however, be a benefit of these regulations. (Additional methane considerations are discussed in section 2.18.1, Consideration of Methane.)

A TOC surrogate may track methane, one of the larger fractions of the MSW emission mixture more closely, but would not respond to varying NMOC levels as well as the NMOC surrogate, because of the dominance of methane. Therefore, a TOC surrogate would not allow the EPA to tailor the regulations to the overall environmental concerns of MSW landfill emissions. There has been considerable concern expressed about the toxicity of NMOC. Given the requirement to select BDT considering costs and other impacts, the EPA has chosen to base these regulations on an NMOC cutoff, to control the subset of landfills presenting the greater health concerns, rather than base these regulations on emissions of a more generic surrogate, such as TOC. In this way, the EPA was able to select BDT (based on a cost and impact analysis) addressing the landfills that present the greatest overall environmental concerns at this time.

Finally, the EPA does not agree that a TOC surrogate would be easier to enforce, because enforcement would depend on emission calculations, with opportunity for site-specific testing, whether TOC or NMOC provided the basis for control.

Comment: One commenter (IV-D-54) contended that the EPA changed the regulated pollutant from VOC to NMOC to force State air divisions to formulate plans to regulate landfill emissions using section 111(d) technology-oriented standards. The commenter also contended that this will subject these landfills to additional PSD review, which will consume valuable State resources.

Response: If the EPA had not established a significance level for MSW emissions for inclusion in 40 CFR 51 and 52, MSW landfills would be subject to PSD review whenever any increase in MSW landfill emissions occurred. The 45 Mg/yr (50 tons/yr) significance level for NMOC in the final rule is comparable in stringency to the 36 Mg/yr (40 tons/yr) significance level established for VOC. The EPA estimates VOC to account for approximately 70 percent of total NMOC from MSW landfills, but this percentage varies among landfills. Landfills with emission increases greater than 45 Mg/yr NMOC or greater than 36 Mg/yr VOC would be required to undergo PSD review. The PSD significance level for landfill emissions was changed from 36 Mg/yr (40 tons/yr) at proposal to 45 Mg/yr (50 tons/yr) to be more consistent with the previously established significance level for VOC. The EPA considers the significance value appropriate for the health and welfare effects of the MSW landfill emissions.

2.6 SELECTION OF BEST DEMONSTRATED TECHNOLOGY

Comment: One commenter (IV-D-15) requested that the stringency of the standards be increased, so that better technology could be incorporated. The commenter also maintained that BAT should be used in place of BDT to encourage continuing research in emissions control.

Response: These standards and emission guidelines are promulgated under section 111 of the CAA, which requires the standards be set based on the application of the BDT considering costs and any nonair quality health and environmental impacts and energy requirements, at the time the standard is promulgated. An NSPS establishes a nationwide minimum level of control, but it is based on the application of BDT. States do, however, have the freedom to set more stringent standards, whether through establishing a lower regulatory cutoff or requirements for a BACT-type analysis whenever a new or modified landfill is permitted. These regulations, however, must conform to the statutory framework for NSPS. Refer to section 2.6.2 for further discussion on the selection of the regulatory stringency level.

Comment: One commenter (IV-D-21) stated that the proposed regulations would discourage owners or operators from using alternative control devices, because all control devices except open flares would have to demonstrate compliance by testing. The commenter suggested that other control technologies, including energy recovery technologies, should be defined as BDT. The commenter requested that, at the very least, additional language and guidelines be added to the regulation to strongly endorse and encourage energy recovery.

Response: The regulation allows any control system designed and operated within the parameters demonstrated in the performance test to reduce NMOC by 98 weight-percent or reduction to 20 parts per million by volume. The preamble to the final rule defines combustion control achieving 98 percent reduction or 20 ppmv as BDT. The rules are not intended to encourage open flares instead of energy recovery devices. The regulation does not require testing of open flares because testing is infeasible. However, flares must be designed and operated according to specified criteria and visible emission determination is required by 40 CFR 60.18. Additional impacts analyses of energy recovery technologies were performed after proposal and the results have been incorporated in the preamble of the regulation. The nationwide impacts of flare and energy recovery options are detailed in the memorandum "Revised Nationwide Impacts for Development of Regulatory Alternatives" (Docket No. A-88-09, Item No. IV-M-7).

2.6.1 Selection of Best Demonstrated Technology--Passive Systems

Comment: One commenter (IV-D-29) requested that the regulation provide specific criteria and test methods that a passive venting system must meet to satisfy BDT. The commenter questioned why the EPA is allowing passive systems when it has stated in the 1988 Preliminary Draft BID that "gas captured in a passive system is not amenable to control or recovery."

Another industry commenter (IV-D-27) argued that passive systems can be designed to meet BDT, and provided a table cross-referencing previous submittals providing useful information on such systems.

One commenter (IV-D-17) stated that the EPA should demonstrate the relationship between passive and active collection systems. They further state that if a correlation exists, passive systems such as landfill vents could be used to predict the performance of, or need for, active collection systems.

Response: The EPA investigated the use of passive systems prior to proposal, and some design guidance was also provided in chapter 9 of the proposal BID. The EPA assumes that the 1988 preliminary draft BID commenter IV-D-29 referred to was an early draft that differs from the BID published at proposal in March 1991. Although the EPA found passive systems generally to be less practical and more expensive than active collection systems, such systems may achieve an equivalent level of control, provided that the landfill installs and carefully maintains a liner on all six sides of the landfill as required under subpart D, section 258.40 of the final solid waste disposal facility criteria regulation (56 FR 50978; October 9, 1991). The owner or operator would, however, need to submit a design plan that demonstrates that the system provides an equivalent amount of control to an active system meeting the criteria in § 60.759 of the NSPS. Section 63.752(b)(2)(ii)(B) includes criteria passive collection systems must satisfy and a requirement for a design plan. The relationship between passive and active systems would depend on site-specific landfill characteristics and system designs. Based on existing information, it is not practical to establish a correlation. A site-specific design approval approach is more appropriate.

2.6.2 Selection of the Emission Rate Cutoff

Comment: Several commenters requested a more stringent emission rate cutoff, while others favored the 150 Mg/yr rate proposed, and some favored a less stringent standard. Four commenters (IV-D-18, IV-D-25, IV-D-34, IV-D-44) supported the proposed regulatory emission rate cutoff of 150 Mg/yr. Some of these and other commenters (IV-D-15, IV-D-18, IV-D-20, IV-D-25, IV-D-27, IV-D-34) stated they would support a more stringent level. One of these commenters (IV-D-20) asserted that the data provided by the EPA supports a more stringent level, that this level would not significantly increase the control period, and that it would be cost-effective. Another commenter (IV-D-21) stated than an economic analysis including energy recovery would support a more stringent standard, and the regulatory cutoff level should be lowered.

Two commenters (IV-D-11, IV-D-33) supported a stringency level of 25 Mg/yr because of the methane reductions that would result. One of the commenters (IV-D-11) stated that such an emission level would reduce 90 percent of NMOC and 80 percent of methane emissions from MSW landfills. The other commenter (IV-D-33) presented an analysis to show that NMOC and methane reduction from landfills emitting above 25 Mg/yr NMOC is cost-effective, particularly if benefits from abatement of global warming and energy recovery are considered. One commenter (IV-L-7) recommended an emission rate cutoff of 25 Mg because only 10 percent of methane generated by landfills is being burned for energy recovery and the commenter wanted the rule to encourage the development and installation of energy recovery systems. Another commenter (IV-D-29) suggested examining a level between 25 Mg/yr and 150 Mg/yr. In particular, the commenter claimed that health risks posed by landfills between these two cutoff levels may be significant.

Another commenter (IV-D-39) stated that the BID and RIA for the proposal do not provide a clear rationale or cost effectiveness for the selection of a 150 Mg/yr NMOC emission limit. The commenter asserted that, because of the uncertainty in the actual benefits (i.e., health and environmental), an emission rate cutoff of 250 Mg/yr could have been justified. This commenter stated that the data necessary to adequately characterize the environmental benefits of the proposed regulation should be collected prior to setting an emission rate cutoff.

One industry commenter (IV-D-27 and IV-F-5) requested that the EPA fully reevaluate the 150 Mg/yr cutoff after correcting for a reported incorrect conversion factor and recalculating the defaults.

Response: Prior to proposal, the EPA considered setting a more stringent cutoff but concluded that the data available at that time best supported the 150 Mg/yr level. As explained in the proposal preamble, preliminary evaluations were performed on several different emission rate cutoffs, ranging from 25 to 500 Mg/yr. Three regulatory alternatives were then chosen for more rigorous review: 25 Mg/yr (Alternative 1), 150 Mg/yr (Alternative 2), and 250 Mg/yr (Alternative 3) NMOC. The alternatives provided the basis for the selection of BDT.

Based on consideration of the emission reduction estimated at proposal and other factors specified in section 111 including health and environmental impacts, energy, and cost, 150 Mg/yr of NMOC was proposed as the emission rate cutoff in these regulations (56 FR 24468, May 30, 1991).

As a result of the changes in the data and methodology for estimating emissions and costs for control of MSW landfill emissions, and in the response to the public comments, the regulatory alternatives and the estimates of the emission reductions and the control costs of alternative stringency levels were revised after proposal. The changes in the data and methodology for estimating emissions and costs are described in the memoranda "Methodology Used to Revise the Model Inputs in the Municipal Solid Waste Landfills Inputs Databases" (Docket No. A-88-09, Item No. IV-M-4) and "Changes to the Municipal Solid Waste Landfills Nationwide Impacts Program Since Proposal" (Docket No. A-88-09, Item No. IV-M-3), and were summarized in the supplemental notice of data availability in the Federal Register (58 FR 33790, June 21, 1993).

The proposal value of 150 Mg/yr is now estimated to affect less than 2 percent of the landfills, obtaining only 45 percent NMOC and 24 percent methane emission reduction with an average cost effectiveness of $800/Mg NMOC for new landfills and $750/Mg NMOC for existing landfills. Therefore, more stringent cutoffs were evaluated. At a cutoff of 50 Mg/yr, 5 percent of the landfills would install controls with an NMOC reduction of 53 percent and a methane reduction of 39 percent. The average cost effectiveness of this option is $1,200/Mg NMOC for new and existing landfills. The incremental cost effectiveness of going from a 150 Mg/yr cutoff level to a 50 Mg/yr cutoff level is $2,900/Mg for new landfills and $3,300 Mg for existing landfills. The incremental cost effectiveness of cutoffs lower than 50 Mg, or no cutoff would be unreasonable. Based on the revised impacts analyses and the criteria for setting NSPS under section 111, 50 Mg/yr of NMOC was chosen as the emission rate cutoff.

2.6.3 Requirements for Control Equipment

Comment: Two commenters (IV-D-27, IV-D-41) requested that testing requirements for enclosed flares be eliminated if their design specifications report at least a 98-percent destruction efficiency. One commenter (IV-D-41) stated that both open and enclosed flares can achieve 98 percent efficiency, while the other commenter (IV-D-27) provided additional emission information to demonstrate that enclosed flares, when properly designed and operated, can meet 98-percent destruction efficiency. Two industry commenters (IV-D-27, IV-F-6) opposed the provisions for emission sampling and testing for enclosed combustors (e.g., enclosed flares) arguing that these flares are more efficient than open flares, for which performance tests are not required. Another commenter (IV-D-39) contended that the same testing be required for all control devices, stating that it is not clear why performance tests are not required for open flares. Two commenters (IV-D-27 and IV-F-5, IV-D-39) also recommended that a performance standard for enclosed flares be developed to replace the testing requirements, while another commenter (IV-D-41) requested that the design guidelines include operating temperature, flow rate, and residence time for enclosed flares.

Two commenters (IV-D-19, IV-D-27) recommended that the EPA identify both open and enclosed flares as BDT, and allow owners and operators to choose between the two options. Another commenter (IV-D-29) stated that their State requires all new flares to be enclosed. The commenter suggested that the regulations require that previously-installed open flares be allowed to continue operation as long as they meet the stated requirements. The commenter also suggested basing the regulation on enclosed flares because they are more easily tested, are quieter than open flares, and have no visible light. Another commenter (IV-D-41) pointed out that open flares present a visual nuisance.

Response: The BDT for landfills is a collection system and a combustion device. The combustion control device must be capable of reducing NMOC emissions by 98 percent or to an outlet concentration of 20 ppmv, dry basis, as hexane, at 3 percent oxygen. Both open flares and enclosed combustion devices that achieve this performance level are BDT and can be used to meet the standards. Although performance testing is the norm under section 111, it is impractical to require testing of percent reduction from open flares, because outlet concentration is infeasible to measure. The EPA developed

40 CFR 60.18 to address this problem. The provisions for open flares in § 60.18 resulted from extensive testing by the EPA demonstrating that properly operated open flares achieve 98 percent destruction efficiency. This testing would, however, be too expensive for an individual owner or operator. On the other hand, the performance testing for enclosed flares and other enclosed combustion devices, is feasible. Thus, the EPA considers required testing to be warranted for enclosed flares consistent with the requirement for testing percent reduction for other enclosed combustion devices, such as incinerators.

States may impose additional requirements or restrictions on the types of control devices used to address local concerns such as noise and aesthetics. The fact that enclosed flares are quieter and less visible does not mean that they provide improved emission control over open flares.

Comment: One commenter (IV-D-37) requested that the EPA explore the possibility of including NO_X and CO limits in the standards in order to reduce ozone formation and improve air quality.

Response: The EPA appreciates the commenter's concern about NO_X and CO emissions from MSW landfills. In the development of these standards, however, there were insufficient data available for proposal of additional standards for control of NO_X and CO. Moreover, NO_X and CO concerns are addressed through the State Implementation Plans (SIPs). States having NO_X or CO concerns may address these pollutants both through their SIPs and through establishing more stringent standards for new sources under individual State regulations.

Comment: One commenter (IV-D-38) stated that enclosed combustors reaching the required 20 ppmvd of NMOC as hexane may, in some cases, only meet a destruction efficiency of

93 percent or less, instead of the 98-percent reduction of NMOC required in the proposed NSPS.

Response: The 20 ppmv alternative requirement to the 98-percent reduction of NMOC was established for the cases where the initial NMOC concentration in the collected gas at the combustor inlet is so low that demonstration of a 98-percent reduction would be infeasible. Thus, there are times when less than 98 percent reduction is achieved, but these are in cases where the inlet concentration is low and a higher percent reduction is difficult to achieve. The alternative is appropriate under the NSPS because technical feasibility, cost, and demonstrated level of performance are considered in the selection of BDT. While 98 percent reduction cannot be demonstrated for all gas streams, 20 ppmvd can be achieved.

Comment: Five commenters (IV-D-2, IV-D-18, IV-D-19, IV-D-27, IV-D-29) addressed some aspect of I.C. engines. One commenter (IV-D-18) agreed that if lean-burn I.C. engines are to be used in nonattainment areas, they should be capable of achieving a 98-percent destruction efficiency. One of the commenters (IV-D-29) reported that I.C. engines having permit conditions of 98-percent destruction efficiency had been installed at local landfills, but they had not yet received the compliance tests for review.

One commenter (IV-L-1) stated that the EPA should exclude I.C. engines from those control devices deemed to be BDT and adopt technology specific performance standards. The commenter (IV-L-1) noted studies on landfill gas control devices in Germany and Montgomery County, Maryland that reported the multipathway cancer risk associated with dioxin emissions for a 1,500 ton per day landfill using an I.C. engine were as much as 5×10^{-6}. The commenter (IV-L-1) stated that the risk for a landfill using a flare is 0.6×10^{-6}.

The commenter (IV-L-1) also stated that the California Air Resources Board (CARB) has calculated NO_X and CO emissions from a 1,500 ton per day landfill using an I.C. engine to be 379 and 452 tons per year, respectively. The commenter noted that these levels of emissions qualify these sources as major under both PSD and nonattainment area new source review regulations and that CARB has adopted rules limiting NO_X and CO emissions to 0.006 and 0.02 lb/MMBtu for any treatment system requiring 98 percent NMOC destruction.

Another commenter (IV-D-2) also did not support the use of I.C. engines as a control device, and stated that I.C. engines are not as efficient as other control devices and may add to the formation of carcinogens.

One industry commenter (IV-D-27) reported that leanburn I.C. engines are appropriate and capable of meeting the 98-percent destruction efficiency criteria on an average basis. The commenter noted that the reduced load periods reported as a concern in the preamble are unavoidable but infrequent, and would not threaten achieving 98 percent destruction on average. The commenter argued that lowering the 98-percent destruction efficiency requirement would only reduce the incentive for vendors to produce these engines with that level of efficiency.

Response: The EPA selected a 98-percent reduction as the level representing BDT for control because this is the level achievable by demonstrated technologies. The EPA has determined that this level is reasonable considering costs, energy, and other environmental impacts. Thus, the regulations will require all control devices to demonstrate 98 percent reduction or an outlet concentration of 20 ppmvd of NMOC, as hexane. Commenters have not provided data showing that a lower performance level is appropriate for I.C. engines.

Office of Research and Development (ORD) experts believe that conditions for dioxin formation are not favorable. There is very limited data available on this, and for studies such as the German and Maryland ones mentioned in the commenter, the data have low quality assurance. After a review of the information available, the EPA has determined that benefits of LFG reduction far outweigh the uncertain concerns of secondary pollutants generated. However, States that have concerns regarding the use of I.C. engines can specifically disallow them.

In the development of these standards, there were insufficient data available for proposal of additional standards for control of NO_x and CO. States having NO_x or CO concerns may address these pollutants both through their SIP and through establishing more stringent standards for new sources under individual State regulations.

Comment: One commenter (IV-L-6) was concerned that the EPA had not acknowledged the role that air pollution control costs for NO_x emissions, especially in ozone nonattainment areas, may play in the selection among flares, I.C. engines, and turbines as the least cost option for control. The commenter (IV-L-6) included NO_x emission information for flares, I.C. engines, and turbines. The commenter (IV-L-6) requested that the EPA make sure that control systems are not inappropriately subject to LAER and offset requirements pursuant to the CAA.

Response: There are numerous factors that affect a facility's decision on an appropriate control device for a given landfill: ability to sell energy from energy recovery devices, ability to switch control device during a landfills history, community attitudes, financial restrictions, age of the landfill, length of time control is necessary, attainment status, location, etc. The least cost analysis was performed on a nationwide basis as an indication of how many landfills might be able to use energy recovery as a savings on control costs. It was not meant to be a landfill specific analysis where all factors affecting the landfill were included. The facility will have to consider many factors when selecting the means of control for a given landfill including the attainment status of their area. If LAER and offset requirements are triggered by the emissions from the control device chosen, it is appropriate that these requirements be met. It should also be noted that controls added to comply with the landfills rule may, at the discretion of the State, qualify for the pollution control exemption from NSR.

Commenter: One commenter (IV-L-1) contended that additional impacts from the purification of landfill gas are not addressed in the proposed NSPS. The commenter contended that emissions associated with any treatment or regeneration of molecular sieves or other equipment employed to achieve purification; and the need to control water quality impacts from (a) the discharge of the blowdown and wastewaters from both the purification and regeneration steps and (b) the condensate removed from the gas collection systems should be considered.

Response: The rule does not specify the types of control devices that must be used, only that equipment achieve 98-percent reduction of NMOC or 20 ppmvd.

The nationwide impacts estimate considered the cost of a flare for each landfill, which did not require costs of purification. In the nationwide impacts estimate under the energy recovery scenario, costs were included for filtering the gas prior to an I.C. engine. The cost for handling condensate removed from the gas collection system was also included in the analysis; however, the rule does not specify handling methods or techniques.

For further information on comments received on the handling of gas condensate and the EPA's response see section 2.16.3 "Subtitle D Interface" of this chapter.

2.7 FORMAT OF THE STANDARD

Comment: One commenter (IV-D-37) stated that the format of their State regulation (California Model Regulation) for measuring emission rates and determining whether controls are required is simpler than the proposed regulation. In the State regulation, any site with greater than 500,000 tons of waste must install gas collection systems, unless the owner or operator can demonstrate there are only small amounts of surface emissions. The commenter suggested that no landfills having less than 500,000 tons of waste-in-place would ever be required to install controls under the proposed regulation anyway.

One commenter (IV-D-26) stated that it would be easier to use a total "tonnage in place" as a trigger to install active gas extraction systems as opposed to the tiered approach. The commenter contended that because of the conservative default values, the Tier 1 calculation becomes academic and the "tonnage in place" trigger would be a suitable alternative.

Response: The purpose of this regulation is to reduce MSW landfill emissions or LFG, the designated pollutant. Landfill gas is comprised of methane, CO_2, and NMOC, and emission rates of these compounds vary from landfill-to-landfill, even when refuse in place (RIP) is virtually identical.

Early in the development of these regulations, the EPA proposed to base applicability of controls for MSW landfills on RIP, and a RIP of 1 million Mg was selected. This format was presented at the NAPCTAC meeting in May 1988. Both NAPCTAC members and industry representatives advised that, size and/or RIP were not sufficient basis for determining that control or exemption from control is appropriate because of variability of emission levels from landfill to landfill. (See Docket No. A-88-09, Item No. II-B-15.)

As discussed in the proposal preamble under "Format for Applicability," the EPA found that the NMOC emission rate format achieved a greater emission reduction for lower costs than a RIP format. The proposed NSPS combined a design capacity exemption level of 100,000 Mg with an NMOC emission rate trigger for control. The design capacity exemption was reevaluated in the interim between proposal and promulgation after review of additional data regarding gas generation rates, and has been revised to 2.5 million Mg or 2.5 million m^3. The revised cutoff would exempt approximately 90 percent of landfills from the testing and recordkeeping required under the NSPS and EG, while only 15 percent of the potential NMOC emission reductions would be lost.

Comment: Eight commenters (IV-D-25, IV-D-26, IV-D-31, IV-D-34, IV-D-37, IV-D-39, IV-D-55, IV-F-4) supported a performance based standard. Some of these same commenters (IV-D-25, IV-D-26, IV-D-31, IV-D-34, IV-D-55) noted that generated MSW gas does not equal emitted gas and indicated the standard be based on measurement of gas emitted. One commenter (IV-D-31) suggested the use of flux box testing or monitoring concentrations of methane (as a surrogate for NMOC).

Four commenters (IV-D-25, IV-D-34, IV-F-4, IV-D-55) supported a performance standard based on TOC levels. The commenters further suggested that the performance standard be tailored after SCAQMD field monitoring based performance standards, which specify that the maximum concentration of methane at any point on the surface of the landfill cannot exceed 500 ppmv, and that the average concentration cannot exceed 50 ppmv. One commenter (IV-D-26) stated that the California approved surface testing methods should be allowed as a means to determine if controls are needed. Another commenter (IV-D-55) also contended that because there is no performance standard for the collection system, there is no requirement to confirm that the collection system is performing adequately. One commenter (IV-D-26) contended that the EPA monitoring method for subsurface measurement of NMOC is very costly and fails to focus on the true problem of surface emissions of LFG and NMOC.

One commenter (IV-D-37) discussed their State's performance-based regulation for reduction of NMOC. This regulation was based on actual landfill testing, which revealed that at least one of the 10 air contaminants present in LFG was found at 70 percent of landfills. Underground migration of methane was a problem at 20 percent of the sites. Their State regulation differs from the proposed standard in that it contains different provisions concerning which landfills should be controlled, collection efficiency, and its requirements for control system design, reporting, recordkeeping and compliance. The commenter noted that although the proposed regulations provide design flexibility and encourage States to allow flexibility, their State's regulation was simpler than the proposed standards.

Two commenters (IV-D-25, IV-D-34) asserted that the EPA had not met its statutory obligation to demonstrate that it is infeasible to set a performance standard prior to setting a design standard for control of landfill emissions. The commenter asserted that the performance-based SCAQMD landfill regulation achieves 90 percent TOC destruction efficiency and demonstrates that a performance standard is feasible.

One commenter (IV-D-39) suggested that a performance standard based on an emission limit be proposed for controlling air emissions at MSW landfills and that the method of achieving the emission limit should not be specifically addressed by the regulation. The commenter argued that by establishing very specific design, operational and work practice standards, the system will not function optimally and cannot incorporate innovation in design. The commenter said that an emission limit of 150 Mg/yr of NMOC alone will provide the same level of environmental protection as the combined design, equipment, and work practice standards, and allow designers of LFG systems the flexibility needed to optimize the design to fit the specific landfill situation.

The commenter also stated that the courts have expressed a clear preference for the development of emission standards as opposed to design, operational and work practice standards.

Another commenter (IV-D-55) noted that little if any NMOC passes through the soil and that most of the emission release points are through holes and channels. The commenter stated that with the notable exception of vinyl chloride and a few other trace compounds, the primary source of NMOC is the evaporative emissions of leachate. The commenter recommended that leachate exposure be prohibited anywhere on the surface of the landfill.

Response: A performance standard is not appropriate for gas collection system design because it is not feasible to measure gas generated versus gas collected at a landfill and determine what performance a collection system is achieving. Monitoring surface concentration alone also does not demonstrate what fraction of gas is being collected or whether the system is designed and performing optimally. However, monitoring surface concentrations will indicate when cover maintenance and well adjustments should be made as well as when additional wells should be added. Surface monitoring will also provide a safeguard against uncertainties in area of influence determinations. Surface emission monitoring is discussed in section 2.12.1 of this chapter.

Because a performance standard is not feasible, a design and operational standard has been set as BDT for gas collection system design. The specifications for active collection systems do not give prescriptive design specifications; rather, they present criteria on which to base a collection design plan. All owners or operators must submit their collection system design plan to the Administrator for approval. The purpose of collection and control equipment is to capture and control gas generated within the landfill. The collection system must be installed within 1-1/2 years of the design plan submittal or notification of intent to install. In addition to the criteria in § 60.759, the collection system must also meet the four criteria specified in § 60.752(b)(2)(ii), which states that: (1) the collection system design plan must be prepared by a professional engineer, and designed to handle the maximum expected gas flow rate over the intended equipment use period, (2) gas must be collected from all active areas in the landfill in which refuse is more than 5 years old, and from all closed areas (or areas at final grade) in which refuse is more than 2 years old, (3) gas must be collected at a sufficient extraction rate, and (4) the collection system must be designed to minimize off-site migration of subsurface gas.

As discussed in the preamble to the proposal (see 56 FR 24484; May 31, 1991), to establish an emission limit or performance standard for collection, the exact quantity of gas being generated by each area of the landfill would need to be quantified, and then the reductions achieved would need to be compared to it. This is technically infeasible. Estimates vary regarding the actual percentage of produced gas that can be collected, anywhere from 50 to 90 percent, but the EPA and industry alike recognize that these are only estimates. Therefore, design and operational standards were set for the collection system.

A performance standard was, however, set for the control device, because once the gas has been collected, the destruction efficiency of the control device can be established. Landfill owners or operators using the SCAQMD approach can submit designs to the State as provided in 40 CFR 60.752(b)(2) or 40 CFR 60.33c(b). The regulations allow the flexibility to use alternative gas collection and control systems as long as they are demonstrated to be as effective as a system designed to meet the criteria in § 60.759. [See 40 CFR 60.752(b)(2)(i)].

In response to commenters who indicated that gas emitted was not equal to gas generated, as explained in the proposal, the NSPS and emission guidelines address all of the MSW landfill emissions generated within the landfill, and not just those emitted through the cover. The NMOC can be emitted in several ways: through the landfill cover, through holes and channels, through evaporation of leachate, or through underground offsite migration through the soil. The EPA considers the primary source of NMOC emissions to result from transport and stripping by methane-laden gas as it migrates through the soil/refuse. Diffusion and displacement are also transport mechanisms that impact the NMOC emission rate. No matter how the NMOC migrates to the atmosphere, a well-designed gas collection system will minimize the potential for NMOC emissions with the most confidence.

The commenter (IV-D-55) did not provide documentation on the evaporative emissions from leachate and its contribution to NMOC emissions. Leachate on the landfill surface is addressed under RCRA.

2.8 NATIONWIDE IMPACTS

Comment: One commenter (IV-D-17) suggested that the proposed emission estimates may lack accuracy because of variations in the types of waste that landfills accept and the limited availability of records estimating the decomposable amounts of waste. A second commenter (IV-D-55) was concerned that the estimated potential reductions are overstated and are in conflict with CARB estimates, the EPA's own emissions inventory factors (Procedures for the Preparation of Emission Inventories for Precursors of Ozone, EPA-450/4-88-021, p. 4-31), and district field data. The commenter recommended that the calculated NMOC emission reductions should be confirmed and resolved with other conflicting emission estimates. The commenter also suggested that this data be published and submitted for public comment before the data is used.

Response: The nationwide impacts were developed using data from the OSW landfill survey, which provided information from a large number of landfills; information about NMOC concentration and methane generation from section 114 responses and industry submittals; and additional EPA studies. The information from the OSW survey consisted of landfill location, annual waste acceptance rate, refuse in place in 1987, age, depth and design capacity for 931 landfills. The information on NMOC concentration and methane generation used at proposal was randomly assigned to the landfills from the OSW survey because this information was not included in the survey. This additional information was randomly assigned in order to represent the variability reported by industry, and referred to by the first commenter.

In the interim between proposal and promulgation of these regulations, additional NMOC concentration and methane generation data were obtained, and the methodology for randomly assigning the data to the landfills from the OSW survey was revised. These changes are described in the memorandum "Methodology Used to Revise the Model Inputs in the Municipal Solid Waste Landfills Input Data Bases (Revised)" (Docket No. A-88-09, Item No. IV-M-4). The EPA considers the large database of landfills and the assignment of L_o and C_{NMOC} values to reasonably represent the variability among landfills in the U.S. This methodology best represents the variability reported for landfills. If an emission factor method had been used, variations in waste composition, age, landfill geography, etc., would have no opportunity to impact the results.

The NMOC emissions reductions were estimated by the EPA using a modification of the Scholl Canyon model and a range of NMOC values obtained from test data. Because of the change in emissions over time and the varying emission levels from landfill to landfill, nationwide emissions and emissions reductions are best described in terms of NPV. This approach accounts for the variations noted and presents the emissions on a normalized basis for comparison between different emission rate cutoffs. The emissions estimates calculated using the commenter's data would result in annual emissions, which cannot be compared to the net present value. Furthermore, the EPA's approach accounts for the emissions resulting from each subpart of mass at various ages, while the emission inventory factor is constant and would overestimate emissions when used with net present value calculations.

Comment: One commenter (IV-D-26) submitted test data on NMOC concentrations ranging from 300 to 7,500 ppmv.

Response: All values for which the EPA had adequate documentation were used in estimating national impacts of the NSPS and EG. Some of the NMOC concentrations submitted by commenter IV-D-26 were sufficiently documented to be included in the data bases. However, the NMOC concentrations for use in the nationwide impacts were reevaluated and assigned to the input data bases before the values provided by the commenter were received. The values submitted by commenter IV-D-26 fit within the revised range of NMOC concentrations used in developing the final nationwide impacts. The EPA determined that incorporating the NMOC concentrations provided by the commenter would not significantly change the estimated impacts of the regulations, and, therefore, additional resources were not expended to incorporate the additional concentrations into the data bases.

Comment: One commenter (IV-D-22) suggested that the EPA further investigate the effects of moisture on methane generation. The commenter proposed evaluating the effect capping with a geomembrane would have on the moisture content, as well as the methane generation rate.

Response: The EPA considered such variability in moisture content early in the development of these regulations. However, moisture content varies based on geography, topography, and even management practices, such as cover types and maintenance procedures. Although it is infeasible to incorporate all these site-specific factors in the model, the impacts of these factors would be accounted for if gas production testing were performed at the landfill, as in Method 2E, or NMOC concentration was measured, as in Method 25C. The EPA acknowledges that the use of a geomembrane or other effective cover will reduce moisture content to some degree. However, at this time the impact of the use of a geomembrane is unknown, and therefore, was not included in the model.

During the interim between proposal and promulgation of these regulations, the EPA incorporated location within an arid or nonarid region in the analysis. The site-specific methane generation data were categorized as arid or moist based on the location of the landfill from which the data were generated. The methane generation data were assigned to the input data bases in proportions to represent the amount of waste and the number of landfills located in arid and moist regions of the United States. This methodology is described in the memorandum "Methodology Used to Revise the Model Inputs in the Municipal Solid Waste Landfills Input Data Bases (Revised)" (Docket No. A-88-09, Item No. IV-M-4).

Comment: One industry commenter (IV-D-27) contended that the EPA overestimated the number of new MSW landfills opening in the first 5 years of the regulations, and that this number will be smaller because of the combined impact of the proposed regulations, new subtitle D regulations, transport restrictions, waste reduction and recycling programs, and the NIMBY syndrome. The commenter criticized the Agency assumption that existing landfills would be replaced with new landfills having similar characteristics as they closed, noting that the State of the art of landfill design, and growing State and Federal restrictions would result in "different" landfills.

Another commenter (IV-D-39 and IV-F-3) stated that more landfills will actually be affected than the EPA had stated, because there are now approximately 7,500 landfills instead of the 6,000 that the EPA reported to exist in 1987.

Response: The EPA is not certain that fewer landfills will be opened. It is precisely this inability to predict the exact characteristics of future landfills that led to the decision to model new landfills based on the current characteristics of landfills. If fewer landfills will be opened, these landfills may be larger, resulting in a lower costs per Mg of emission reduction.

To estimate the impacts of the regulation through 1997, the EPA modeled landfills opening after 1987 based on the population of landfills in 1987. The EPA estimates that approximately 7,440 landfills existed in 1992, which corresponds to the estimate of 7,500 provided by the commenter.

2.8.1 Cost Impacts

Comment: Several commenters (IV-D-39 and IV-F-3, IV-D-46, IV-D-55, IV-F-4) stated that the EPA underestimated costs for gas collection systems. One commenter (IV-F-4) contended that the underestimation resulted from the analysis being based on large landfills. The commenter asserted that the uncertain service life of system components may contribute to additional nationwide costs. Another commenter (IV-D-39 and IV-F-3) stated that the underestimation resulted from incomplete data. Other commenters (IV-D-55, IV-F-4) argued that the design specifications and proposed method for well spacing would increase the program costs without added benefit.

One commenter (IV-F-5) stated that the cost of many of the monitoring provisions, such as temperature indicators, flow indicators, heat sensing devices, pilot flame indicators, and wellhead pressure gauges, may be too burdensome.

One commenter (IV-D-53) stated that small landfills are experiencing financial hardships due to the increasing number of new landfill regulations. The commenter was opposed to any regulations that are extremely costly or technically unsound.

One commenter (IV-D-52) expressed concern for taxpayers who are constantly being asked to pay for new regulations. The commenter suggested that the proposed regulations should focus on using control methods already in practice at larger facilities.

Two commenters (IV-D-25, IV-D-34) reported that preliminary information from the SWANA survey of selected collection system owners and operators indicated that the EPA's cost projections were too low due to underestimating system capital and operational and maintenance costs. The commenters further argued that because the modeling assumptions result in inflated emission rates, the cost effectiveness of the standard is also skewed. One of the commenters (IV-D-25) noted that all of the data received in response to the survey would be reviewed and submitted for Agency review. (These surveys, along with a cost analysis, were submitted to the EPA and reviewed. See Response for details.)

Response: The cost impacts were determined using data from the OSW data base, section 114 responses, industry information voluntarily submitted over the course of regulatory development, and standard engineering sources. The collection system design for the proposed regulations was similar to systems in place at many landfill sites, and information on component design included data gathered both from collection system operators and vendors. The cost basis for the proposed regulations were presented in chapter 7 of the proposal BID. However, to provide flexibility and reduce costs, the EPA removed the prescriptive design specifications for gas collection systems and replaced them with design criteria. This allows owners and operators to design the most cost-effective gas collection system (meeting certain minimum requirements) for their landfill.

As stated in the proposal BID, the OSW data base, which made up the overall structure of the data base used for the cost impacts, included 151 large landfills and 780 small landfills. The EPA is satisfied that large landfills were not over represented.

Nationwide control costs were developed by designing and costing a control system for each landfill in the data base, and these costs were determined to be reasonable for most landfills which would require control at the proposed regulatory emission rate cutoffs. Also, the design capacity exemption was reevaluated in the interim between proposal and promulgation, and has been revised to 2.5 million Mg. Landfills with a design capacity less than 2.5 million Mg will not be affected by the final regulations. Therefore, small landfills will not be adversely impacted by the regulation.

Both collection and control system design and costing were developed with a high level of industry participation (see Docket A-88-09, categories II-C and II-D). The service lives of blowers, motors, turbines, and flares were considered in the proposal and promulgation cost impacts analysis. Consideration of I.C. engine and well service lives were added to the promulgation cost impacts analysis. The final cost analysis presents a reasonable estimation of cost impacts that are to be representative of both large and small landfills.

The monitoring provisions in the final standards are typical of monitoring provisions under the NSPS program for similar control equipment, and are necessary to ensure proper operation of the equipment, and to avoid fire or explosion hazard. However, since proposal the EPA has provided for the option of monitoring of bypass systems rather than monitoring flow to a control device. The use of flow indicators in bypass lines or the use of bypass systems with car-seals, lock and keys, or other configurations that provide a record of bypass system use may reduce the monitoring burden associated with the monitoring of flow to the control equipment. The EPA determined that the monitoring costs of the final regulations were reasonable and necessary to ensure proper operation of collection and control equipment.

The EPA received and reviewed the SWANA survey and associated cost analysis. The EPA cost numbers, at first review, appear lower than the survey results. However, the costs analyses presented in the proposal BID were based on equipment costs in 1987 dollars, several years before the SWANA survey was conducted. Also, the EPA cost impacts analysis at proposal was a rigorous two-stage time accounting of dollars in 1992 NPV. The SWANA cost analysis is a summation of dollars expressed in varying years. If the SWANA data were in a form which could be utilized in its nationwide impacts model, the results would not differ significantly.

The EPA considers that the information provided by respondents to the EPA's section 114 information requests was accurate, and was generally provided in direct response to specific questions. The SWANA survey was not conducted under such rigorous conditions or requirements, and consequently did not provide as specific a system or cost breakdown. Additionally, the SWANA costing survey compiled answers from only 13 actual landfill collection systems, managed by five individuals or organizations and, therefore, did not represent a large increase in information. However, The EPA did utilize the results of the SWANA survey wherever possible, such as in developing time frames for system component replacement.

Comment: One commenter (IV-L-3) maintained that cost information is readily available only from certain vendors and major gas system developers. The commenter (IV-L-3) was concerned that the cost information used in the development of the regulations is not representative, particularly for smaller developers. The commenter (IV-L-3) maintained that small developers will not enjoy economies of scale and recommended that the cost analysis account for varying economies of scale for equipment purchases and operation and maintenance services.

The commenter (IV-L-3) cited the EPA report, "Landfill Gas Energy Uses: Technology Options and Case Studies." The commenter (IV-L-3) stated that this report shows 1992 median I.C. engine costs of about $1,300 per kilowatt. The commenter (IV-L-3) also cited a George Jansen, of Laidlaw, report, "The Economics of Landfill Gas Projects in the United States" presented in Australia in February of 1992. The commenter (IV-L-3) stated that this report estimated I.C. engine system costs of $1,500 per kilowatt. The commenter (IV-L-3) contended that when the economy improves, the costs of installation for electrical projects may increase towards a value of $1,200 to $1,500 per kilowatt of installed capacity, not the $1,000 we see today. The commenter (IV-L-3) stated that the Jansen report has good cost insights which should be more representative of an average economy.

The commenter (IV-L-3) also listed other factors and obstacles that make capital and operations costs higher, including distance from transmission lines, difficulty in getting needed water, and difficulty with permitting. The commenter (IV-L-3) recommended that the EPA reexamine the various gas to energy implementation and operational costs.

Response: The cost figures were meant to be an average cost that could be applied to various energy recovery projects across the Nation, in order to develop nationwide cost estimates. It is true that small developers may have to pay a higher fee than larger developers, and some developers will pay a lower fee because of their location. The EPA does not contend that all developers will pay the same price, but does consider the costs applied to be average costs suitable for nationwide impacts estimates.

The costs that were used for I.C. engines were based on information from two I.C. engine vendors and a vendor-referred contractor. These vendors supply many of the I.C. engines used for landfill gas combustion. The calls collecting the data were made in early 1992. At this time, neither the EPA report or the George Jansen report were available to the EPA. The EPA used the best data available at the time. In addition, the I.C. engine cost used in the nationwide impacts analysis is still within the range of the I.C. engine costs predicted by the EPA report. The EPA report cites I.C. engine costs in the range of $1,000 to $2,500/kW with lower costs for smaller I.C. engines and used equipment.

The commenter also showed their agreement for the $1,000/kW figure by stating that the $1,000/kW is the price seen today, and that the cost of I.C. engines will increase to $1,200 to $1,500/kW when the economy improves. It is true that the costs may change with the change in economic factors, however, the purpose of this analysis was to acquire a reasonable estimate of cost and then determine the nationwide impacts. The effect of many factors on the operation and capital costs of control equipment cannot be predicted especially considering the schedule and resources available to the EPA. These factors include distance from transmission lines, availability of water resources, and permitting issues.

Comment: Two commenters (IV-D-21, IV-D-33) suggested that the cost analysis be revised to incorporate the role of energy recovery.

Response: In response to these and other comments indicating that the likely use of energy recovery should be incorporated in the nationwide impacts and analysis, the nationwide impacts were revised to include a more detailed review of energy recovery prior to promulgation of the final NSPS and EG. See section 2.8.3, Cost-Benefit Analysis, for a detailed discussion of the revised analysis.

Comment: One commenter (IV-L-7) objected to the EPA's decision to delete the 138 most profitable landfills from the nationwide impacts. The commenter (IV-L-7) contended that there is no basis on which to exclude the data on the best (most productive) landfills in a way that hurts the cost/benefit analysis of such regulatory measures. The commenter (IV-L-7) noted that information given in the memoranda, "Changes to the Municipal Solid Waste Landfills Nationwide Impacts Program Since Proposal," April 28, 1993, (Docket No. A-88-09, Item No. IV-M-3) and "Landfill Rule Energy Recovery Cost Analysis," December 16, 1992, (Docket No. A-88-09, Item No. IV-M-2) indicated that many sites will not install energy recovery equipment in absence of these rules; and that new landfill rules in California have caused many sites to install energy recovery equipment in order to comply with the new rule. The commenter (IV-L-7) stated that these rules will force the development of new technologies and landfill gas recovery vendor services that will transform the market, which will decrease up front installation costs and increase efficiency.

Response: The EPA agrees with the commenter that the landfill gas market will be transformed by new rules forcing the development of new technologies and landfill gas recovery vendor services. This was a main reason the least cost analysis option was developed; in order for the standard to "take credit" for the positive changes to the landfill gas market and the increased use of energy recovery technology which the standard will generate. There are several site-specific reasons that influence the choice of whether to recover energy: financial limitations (there is a large initial investment), ability to sell the energy, the risk factor (it is difficult to predict the productivity of a landfill), etc. The standard should influence these factors and make it favorable for landfill owners or operators to choose energy recovery. However, there are landfills that have energy recovery systems and some future landfills that will potentially have energy recovery systems in the absence of this standard. The adjustment of deleting the 138 landfills was made so as not to "take credit" for those landfills that would recover energy from landfill gas without the influence of this standard. The 138 landfills estimated to install control in the absence of the standard is based on past numbers of landfills installing energy recovery and projecting into the future. More information may be found in the memorandum "Landfill Rule Energy Recovery Cost Analysis," December 16, 1992 (Docket No. A-88-09, Item No. IV-M-2).

As this commenter has stated, when the NSPS and EG go into affect it is likely that more landfills will choose energy recovery which will have an affect on the market and the up front installation costs. However, the nationwide impacts are correctly based on current information. The CAA requires periodic reviews of NSPS. Advances in energy recovery may be considered in the periodic reviews of this NSPS.

2.8.2 Secondary Air Impacts

Comment: One commenter (IV-D-20) suggested that the EPA has not thoroughly assessed secondary air pollutant emissions impacts from open flares. The commenter questioned whether open flare control devices are BDT and stated that the proposal BID contains little information on secondary air pollutant emissions from open flares. The commenter recommended that enclosed flares be chosen as BDT if further evaluation demonstrates that open flares have higher levels of secondary air emissions than enclosed flares.

Another commenter (IV-D-17) recommended that the occurrence of PICs from open flares be addressed (references to combustion data were included). The commenter stated that PCDD might be produced by combustion of NMOC, and suggested that the occurrence or lack of occurrence of PCDD must be addressed before combustion can be classified as BDT.

The commenter (IV-D-17) indicated that flare combustion analysis should be required and should incorporate the percent of chlorine in LFG, flare operating conditions (i.e., temperature, residence time, POHC, PIC (PCDD/PCDF, etc.), and risk assessment. For risk assessment, the commenter indicated that the normalized distribution for an emissions source of 1 gram/sec with a dilution factor of 1 to 10 km should be supplied.

Response: Open flares have already been established as an appropriate control technology under section 111. Open flares are suitable for LFG if they meet the provisions under 40 CFR 60.18, as discussed under section 2.6.3. The EPA knows of no data that indicates that open flares have higher secondary emissions than other combustion devices.

The EPA has already determined under previous projects that flares operated according to section 40 CFR 60.18 will achieve greater than 98 percent organics destruction. The available data considered by the EPA, while indicating the presence of PCDD precursors in landfill gas, does not indicate PCDD precursors after combustion in flares.

Comment: One commenter (IV-D-50) said that the proposed regulation appears to underestimate secondary emissions from LFG combustion, and challenged the assumption that LFG-generated electricity would likely replace coal-fired generation. The commenter cautioned that previous EPA studies showed that energy recovery systems can result in a more expensive and less efficient source of energy due to higher secondary air emissions from energy recovery systems fueled with LFG and reduced thermal efficiency compared to natural gas-fired generation.

Response: The EPA assumes that market forces govern the purchase of LFG-generated electricity. The proposal BID discussion of secondary impacts assumed that a utility purchasing LFG-generated electricity would replace the most expensive electricity being purchased, which, at that time was usually coal-fired, not natural gas-fired, generation. Since coal-fired generation is more costly and has greater secondary air impacts than LFG generation, LFG-generated electricity would reduce secondary air impacts from electricity generation. The EPA reviewed the references provided by the commenter, but found no data included specific to LFG. It must be noted that no quantitative adjustment to the secondary air impact tables in chapter 6.0 of the proposal BID was made. The EPA made only a qualitative judgment about secondary air impacts of LFG-versus coal-generated electricity. Information on LFG-generated electricity programs and the estimated impacts of the LFG-versus coal-generated electricity is presented in the memorandum "Analysis on Landfill Gas Utilization of the Soon-to-be Promulgated Clean Air Act

Regulations for Municipal Solid Waste Landfills" (Docket No. A-88-09, Item No. IV-B-5).

Comment: One commenter (IV-D-19) noted that turbines, boilers, and I.C. engines tend to have much higher NO_X emissions than flares. In addition, I.C. engines have higher CO emissions, while boilers and turbines have lower CO emissions than flares.

Response: The goal of the regulation is to reduce the amount of LFG emitted to the atmosphere. If a State has specific concerns regarding NO_X or CO, they may implement additional or more stringent regulations to address these concerns.

The EPA data does indicate greater NO_X emissions from turbines, boilers, and I.C. engines than flares. However, this fact may be offset by the fact that these devices can recover energy from LFG. Energy recovery will have benefits of conserving the nation's supply of nonrenewable energy resources and will decrease pollution from the energy generation displaced by the use of these devices. These benefits are discussed in chapter 6 of the proposal BID, as well as in the proposal preamble (56 FR 24498; May 30, 1991).

2.8.3 Cost-Benefit Analysis

Comment: One commenter (IV-F-6) questioned whether the costs of the regulation are equal to the health improvements. The commenter claimed that there has been no analysis of potential benefits of the regulation and that only the threshold levels and control options have been considered in the rulemaking. Another commenter (IV-D-39) asserted that sufficient justification for the standards has not been provided on the basis of cost effectiveness and environmental benefits. A third commenter (IV-F-3) said that the data used in the RIA concerning the cost effectiveness and environmental benefits of the regulation were incomplete.

Response: Section 111(b) of the CAA addresses categories of sources which cause, or contribute significantly to air pollution, which may reasonably be anticipated to endanger public health or welfare. The NSPS are technology-based, rather than risk-based, standards. As stated in the preamble under this NSPS, MSW landfill emissions must be controlled to the level achievable by BDT, considering costs and any nonair quality health and environmental impacts and energy requirements. The NSPS are not primarily concerned with quantifying health improvements, as are NESHAP.

As explained in the preamble, the BDT was selected based on consideration of the costs and emissions reduction achieved by the regulatory alternatives as provided in section 111(b) of the CAA.

Comment: One commenter (IV-D-36) stressed that the high costs incurred from addressing the small percentage of methane emissions derived from MSW landfills were not justified. Another commenter (IV-D-11) indicated that public utilities should excuse methane generated fuel cell power from least-cost regulations because of the social benefits gained from this clean fuel source.

Response: The selection of the NSPS and EG was not determined by the cost of methane reduction. Methane reduction was considered as an ancillary benefit. Nationwide annualized costs were estimated for new and existing MSW landfills to be approximately $4 and $90 million, respectively. The average cost effectiveness of the NSPS and EG are $1,200 per Mg of NMOC emission reduction. The incremental cost effectiveness of going from a 150 Mg/yr emission rate cutoff to a 50 Mg/yr cutoff is $2,900/Mg for new landfills and $3,300/Mg for existing landfills. The standards address MSW landfill emissions in a cost effective manner.

The EPA is investigating fuel cells; however, the investigation is not complete to incorporate at this time.

Additionally, the decision to require public utilities to deal with fuel-cell generated methane in a prescribed manner is beyond section 111 Authority.

Comment: One commenter (IV-D-50) noted that the proposal BID lacks correct information regarding costs of energy recovery systems because it does not include discussion of a backup flare system and system availability and reliability.

Response: The cost impacts of these regulations were calculated based on the use of flares and on the use of least cost devices (including energy recovery). Although the EPA is aware that many operators do maintain backup flares on site, they are not required in the NSPS and EG. Operators may determine on a site-specific basis whether to install a back-up device. In many cases control devices may be reliable enough that a back-up is not needed, especially considering that the NSPS emission standards do not apply during periods of malfunction. Additionally, when a backup flare is installed, it would likely last indefinitely and contribute relatively little to the overall cost of compliance with the standard.

In regard to system availability and reliability, the proposal BID did not attempt to provide exhaustive information regarding energy recovery systems, specifically because of the site-specific nature of factors influencing energy recovery selection decisions. The proposal BID and subsequent analyses reasonably represent energy recovery system costs, however these costs are greatly affected by site-specific factors, which are best addressed by the MSW landfill owner or operator when the use of energy recovery is considered.

2.9 MONITORING AND TESTING

2.9.1 Monitoring

Comment: One commenter (IV-L-1) recommended that the NSPS require the measurement of landfill gas emissions from collection systems and/or control devices on a real time basis using continuous emissions monitoring instrumentation rather than annually performing manual measurements such as Method 25C.

Response: In selecting measurement methods for measuring LFG emissions, the EPA selected methods that were simple, yet would provide information adequate for establishing compliance. Other methods may be used if they have been approved by the Administrator.

The final rule also requires surface emission monitoring of landfills on a quarterly basis to confirm correct system operation. Surface emission monitoring will ensure that landfill gas control systems are operating adequately and that no significant emissions are escaping from the landfill surface. For control devices, continuous monitoring of operating parameters is required. The EPA will not require continuous emissions monitoring instrumentation when other less expensive methods are available that are appropriate for establishing compliance.

Comment: Two commenters (IV-D-27, IV-D-39) asserted that the requirement to monitor residence time during the initial performance test cannot be met, because residence times for control devices can only be calculated and cannot be monitored.

Response: The compliance provisions of the final NSPS (§ 60.755) are based on typical section 111 provisions for open flares and enclosed combustion devices. The intent of this section of the regulation is to require that residence time be determined during the initial performance test for enclosed combustion devices. The final regulation was changed to reflect that residence time should be determined in conjunction with gas flow measurements and temperature rather than "monitored." After the initial performance test, the NSPS only requires that temperature be recorded with equipment calibrated, maintained, and operated according to the manufacturer's specifications. Flow to the control device must be monitored, or else bypass line flow can be monitored or bypass lines can be sealed to prevent bypass.

Comment: Two industry commenters (IV-D-27, IV-D-39) recommended that monitoring temperature not be limited to Celsius units of measure, since most devices are provided with Fahrenheit units.

Response: Current policy is to use metric units in reporting; however, this does not preclude measuring in English units. The following equation can be used for converting degrees Fahrenheit to degrees Celsius: $^{o}C = (^{o}F - 32)/1.8$.

Comment: One industry commenter (IV-D-27) suggested that the provisions for monitoring temperature at enclosed flares be changed to require monitoring "at least every 15 minutes" rather than "every 15 minutes" to increase flexibility in how this requirement is met.

One commenter (IV-D-39) asserted that requiring a flow indicator that provides a record of gas flow at intervals of every 15 minutes is an unnecessary and expensive method to collect the required data. The commenter recommended that this requirement be replaced with the requirement that the owner or operator simply record flow at 15 minute intervals, which would allow for other methods of obtaining the data without requiring a specific type of equipment.

Response: The provisions for monitoring temperature of an enclosed combustion device have been revised. The final provisions require a temperature monitoring device equipped with a continuous recorder and having an accuracy of $\pm$ 1 percent of the temperature being measured expressed in degrees Celsius or $\pm$ 0.5°C whichever is greater. Records must be made at least every 15 minutes. Also, the requirement of using a flow indicator that provides a record of gas flow at intervals of every 15 minutes has been changed to requiring a gas flow measuring device that provides a measurement of gas flow to, or bypass of, the control device. If gas flow is monitored, the gas flow rate must be recorded at least every 15 minutes. Alternatively, a bypass system that has either a car-seal, lock and key, or other device that reveals if the bypass system has been used can be installed instead of monitoring flow.

Comment: Two commenters (IV-D-26 and IV-F-6, IV-D-27) recommended that the flare flame rather than the pilot flame be monitored to verify that the flare is operating at all times. One of the commenters (IV-F-6) stated that MSW landfills that have flares typically use intermittent pilots to conserve propane. The commenter stated that continuous pilots are costly, inefficient, and unsafe. One of the commenters (IV-D-27) opposed the stringent provisions for monitoring flow to the flare or other control device, reporting that such equipment could cost from $4,000 to $12,000. The commenter proposed that a monthly measure of flow at the flare using various devices (e.g., pitot tube, orifice plate, etc.), along with continuous flame temperature monitoring, would be sufficient to catch any major changes in flow.

Response: The monitoring provisions of § 60.756 were revised to allow for continuous monitoring of flow to the flare pilot flame or the flare flame itself. An intermittent pilot would not meet this requirement because it could not be continuously monitored. If direct monitoring of the flare flame is not feasible because the temperature of the flare flame is too high and will cause the thermocouple of the monitoring device to burn out more quickly than if the pilot is monitored, the source may chose to monitor the pilot flame. The requirement to monitor flow to the flare or other control device at least every 15 minutes was intended to ensure that the collected landfill gas is being conveyed to a flare, or other suitable control device, rather than being discharged to the atmosphere. The regulation has been changed since proposal to allow the alternatives of monitoring flow in each bypass line, or sealing bypass lines with car-seals or lock and key configurations that prevent bypass and reveal whether bypass has occurred. This will allow flexibility and reduce costs. Other comments and responses pertaining to open flames are contained in 2.8.2 of this chapter.

2.9.2 Nitrogen Monitoring

Comment: Many commenters (IV-D-7, IV-D-26 and IV-F-6, IV-D-27, IV-D-35, IV-D-39, IV-D-55, IV-F-4, IV-L-5) contended that the 1 percent N_2 limit in the proposed standard is unrealistic, and that levels of 11 (IV-D-35), 12 (IV-D-27), 20 to 25 (IV-D-26 and IV-F-6) and no less than 6 percent (IV-D-39) are more appropriate. One commenter (IV-D-39) also reported that successful operation has been shown at levels as high as 20 percent. Three of the commenters (IV-D-7, IV-D-25 and IV-F-4, IV-D-34) recommended dropping the N_2 limit altogether. Two commenters (IV-D-25 and IV-F-4, IV-D-34) stated that the requirement restricts operators in maximizing vacuum levels. One commenter (IV-D-7) stated that setting the limit based on combustibility had no engineering basis. Another commenter (IV-D-39) also asserted that the 2 percent N_2 limit in the collection header is too stringent.

Several commenters (IV-D-26, IV-D-35, IV-D-39, IV-D-55) discussed the N_2 content of landfills. The commenters stated that N_2 levels of 7 to 8 percent (IV-D-35), 5 percent (IV-D-39, IV-D-55) and between 1 and 4 percent (IV-D-26) are common. One commenter (IV-D-55) stated that Figure 3-3 of the proposal BID indicates that the N_2 content of landfills levels out at 5 percent. Another commenter (IV-D-39) referenced a document by EMCON Associates, "Methane Generation and Recovery from Landfills", as the source for the 5 percent N_2 level. The commenter also reported that the EMCON Associates document states that N_2 is expected to peak just after placement of refuse, and will then fall dramatically as the refuse begins to decay to the 5-percent steady state level. The commenters stated that the N_2 content was due to trapped air buried at the time of filling the landfill (IV-D-26) and/or is released from the refuse (IV-D-39). Another commenter (IV-D-3) suggested that it would be difficult to determine if the N_2 came from buried nitrogen or improper sampling.

One commenter (IV-D-39) suggested the EPA develop a method to calculate NMOC corrected to a standard value of N_2, if the EPA is concerned that excessive air intrusion will cause a false measurement of NMOC in the LFG. The commenter (IV-D-39) asserted that this N_2 is released from the refuse and is not a result of air intrusion.

Another commenter (IV-F-6) suggested that well temperature and percent methane, should be used as the infiltration indicator, instead of difficult and expensive N_2 measurement techniques.

One of the commenters (IV-D-27) approved of the 1 percent N_2 limit in Method 2E while performing gas generation rate testing, but said that 12 percent is more appropriate for operating gas collection systems. The commenter noted that it is only above 12 percent that methanogenic bacteria become dormant. Another commenter (IV-D-39) asserted that a small amount of air intrusion (less than 3 percent) does not significantly reduce methane quality, nor does it cause subsurface fires.

One commenter (IV-D-29) suggested that the regulation allow landfill operators a choice between portable O_2 monitors or Method 3C in order to detect infiltration in the header system. The commenter reported experience using portable O_2 monitors and noted that they give instantaneous readings, whereas Method 3C often requires laboratory testing. In addition, the commenter requested that either O_2 or N_2 be allowed for use in the detection of header system leaks. The commenter suggested that the requirement be revised to a maximum of 3.5 percent O_2 content in the header system, based on experience with LFG containing an O_2 content between 0.5 and 3.5 percent without any adverse problems.

Two commenters (IV-D-30, IV-D-39) stated that there are simpler methods for leak detection. Another commenter (IV-D-27) suggested that the EPA establish alternative methods for monitoring air intrusion because N_2 testing is so expensive. The commenter reported costs of $150 per well per month. The commenter recommended a number of options for determining air infiltration, including: (1) deviations around a stabilized air N_2 level, (2) deviations (10° C) around a stabilized temperature at the wellhead, and (3) surface-integrated measurement.

Response: In Method 2E as well as daily operation, the N_2 concentration in the extracted LFG is important because it indicates whether the maximum vacuum achievable without air infiltration is being obtained from the landfill. The N_2 limit is provided as a safety measure to avoid fires and explosions that may result from pulling too much air into the landfill, and to avoid altering the anaerobic state of the landfill. For compliance purposes, the main concern is that the system is pulling at maximum capacity up to the point of infiltration. The 1 percent value was based on previous comments received from industry, which were misunderstood in establishing 1 percent as a limit, when in reality, the sources were using the 1 percent as a target. The reason N_2 concentration was being restricted at proposal instead of O_2 is that the portable O_2 meters were unable to measure O_2 to the low levels necessary, and that O_2 may be consumed and not detected.

The monitoring provisions of the final NSPS have been revised after consideration of the comments. The N_2 limit during operation of the collection system at the wellhead has been increased to a level less than or equal to 20 percent as determined by Method 3C. Because the N_2 concentration limit was raised, it is now also feasible for sources to monitor O_2 to indicate the maximum vacuum achievable without air infiltration. Therefore, a provision allowing for an O_2 limit of 5 percent as indicated by an oxygen meter calibrated according to Method 3A of Appendix A of 40 CFR 60 has been added to the final rules. In addition, a provision has been added to require the operation of the collection system with a landfill gas temperature of less than 55°C (or the maximum established value) demonstrated under § 60.753(c). The final provisions require monthly monitoring of these parameters.

The N_2 limit in Method 2E has also been increased to 20 percent. If a sample is found to contain more than 20 percent N_2 in Method 25C, then that sample should be removed from the collection. The equation for calculating the concentration of NMOC in Method 25C has also been revised to correct the NMOC concentration in the LFG sample to zero percent N_2.

As mentioned above, a provision has been added to the final rule requiring the temperature to be maintained at less than 55° (or higher site-specific established value) at each well. If the LFG temperature at the wellhead increases above the temperature threshold, the new provisions require an adjustment of the vacuum to reduce the temperature. The value of 55° C was cited by industry experts as an alert temperature that may indicate a problem. Since temperature variability exists between landfills and between wells within a landfill, the provisions to establish higher operating temperatures at individual wells has been added. A higher temperature limit will be allowed if the owner or operator can demonstrate with supporting data that the higher temperatures do not cause fires or adversely affect the anaerobic decomposition of the waste.

Comment: One commenter (IV-D-26) contended that maintaining an O_2 level in a flowing LFG stream below 1 percent is unreasonable, unnecessary and also not cost effective. The commenter asserted that more sensitive and accurate well adjustments are made from temperature, percent methane, amount of vacuum, and flow volume. The commenter stated that intruded O_2 would be stripped off by the landfill, and that temperature and percent methane would be immediately affected by both intruded air and direct leaks into the system.

The commenter further recommended that no O_2 limitations for individual wells be set, and that an O_2 level of 8 percent in the main header would be appropriate.

Response: The EPA is assuming that this commenter was referring to N_2 instead of O_2 (see above response) or that the commenter was commenting from a previous version that discussed air intrusion testing, which differs from the proposed regulation. The commenter did not provide details concerning how temperature, percent methane, amount of vacuum, and flow volume could be used to determine appropriate adjustments. The proposed regulations required monitoring of N_2 to control air intrusion. Changes to the final regulation addressing air intrusion were discussed in the response to the previous comment.

2.10 MODELING

Comment: Two commenters (IV-D-30, IV-D-39) stated that the use of the first-order gas rate generation model in Method 2E was not backed up by evidence which shows it to be more accurate than other available models. The commenters asserted that this discourages the development of more accurate models, and cited the modeling discussed in the

December 1989 ASCE Environmental Engineering Journal as examples of models under development.

Three commenters (IV-D-46, IV-D-49, IV-F-4) argued that the EPA LFG emission models overestimate the effects and amount of LFG produced, resulting in the installation of control systems that are larger than necessary. The commenters suggested using methods and technology currently in practice at landfills.

One commenter (IV-D-55) argued that the EPA has no data to support the use of their model equation. The commenter asserted that the model equation is based on the premise that the LFG generation rate is solely a function of age and the amount of refuse. The commenter stated that LFG generation rates are highly dependent upon fluctuating moisture content of the refuse, and, therefore, there is no such thing as a "gas generation rate constant" that only needs to be calculated once. The commenter further argued that the NMOC emissions mechanism is not described by the Scholl Canyon model, and encouraged the elimination of the use of mathematical formulas for applicability of controls.

Another commenter (IV-D-45) stated that because of the health effects of NMOC, testing should be performed to determine NMOC emission rates rather than relying on estimates of NMOC emissions.

Another commenter (IV-D-17) stated that the final results of the model, although based on sophisticated formulae, may be inaccurate because of the quality of background data.

Response: Although the EPA acknowledges that other models may be in use or under development, the Scholl Canyon based model used within these regulations was chosen because it is both simplistic and adequate for purposes of estimating LFG emissions. The model was submitted to industry for review at frequent intervals throughout its development (see Docket A-88-09 subcategory II-C for Agency submittals and subcategory II-D for industry and vendor responses). The EPA considers it adequate and effective for purposes of these standards. Actual landfill gas emissions data were collected and compared to emissions estimates using the model. The actual emissions and the modeled estimates correlated satisfactorily (see Docket A-88-09, Item No. IV-A-1).

In the interim between proposal and promulgation of the regulation the EPA obtained site-specific gas generation data characterizing landfill emissions from both arid and moist regions of the United States. The data were applied to the input data bases proportionally, to account for the effect of moisture on gas generation. This data and the methodology used to assign it to the input data bases is described in the memorandum "Methodology Used to Revise the Model Inputs in the Municipal Solid Waste Landfills Input Data Bases" (Docket No A-88-09, Item No. IV-M-4).

While the model is used to select the regulatory cutoff, the NSPS allows site-specific data to be used to improve the resulting NMOC emission rate upon which the applicability of controls depends. As commenter IV-D-55 noted, the Scholl Canyon model does not describe NMOC emission mechanisms; rather it describes methane generation. In the tier system, if the Tier 1 NMOC emissions estimates are above the regulatory cutoff, the owner or operator may elect to sample for a site-specific NMOC concentration to improve the NMOC emission rate estimation. If the resulting NMOC emission rate is still above the regulatory cutoff, the owner or operator may also perform gas flow testing to obtain a site-specific k, for use in the emission rate calculation.

These options improve the applicability of the model to the individual landfill. The gas flow testing, if performed, can also be used to determine a site-specific area of influence for use in determining system design. (See section 2.12, "Design Specifications," for discussion of system design.)

The EPA understands that the tier default values have been misused (e.g., emission inventories, control system design, etc.). The default values should only be used for applicability of the regulations. They were selected to be used as a screening tool to determine applicability of the control requirements of the regulations. They should not be used to estimate emissions for inventories or control equipment design.

Comment: One commenter (IV-D-32) discussed various aspects of the equations used in calculating the NMOC emission rate using default information in § 60.753 of the proposed regulation. The commenter stated that the proposal BID and regulation did not clearly describe how the values M and R were derived, and recommended either the BID be made consistent with the regulation or the definition for R and M exclude discussion of nondegradable waste. In addition, the commenter requested that the variable C_{NMOC}, which is defined differently in two equations, be used in a clear and consistent manner. The commenter noted that the equation in § 60.753(a)(1)(ii) of the proposed regulation differs from the equation on page 9-6 of the proposal BID in that the time since closure (c) does not always equal zero and e^{-ck} does not always equal one.

The commenter reported that the regulation does not clearly state what value should be used for the NMOC concentration, and that § 60.753(a)(2) refers to the calculated emission rate of NMOC, not to the NMOC concentration. The commenter also suggested that it is unclear whether the annual emissions rate is determined using the 8,000 ppmv default value for NMOC concentration or using the site-specific value calculated via § 60.753(a)(3) along with the site-specific k value. Lastly, the commenter requested clarification of how frequently the NMOC concentration should be revised.

Response: The definition of C_{NMOC} is the same in all equations. "As hexane" was inadvertently left off one of the definitions, and has been corrected in the final regulation. The equation in § 60.753(a)(1)(ii) of the proposed NSPS is for new landfills opening after May 31, 1991. It was assumed that new landfills will not be closed by promulgation of this regulation, in which case e^{-kc} is equal to one. However, this section is referred to by the EG in § 60.34c, which may require calculation of an NMOC emission rate after landfill closure. Therefore, the equations in § 60.754(a)(1) of the renumbered final NSPS have been changed to include the closure term e^{-kc}. The use of default or site-specific values, when calculating the NMOC emission rate, depends on what tier the owner or operator is in at the time. The Tier system should be viewed as a step system with Tier 1 being the first step. A diagram of the entire tier system was provided in figure 1, Overall Three-Tiered Approach for Determination of Control Requirements, in the proposal preamble. Section 60.754(a)(1) of the final renumbered NSPS specifies that 4,000 ppmv as hexane be used for calculating the mass emission rate of NMOC (M_{NMOC}). Paragraph (a)(2) correctly refers to the calculated M_{NMOC} when comparing it to the 50 Mg/yr standard. This process is referred to as Tier 1, where default values are used to calculate M_{NMOC} and then compared to 50 Mg/yr. Tier 2 incorporates a site specific NMOC concentration and is described in § 60.754(a)(3). Tier 2 would only be used if the M_{NMOC} as calculated in Tier 1 is greater than 50 Mg/yr. If the M_{NMOC} calculated in Tier 2 is greater than 50 Mg/yr, the owner or operator can elect to install controls or use Tier 3, which is described in § 60.754(a)(4). Section 60.754(a)(4) has been revised to specify that both the site-specific NMOC concentration and site-specific methane generation constant (k) be used in Tier 3.

Tier 2 requires that a site-specific NMOC concentration be determined from a number of surface locations at a landfill. Many commenters stated that the statistical approach to calculate the number of samples and sampling frequency is not supportable. In an effort to address the comments, the required number and location of the sampling probes were revised. A landfill performing Tier 2 is required to take two samples per hectare of surface area, up to 50 samples. Because the confidence level calculation was removed, the site-specific NMOC concentration is required to be recalculated every five years. The ten year recalculation period option has also been removed.

Because of the lower NMOC emission rate stringency level of 50 Mg/yr and the fewer number of landfills affected by the regulations due to the 2.5 million Mg maximum capacity exemption level, a single tier 2 recalculation period of every 5 years is considered justified and not overly burdensome. The lower stringency level makes it more likely that a landfill's NMOC emission rate could increase such that it significantly exceeds the 50 Mg/yr stringency level during a 10 year period.

Additional guidance has been incorporated into the final regulation in § 60.754(a) for determining values for M_i (mass of refuse in the i^{th} section, Mg) and R (average annual refuse acceptance rate, Mg/yr). As specified in chapter 9 of the proposal BID, the mass of the nondegradable refuse should be subtracted from the total mass of refuse in a particular section of the landfill or from the refuse acceptance rate to avoid overestimating the LFG emission rate.

Comment: One commenter (IV-D-25) suggested using site-specific kinetic coefficients in Tier 3, instead of site specific emission rates. The commenter gave information on how the kinetic coefficients would be estimated.

<u>Response</u>: The purpose of Tier 3 is to determine a site-specific methane generation rate constant (k). The k value is determined from a site-specific emission determined by extracting LFG from a portion of the landfill (i.e., installing gas extraction wells).

<u>Comment</u>: One industry commenter (IV-D-27 and IV-F-5) noted that a conversion factor used in the calculation of the default concentration of NMOC fails to account for the final product needing to be given "as hexane." The commenters concluded that this resulted in a default value nearly five times greater than the values upon which it was based, and requested that the default value be recalculated. The commenters also contended that the mass emission rate of NMOC would be affected by the "as hexane" error. The commenter found the different conversion factors provided in the proposed regulation and BID to be overly confusing, and recommended an alternative conversion factor, providing the calculations upon which it was based.

<u>Response</u>: The problem with the conversion factor noted by the commenter is actually a problem within the section of the regulation where the NMOC concentration from Method 25C is used to calculate the NMOC emission rate. This error occurred as an oversight in the typing of the proposed regulation, which should have included additional text in the proposed NSPS.

The appropriate text has been added to § 60.754(a)(3) to indicate that the NMOC concentration from Method 25C must be divided by 6 to convert from NMOC concentration as carbon to a concentration in terms of hexane. The conversion of NMOC concentration from as carbon to as hexane was performed correctly in the analysis upon which the selection of the regulatory emission rate cutoff was based.

2.11 TEST METHODS

Comment: One commenter (IV-D-10) expressed concern that the proposed test Methods 25C, 3C and 2E contain procedures that can be both laborious and costly. The commenter suggested that the regulations include provisions that do not limit owners or operators to only these three methods if other equivalent methods exist or may be developed. The commenter stated that this will reduce costs and allow a field sampling technique they are developing to test methane and NMOC emission rates that will be less expensive and more accurate than current methods.

Response: Owners and operators may propose alternative methods, provided they are approved by the appropriate reviewing agency.

Comment: One commenter (IV-D-54) suggested that the nomenclature be changed from NMOC to TGNMO in proposed test Method 25C because the technique for analyzing NMOC is substantially similar to the technique for TGNMO. The commenter stated that it would be less confusing for the nomenclature to remain TGNMO for the technique.

Response: The EPA has defined C_{NMOC} and NMOC within the methods according to the purposes for which the methods were developed. Since the surrogate for the designated pollutant in these regulations is NMOC, Method 25C, which was developed to support these regulations, references NMOC.

2.11.1 Nonmethane Organic Compound Sampling and Analysis

Comment: One commenter (IV-D-19) requested that alternatives other than Method 25C (for example, meters, SUMMA canisters as in the EPA method TO-14, and total hydrocarbons, and total nonmethane hydrocarbon analyzers) be allowed in the regulations for the sampling and measurement of LFG. Another commenter (IV-D-3) suggested that EPA Method 18 and Method 8240 be used in place of Method 25, because Method 25 is more expensive. The commenter also stated that Method 25 does not allow for chemical-specific data, would not indicate any contaminants at significant toxic levels, and does not meet the criteria set forth in RCRA guidelines SW-846. The commenter further indicated that the sampling depth in Method 25 is too shallow and, therefore, yields no representative NMOC concentrations.

One commenter (IV-D-32) recommended that test Method 25C, used for collecting and analyzing NMOC concentrations from probes and referenced to in § 60.753(a)(3), be incorporated into the regulation by reference. The commenter was, however, concerned about the use of a sampling requirement that may create up to 50 holes through the cover of the landfill every 5 to 10 years. The commenter suggested that language be included in the regulation or test method to decommission the sampling wells to maintain the integrity of final cover. Also, another commenter (IV-D-55) stated that penetrations of the landfill cover to install additional wells or for sampling provide avenues of escape for the toxic compounds. The commenter recommended that the approval of mitigation measures be required prior to cover penetration.

One commenter (IV-D-39) asserted that the use of Method 25C for determining NMOC concentrations is questionable because: (1) probe samples and gas extraction well samples do not typically agree with each other, (2) probes only give a static measurement of NMOC under the cap, and (3) probe samples are not representative of the heterogeneous nature of landfill wastes. The commenter recommended that a number of methods should be allowed, including Method 25C, as well the collection of bag samples from a larger area of the landfill at the surface, and sampling wells sunk completely through the trash that could later be used in the collection process.

One commenter (IV-D-26) stated that operators of multiple landfill sites should be allowed to statistically determine average NMOC concentrations throughout the landfill system, rather than on a landfill-by-landfill basis. The commenter argued that for a gas analysis to be truly representative of what is in the landfill, gas needed to be collected within the trash and not beneath the cap.

Another commenter (IV-D-55) asserted that due to the uneven distribution of pools of leachate (the source of most NMOC emissions), the use of concentration samples from only five probes can lead to extremely misleading conclusions.

One industry commenter (IV-D-27) supported the requirements for determining NMOC concentration with an 80-percent confidence, but requested that composite sampling be allowed on the additional sampling (maximum 50), arguing that the average concentration is all that is finally used. The commenter noted that this would greatly reduce the cost of such sampling and analysis. This commenter also suggested that an alternative be allowed to installing probes.

One commenter (IV-F-6) claimed that the 80 percent confidence interval in Method 25C is being compared to the variation between the samples. The commenter asserted that since the focus is on the difference between the 5 sample averages and the 8,000 ppmv, there is no reason to take more samples when the difference between them is large.

Two commenters (IV-D-30, IV-F-3) stated that the 80 percent confidence level for NMOC sampling is not based on sound logic since there is no proof that the distribution of LFG is normally distributed as is the t-statistic on which the confidence level is based.

One commenter (IV-D-39) asserted that no data are presented to show that the student t-test is a valid procedure for analyzing data collected from LFG sampling. The commenter argued that other environmental monitoring programs such as groundwater monitoring data have shown that the student t-test is not a valid test in most cases and that the EPA has previously allowed more appropriate alternative statistical analyses. The commenter suggested that a specific statistical test not be required, but rather that an appropriate statistical method be used.

Response: When specifying a method for demonstrating compliance, the EPA seeks to select a method that is as simple as possible but provides information adequate for establishing compliance. Method 25C was developed for this rule because it measures total nonmethane organics, which is the surrogate specified within these regulations for the designated pollutant. Methods that do not separate methane from the other organic compounds, such as Method 21, are not readily amenable for measuring NMOC in LFG. Methods T0-14 and 8240 are not appropriate alternatives to Method 25C, for the following reasons. Method T0-14 is more expensive than Method 25C and analyzes specific compounds rather than simply NMOC. Method 8240 is a GC/MS analytical procedure for a predetermined list of compounds and could not be used effectively for measuring NMOC concentration.

Based on the comments received, the EPA decided to specifically allow the use of Method 18 or Method 25 for determination of reduction efficiency. If Method 18 is used it must be speciated at a minimum for the compounds listed in the most recent version of AP-42. While the EPA believes Method 18 may be more costly to implement than Method 25, it does not doubt the adequacy of either method for determining reduction efficiency. However, other test methods may be used for any of the specified methods if they are approved by the appropriate reviewing agency. Although other methods may be used, if properly validated, usually only one or two established EPA methods are specified because they have been demonstrated to provide valid results and because the comparative results from several sources reporting to one agency are more meaningful when the same analytical method has been used.

A requirement has been added to the regulation to refill the probe holes with cover material once sampling has taken place. The owner or operator may choose to leave the probe in place and simply plug the sampling probe or remove the probe and refill the hole with cover material.

The NMOC sampling requirements of tier 2 in the final regulation have been revised. Many commenters stated that the statistical approach to calculate the number of samples and sampling frequency is not supportable. In an effort to address many of the comments, the required number and location of the samples were revised. A landfill performing the tier 2 sampling to obtain a site-specific NMOC concentration is required to take two samples per hectare of surface area up to 50 samples. A landfill owner or operator may take more than 50 samples, but all the samples must be included in the calculation to obtain the average NMOC concentration.

Due to the large variation in NMOC concentration from landfill to landfill, using average NMOC concentrations from multiple landfill systems would not provide a reasonable basis for installing collection and control systems at individual landfills. The EPA considers that when the regulatory cutoff is exceeded and NMOC sampling is performed, the site-specific NMOC concentration should be the basis for applicability, not an average concentration based on multiple landfills. Additionally, a multiple landfill average might result in control applied to fewer landfills. Instead of landfills emitting greater than 50 Mg NMOC/yr being controlled while others emitting less than 50 Mg NMOC/yr are not, the use of a multiple-landfill average NMOC concentration might exempt all of the landfills in the system. The NMOC sampling is meant to improve the accuracy of the estimate for landfills near the regulatory cutoff, to determine if the specific landfill warrants control.

The sample probe depth requirement has been changed to read sunk "at least" 3 feet below the cover material or cap to give some flexibility in sampling.

Composite sampling can be allowed only if each individual sample is of equal volume. This is to insure that the resulting NMOC concentration is equal to the value that would be obtained if an average value from concentrations of multiple samples were used.

2.11.2 Method 2E

Comment: Many commenters (IV-D-25, IV-D-30, IV-D-31, IV-D-34, IV-D-39, IV-D-47, IV-F-4) questioned the accuracy and validity of Method 2E. One commenter (IV-D-30) argued that Method 2E is based on questionable engineering assumptions, and limited testing of a volume of the landfill that is unknown at a single point in time, since the true region influenced by the extraction well is unknown. The commenter maintained that the EPA did not provide documentation to confirm the accuracy of the proposed test method. Two commenters (IV-D-25, IV-D-34) stated that Method 2E either overestimates or underestimates well-spacing requirements, depending on landfill characteristics. While another commenter (IV-D-46) stated that the treatment systems will be overdesigned and inappropriate for small and medium size landfills. One commenter (IV-F-4) stated that Method 2E may overestimate well spacing by two to three times.

Another commenter (IV-D-31) stated that active extraction testing using Method 2E lacks accuracy, is too involved, and is too costly to be the basis for design or the decision to install collection systems. The commenter claimed that the extraction well depth should not extend to 75 percent of the landfill depth, except in small landfills, due to the expense of wells deeper than 30.5 to 36.5 meters. The commenter recommended that perimeter wells could catch gas escaping from deep wells.

Several commenters (IV-D-25, IV-D-27, IV-D-30, IV-D-31, IV-D-34) were concerned about the cost of Method 2E. Two commenters (IV-D-25, IV-D-31) noted that in the case of small landfills, the cost of performing Method 2E could exceed the cost of an adequate control system. Two commenters (IV-D-25, IV-D-34) argued that using Method 2E to determine well spacing would increase costs because wells would be spaced too close together, due to fluctuations in barometric pressure.

Response: The EPA developed Method 2E with input from industry representatives. Industry provided experience on techniques that the EPA then developed into Method 2E. Since these techniques are used by industry representatives, the EPA is confident that Method 2E can be used effectively to estimate the area of influence. The final regulations, however, no longer require a specific determination of the area of influence, so sources that are not comfortable with Method 2E are not required to use it.

Method 2E was also developed to be used to determine a site-specific methane generation rate constant (k), for use in Tier 3 of the applicability determination. Method 2E, as a method of determination of k, is based on the Scholl Canyon model and the area affected by a given well (ROI), as determined by testing. Since the site-specific k value would replace the default k value, the EPA is confident that a site-specific k value determined by Method 2E would better represent an individual landfill than the default k value. It should be noted here that use of the Tier system is also optional, and sources not comfortable with the use of Method 2E could document the sufficiency of another method, or install controls.

Since the EPA removed the prescriptive requirements for collection system from the final regulations, and replaced them with design criteria, the concerns expressed by commenters over these issues should be alleviated.

The cost of performing Method 2E was taken into account when the tier default values were selected. Default values were selected in an attempt to minimize the number of landfills that would perform Tier 3 and then not be required to install controls. In other words, the default values were selected in an effort such that landfills that were estimated to emit more than 50 Mg/yr by Tiers 1 and 2 and therefore elected to perform Tier 3 would still likely need to install controls, thereby making use of the wells already installed for Tier 3. This is also a factor landfill owners and operators will need to take into account when deciding whether to advance to Tier 3 or to install controls after Tier 1 or Tier 2. The EPA acknowledges that landfill owners and operators will base how far to advance in the tier system on site-specific factors, including cost.

The EPA also increased the maximum capacity exception level to 2.5 million Mg. This exemption will exempt approximately 90 percent of all landfills from the requirements of the regulations.

Comment: Several commenters (IV-D-25, IV-D-30, IV-D-31, IV-D-34, IV-D-51) were concerned about the impact of barometric fluctuations on the accuracy of Method 2E. One commenter (IV-D-31) reported that, in his experience, pressure differences are very slight and these differences can be overwhelmed by barometric fluctuations. The commenter suggested placing pressure probes closer to the well, at 3, 7.6, and 15.2 m, and plotting the pressure differentials versus the natural logarithm of distance to extrapolate to get the distance at zero pressure difference. The commenter contended that the correction for barometric pressure does not take into account time lags for the landfill pressure to equilibrate to barometric swings. The commenter maintained that extracting two void volumes does not assure that "new gas" is being collected or that gas is being extracted at the same rate it is being generated. The commenter recommended that steady state pressure distributions should be achieved first, meaning that pressures are rising or declining at a steady gas extraction rate.

Another commenter (IV-D-51) suggested that better methods for determining the area of influence for a given well (other than Method 2E) included continuous recordings of probe and atmospheric pressure or spreading out the time frame for spot monitoring performed at the same time each day.

<u>Response</u>: In Method 2E, pressure readings are taken, and, as in the case of all pressure readings, these pressure readings are measured as a pressure differential. In this case, it is the difference in pressure between the atmosphere (barometric pressure) and the landfill. In Method 2E, the pressure differential is corrected for barometric pressure to determine the landfill pressure. It is irrelevant that the correction of barometric pressure does not take into account the time lag between barometric pressure changes and landfill pressure changes, because in Method 2E the concern is with the relative difference in landfill pressure from probe to probe at a given moment in time.

The barometric fluctuations may affect the landfill gas generation rate; however, the landfill gas generation rate is being determined over a period of time where varying barometric pressures impact the gas generation rate and these effects are being averaged together. Since the extraction wells must function during all barometric conditions, any conditions in which Method 2E is performed are conditions that are more or less likely to occur and are applicable to the landfill.

After review and consideration of comments, the EPA has revised Method 2E to allow the use of a semi-logarithmic plot of pressure differentials versus distance from the wellhead for determining ROI.

Method 2E is being kept in the regulation as an alternative means for establishing applicability, as a part of the tier system. In Tier 3, an owner or operator has the option to perform Method 2E to develop a site specific gas generation rate constant for use in estimating the NMOC emission rate. There may be other methods that would estimate the site specific gas generation rate constant more accurately, but these would entail more cost and more testing time. The EPA is confident that Method 2E sufficiently estimates the site specific gas generation rate constant. However, this method does not have to be used. An owner or operator can install controls after Tier 2 and not perform Tier 3 (Method 2E), or the owner or operator can propose another method for estimating the gas generation rate constant.

When Method 2E is used as a means for estimating the area of influence, the EPA does not believe that either continuous recording or prolonged monitoring will improve the accuracy of the area of influence estimate significantly. Method 2E already requires that barometric pressure measurements be taken at the same time as the probe pressure readings. Also, Method 2E requires that the pressure measurements be taken every 8 hours over several days or more, which would mean that pressure measurements are taken at the same time each day.

Comment: One commenter (IV-D-31) stated that single wells are preferred over the cluster wells regardless of whether the history of the site is known, because at sites where the history is known generation rates varied by factors of 1.5 to 3.

Response: A landfill owner or operator has the option to choose between using three cluster wells or five wells spaced evenly over the landfill. The regulation does not require the use of cluster wells for Method 2E testing. In fact, cluster wells should not be used if the composition of the refuse, age of the refuse, and the landfill depth of the test area cannot be determined. Where these factors can, however, be determined, cluster wells are appropriate. Therefore, landfill operators have two options for siting wells in Method 2E testing, when the required data is available.

Comment: Three commenters (IV-D-27, IV-D-31, IV-D-39) were concerned with the depth of perforation of the well due to the possibility of air infiltration. One commenter (IV-D-27) suggested that a perforation depth should start no closer to the surface than 6.1 m, while the second commenter (IV-D-31) suggested that only the bottom one-third of the well be perforated. The second commenter (IV-D-31) pointed out that less perforations would result in a smaller radii of influence. The third commenter (IV-D-39) asserted that a 2/3 perforated section was appropriate for wells deeper than 13.7 m, but for shallower wells a solid section should be no less than 4.6 m, unless a synthetic liner is being used. The commenter asserted that the specific design standards in the proposal be replaced with a performance standard that can be met by qualified professional designers, who can design an optimal gas recovery system.

Response: These commenters have raised a valid concern regarding well perforations too close to the surface. Accordingly, the provisions in § 60.759 have been revised to provide only criteria for designing collection systems, rather than prescriptive specifications.

Comment: One commenter (IV-D-27) opposed the use of Method 2E to calculate maximum expected gas generation rate in § 60.757(b)(1)(i) of the proposed regulation. The commenter argued that using Method 2E here is in conflict with the calculation equation provided in § 60.754 of the proposed regulation which allows, but does not require, a rate to be determined through Method 2E.

Response: Sections 1 through 4 of Method 2E do not apply to a controlled landfill. In addition, the final regulations have been revised at § 60.758(b)(1) to allow the owner or operator to calculate the maximum expected gas generation flow rate according to § 60.755(a)(1) or any other method to determine maximum flow rate, as long as the method is approved by the Administrator.

Comment: One commenter (IV-D-39) discussed the requirement of using a blower with a flow rate of 8.5 m^3/min. The commenter stated that a larger or smaller blower may be needed, depending on site conditions.

Response: The blower capacity requirement of 8.5 m^3/min is the estimated minimum capacity requirement for performing Method 2E. As the commenter pointed out, depending on the flow rate conditions at each particular site, a larger blower capacity may be required. Therefore, the language in Method 2E has been revised to indicate a blower capacity requirement of at least 8.5 m^3/min.

2.11.3 Method 3C

Comment: One commenter (IV-D-27) suggested that only one calibration standard is necessary for calibrating the thermal conductivity detector because of its linear scale.

Response: The requirement for three calibrations is included in Method 3C because it was previously determined to be appropriate during the development of Method 3. Requiring three calibrations enhances the statistical validity of the calibration test, and the EPA does not consider the three tests overly burdensome.

2.12 DESIGN SPECIFICATIONS

Comment: One commenter (IV-D-46) alleged that the proposed regulations may encourage untrained "landfill gas engineer consultants" to offer their services to city administrators. Two commenters (IV-D-25, IV-D-34) were concerned that Method 2E is very complex and will be used by inexperienced gas system designers which will affect the integrity of the results.

Response: In determining whether to hire a consultant, landfill owners and operators should obtain information on the previous experience and qualifications of the consultant and on their professional memberships and certifications. The landfill industry, professional organizations, and State air pollution control agencies may be able to provide city administrators with information about reputable landfill gas engineering consultants. In response to commenters' concerns, the final regulations indicate that the gas collection system design plans must be prepared by a professional engineer. Also, it should be noted that use of Method 2E is optional and might not be used at many landfills, so there should not be a shortage of experienced contractors.

Comment: Two commenters (IV-D-30, IV-D-36) contended that the collection and control design criteria used by the EPA is based on scientifically unproven and, therefore, invalid models and tests. One commenter (IV-D-30) mentioned that various California regulatory agencies had based their standards on actual emission measurements and not on models. Two commenters (IV-D-46, IV-D-49) said that the recommended gas treatment systems are overdesigned for smaller landfills and that the models used overestimate the amount of LFG produced.

Response: The gas generation model and the technical basis for gas collection system design were reviewed by industry frequently during their development and all comments submitted by industry were considered (see Docket No. A-88-09, Items II-C-11, II-C-22 and II-C-24; and Item Nos. II-D-38 to II-D-43, II-D-47 to II-D-50 and II-D-52 to II-D-54). The EPA considers the model reasonable for these regulations and is currently using the model in a number of other studies as well.

As stated in an earlier response, the Tier default values should only be used for determining applicability of the regulations. They were selected to be used as a screening tool to determine applicability of the control requirements of the regulations and should not be used to estimate emissions for inventories or control equipment design.

Comment: One industry commenter (IV-D-27) argued that the equation for determining gas mover sizing incorrectly sizes for the peak flow rate over the life of the landfill and not the maximum LFG flow rate expected over the life of the gas moving equipment. This commenter pointed out that gas movers can be upgraded or downgraded as the LFG moving needs change.

Two commenters (IV-D-39, IV-F-6) questioned the relationship between maximum expected flow rate and gas collection equipment life. The commenters stated that equipment life should not have an effect on gas flow rates and should not be factored into the value of t.

One commenter (IV-D-39) requested clarification on whether a gas collection system needs to be designed to handle the maximum expected gas flow rate from the onset or if the system can be designed in phases as the landfill is developed. The commenter recommended that phased design and installation be allowed.

Response: The EPA agrees that upgrading and downgrading equipment should be allowed, and the definition of the parameter t has been changed to reflect the time frame the owner or operator intends to use the equipment, instead of the equipment life. The new definition states that t is equal to the active life of the landfill or the age of the landfill plus the time the owner or operator intends to use the equipment, whichever is less. Equipment can now be sized for the maximum LFG flow rate expected over the use of the equipment and not over the life of the equipment.

The equation containing the parameter t in § 60.755 calculates the maximum LFG flow rate for the period of time the equipment is being used. The parameter t is defined as the oldest active age of the landfill while a given piece of equipment is being used. For a landfill that will close before the completion of the intended equipment use period, t is the total active life of the landfill. For a collection system that the intended equipment use period will be up before landfill closure, t is the age of the landfill when the equipment will be taken out of service or the age of the landfill plus the intended time of equipment use. For equipment that will be used after closure only, t is the age of the landfill when the equipment is installed.

2.12.1 Collection System Design

Comment: Many commenters (IV-D-7, IV-D-9, IV-D-27 and IV-F-5, IV-D-36, IV-D-38, IV-D-49, IV-D-52, IV-D-56, IV-F-4) wanted more flexibility to be incorporated into the design standards. The commenters asserted that these designs should be more site-specific and determined by the designers and owners. Many of these commenters requested that the regulation allow landfills operated and designed based on the SCAQMD regulation to be considered equivalent to a landfill designed and operated under these regulations. One industry commenter (IV-D-27) urged the EPA to provide less restrictive specifications for well construction and system components, adding that many effective systems have been used that would not meet these specifications.

Another commenter (IV-D-37) conceded that the regulation includes a mechanism for flexibility through alternative design plan submittal to the Administrator or the designated reviewing agency, but requested that the EPA further encourage States to allow such flexibility. Two commenters (IV-D-52, IV-F-4) stated that the proposed regulation does not take into consideration alternative methods of LFG control in use at existing MSW landfills.

Two commenters (IV-D-25, IV-D-34) noted that although the proposed NSPS allows for the submittal of an alternative design, the NSPS and EG require that the collection and control system be designed in conformance with chapter 9 of the BID, where the design specifications are far too rigid. Because of this rigidity, the commenter stated that systems meeting the SCAQMD standard would not meet the alternative design criteria in the proposed standard.

Another industry commenter (IV-D-27) argued that the collection system design specifications in the NSPS should be moved to the proposal BID and used solely as guidance, rather than as a design specification. The commenter noted that industry experts would submit site-specific designs to the State agencies for approval, and that this would foster creativity and the development of innovative systems.

<u>Response</u>: After consideration of the comments, the EPA agrees that the specific design criteria in the proposed rule may be overly restrictive and not the most appropriate design for all landfills. The design specifications in the proposed rule may be useful in designing active vertical collection systems. However, because of the many site-specific factors involved with landfill gas collection system design, alternative systems may be necessary. Therefore, the prescriptive specifications have been removed and § 60.759 has been revised to present more general design criteria for active collection systems. This will allow flexibility and allow, or even encourage, alternative designs. The final standards require all owners or operators to submit design plans to the State agency for review. The design plans must demonstrate that the criteria in § 60.759 are met or that the design is a sufficient alternative, and must be signed by a registered professional engineer. These provisions allow for

use of a wide variety of system designs. Designs could include vertical wells, combination horizontal and vertical collection systems, or horizontal trenches only, leachate collection components, and passive systems. Any design can be used as long as an adequate design plan is submitted and approved.

Additionally, 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 final EG for collection systems references the NSPS. For EG based on sources of health-related pollutants, States are required to submit plans for EPA approval that provide emission limitations at least as stringent as the NSPS. An owner or operator of a system designed for the SCAQMD standard would need to demonstrate that it effectively addresses the design criteria in §§ 60.752(b)(2) and 60.759.

The final EG has been revised as follows to clarify that State plans must require installation of collection and control systems that are equivalent to those required in the NSPS:

> ". . . meeting the conditions provided in § 60.752(b)(2)(ii) of this part."

Comment: Two commenters (IV-D-25, IV-D-34) recommended that the regulations incorporate an alternative collection system design provision, which would establish a performance standard based on the SCAQMD rule. The SCAQMD rule uses integrated surface sampling of TOC to determine the need for additional gas control. This would allow more flexibility for the gas collection designs. One commenter (IV-D-37) noted that their State regulation requires that gas collection systems be designed so that surface concentrations of TOC measured as methane do not occur at levels above 1,000 ppmv or along the gas transfer path. The commenter asserted that the surface test encourages system maintenance. A fourth commenter (IV-D-55) also recommended that a surface emission standard be established which landfill operators must maintain, thereby allowing maximum design flexibility and encouraging more cost effective innovations.

Another commenter (IV-F-6) maintained that production tests should not be required for gas collection system design because they are inaccurate, and that they should be replaced with the use of operating criteria. The commenter advised that all mandatory design features should be removed from the provisions and that all designs should be produced by certified professional engineers instead.

Response: The final NSPS allows for collection system design based on either the criteria provided in § 60.759 of the NSPS or an alternative design, provided that the alternative meets the requirements in § 60.752(b)(2)(ii) and is submitted for review. The final NSPS differs from the proposed regulation in that it no longer provides prescriptive design specifications.

One commenter was concerned about the integrity of the landfill cover and that cracks in the cover could allow emissions to the atmosphere even when an effective collection system has been installed. As mentioned in the proposal preamble and by commenter IV-D-26, surface emission monitoring as used in the SCAQMD seems appropriate for determining that closer well spacing is in fact needed. As mentioned in the proposal preamble, the EPA was already considering what role the California test might reasonably fill in these regulations (see 56 FR 24492-24493).

The EPA considers surface emission monitoring to be an appropriate tool for monitoring both cover integrity and the effectiveness of well spacing. Therefore, some aspects of the surface emission monitoring test have been incorporated in the new § 60.753, where all of the operational provisions for the collection system have been brought together.

After initial installation of the collection system, owners and operators will be required to operate the collection system with a methane concentration less than 500 ppm at all points around the perimeter of the collection area and across the surface of the collection area following a serpentine pattern spaced 30 meters apart.

Compliance with this operational standard is to be demonstrated by monitoring surface concentrations on a quarterly basis using an organic vapor analyzer, flame ionization detector, or other portable hydrocarbon monitor. For closed landfills, if three successive quarterly monitoring periods fail to indicate any methane concentrations of 500 ppm or greater, then the owner or operator may skip to an annual monitoring frequency.

If an instrument reading of 500 ppm or greater is produced, the location of the exceedance must be recorded, and cover maintenance or adjustment to the vacuum at adjacent wellheads must be made within 10 days. The 10-day schedule was selected to allow the personnel to continue monitoring without stopping to make adjustments, but to assure that conditions at the locale of the exceedance are attended to quickly.

The location of the exceedance must be remonitored within 10 days. If a second exceedance is recorded at the same location, additional adjustments shall be attempted and remonitoring performed within 10 days. Any location that exceeds the 500 ppm reading 3 times within a quarterly period must install a well or other collection device within 120 days of the first exceedance.

The methane concentration level of 500 ppm was chosen based on data received from numerous sources, including:

(1) information provided by the SCAQMD stating that this was an appropriate level and the level used at landfills in that district; (2) information indicating that some leak detection programs for other industries currently use 500 ppm and analyzers are capable of detecting this level; (3) instrumentation specifications citing this as an appropriate number and that familiarity with this level is broad; and (4) site visits conducted by the EPA indicating that 500 ppm is an acceptable detection level.

Comment: One commenter (IV-D-20) stated that § 60.758(b) in the proposed regulation should be stated more clearly, suggesting it follow the description given in the summary.

Another commenter (IV-D-29) stated that the preamble explains that the pressure at the wellhead should be negative pressure to collect the gas adequately, but that the regulation does not give this detail. The commenter suggested that this be added to the regulation.

Response: The final NSPS does not present design specifications for a specific gas collection system, but includes design criteria that the EPA believes provides a level of detail and clarity necessary to allow owners and operators to design collection wells meeting BDT.

The final NSPS requires that pressure in the gas collection header be monitored on a monthly basis in § 60.756(a). Section 60.755(a)(3) requires that negative pressure be maintained, or an additional well be added to the system, except in certain specified situations.

Comment: One commenter (IV-F-6) noted that the system designs and diagrams in the preamble failed to provide for either expansion joints or pipe sloping for drainage.

Three commenters (IV-D-20, IV-D-22, IV-D-55) contended that settlement of the refuse mass after extraction well and header line installation is not taken into consideration in § 60.758(b)(2) of the proposed regulation. One commenter

(IV-D-55) recommended that the regulation require that swing joints, slip lines, or other acceptable devices that will allow the collection system to move with the landfill without the collection system breaking be installed. One commenter (IV-D-20) suggested that the majority of header piping be buried underground in severe winter areas, and suggested that provisions be added for routine investigations of buried lateral lines that may become fractured. Another commenter (IV-D-22) questioned the effects of settlement of extraction wells which are 30 m on-center through impermeable caps.

One commenter (IV-D-20) warned that gas extraction wells should usually be located as close to the base of the landfill as can be achieved to prevent problems associated with low vertical refuse permeability. The commenter further recommended that, in the case of landfills with leachate collection systems, the extraction well should terminate at approximately 3 m above the leachate collection system.

Response: The EPA agrees with the commenters concerns regarding settlement. The figures and diagrams provided in the preamble to the proposed regulations were intended to illustrate basic system components, and were not intended to be exhaustive. Because the final regulations require all design plans to be submitted to the Administrator for approval, but do not provide specific designs for gas collection systems, the use of slip lines, swing joints or other devices, and the location and specific length of header pipes, is neither required nor precluded by the final NSPS and EG. The use of these devices can be determined during the site-specific design.

The EPA considers this level of flexibility appropriate for the regulation and believes that operators or owners will choose the appropriate placement for their site specific situation and include that in their design plans. Also, if a State or a landfill owner/operator has a particular concern about pipe freezing or the well depth, they can address that in their specific design plan.

Comment: One commenter (IV-D-32) suggested that provisions be added to the regulation requiring that the LFG collection system design be capable of controlling the off-site migration of subsurface LFG.

Response: The EPA considers collection and control systems designed to meet the criteria in § 60.759 of the final NSPS to be sufficient for the control of off-site migration. The pulling effect of the perimeter wells, which are sited to cover all areas of the boundary, should prevent LFG from migrating off-site. However, the commenter is correct; collection and control systems need to address off-site migration. A provision has been added to § 60.752 requiring collection and control systems be designed to minimize off-site migration of subsurface LFG.

In addition to requiring that migration be addressed in each collection system design plan that is submitted, the final regulation includes a new § 60.753 on collection system operation. This section compiles various operational provisions that had previously been located at different points throughout the proposed regulation into one section. A requirement to operate the collection system with a surface methane concentration of less than 500 ppm, which is fulfilled through the use of a surface monitoring device, has also been included.

The provisions for the surface monitoring include a requirement to monitor surface methane concentrations around the perimeter of the collection area. This will further ensure that offsite migration is controlled. These provisions are applicable to all systems designed according to the provisions of §§ 60.752 and 60.759 and systems which include any alternatives to the provisions of §§ 60.753 through 60.758 that have been submitted for review.

Comment: One commenter (IV-D-27) suggested that the bentonite seal around the collection wells and the probes should be placed at the cover/refuse boundary rather than 4 ft above the gravel pack. The commenter argued that this would reduce the chance of air intrusion.

Another commenter (IV-D-39) also asserted that the proposed gas well design lacks a 1-ft thick bentonite seal immediately above the crushed stone and that the crushed stone has been found to be very important in preventing air intrusion into the well. The commenter also stated that the diameter of the well boring should be 0.61 to 0.91 m, which allows for the use of larger diameter boring rigs, which are used to install a leachate extraction well in the same bore hole as the gas well.

Response: As a result of concerns such as those expressed by these commenters, the prescriptive design specifications for gas collection systems have been removed and replaced with criteria for the design of such systems. The design plans must meet the criteria in § 60.759 or demonstrate equivalence, be prepared by a professional engineer, and approved by the Administrator (i.e. the State or local agency that has been delegated authority).

The proposed design specifications were established to provide an owner or operator a clear design to follow in lieu of submittal of an independently-designed system. However, since the regulation has been revised in § 60.759 to provide criteria for sufficient collection systems which allow sources to design collection systems in any manner they chose (as long as the design plans are prepared by a professional engineer, and are approved by the Administrator), wells of any diameter may be bored, as long as the system is approved.

Comment: One commenter (IV-L-1) recommended that the EPA require either a comparable collection efficiency for affected landfills of all sizes or, for landfills located in environments that prevent achieving the required numerical efficiency value, minimum equipment specifications for the collection system. The commenter (IV-L-1) suggested achieving this by: restricting the lengths, type of materials and techniques used to assemble the well points, seals, pumps, compressors, dryers and collection systems; requiring minimum commitments of resources, expertise and levels of effort to be devoted to system maintenance; and further limiting the time, provided in the proposed NSPS, after initiation of active landfilling operations before which construction and operation of landfill gas collection and treatment systems must take place.

Response: These standards and emission guidelines are promulgated under section 111 of the CAA, which requires the standards be set based on the application of BDT considering costs and any nonair quality health and environmental impacts and energy requirements, at the time the standard is promulgated. An NSPS establishes a nationwide minimum level of control, but it is based on the application of BDT.

The commenter's concern regarding the collection efficiency for affected landfills is a valid concern and has been addressed by the EPA. The EPA considers surface emission monitoring to be an appropriate tool for monitoring both cover integrity and the effectiveness of well spacing and vacuum in order to ensure adequate collection efficiency. Therefore, surface emission monitoring has been incorporated in § 60.753, where all of the operational provisions for the collection system have been grouped together.

2.12.2 Determination of Well-Spacing

Comment: One commenter (IV-D-26 and IV-F-6) argued that less restrictive design and operating parameters for LFG control systems can be specified and yet still achieve the desired emissions reductions. The commenter's particular concern is the design criteria for wellhead spacing. The commenter contended that under normal conditions, well head spacing for central wells of 90 to 120 m is sufficient to control surface emissions and lateral migration of LFG. The commenter stated that at these distances a zone of negative pressure builds beneath the landfill cap and will keep LFG from escaping through the landfill cap. The commenter contended that on occasion this spacing is inadequate due to subsurface factors that restrict the movement of LFG and the vacuum created by the wells. The commenter asserted that in these areas, surface methane readings above 50 ppm can be detected using surface measurements for methane. The commenter agreed that closer well spacing is necessary where this is clearly demonstrated.

Another commenter (IV-D-39) stated that the proposed design specifications for well spacing assume that the landfilled waste is homogeneous. The commenter noted that in reality this is not true because the waste composition varies. Because of the variable nature of the fill, the commenter supported a performance standard rather than a design standard, and recommended that alterative designs be allowed and encouraged.

One commenter (IV-D-30) questioned the use of ROI as determined by the Method 2E pumping test. The commenter asserted that Method 2E is comprised of unnecessary "leak testing" which is more expensive and takes longer than other methods.

One commenter (IV-D-26) contended that short term pumping tests (for k calculation) do not yield accurate data and provide no basis for sizing LFG collection systems. The commenter stated that uncontrolled landfills have built up landfill pressure and that initially, the test wells will show higher flow rates than at true steady state. The commenter asserted that with a full well field in place, 6 to 12 months is required to reach steady state. The commenter contended that no basic pump test, including the EPA's proposal, is reliable and will invariably overestimate the quantity of gas generated.

The commenter (IV-D-26) stated that they have solved the pump test problem by designing gas extraction systems so that the blower compressor has the ability to produce a minimum of 13 to 25 cm of water column vacuum at the most remote point in the header/lateral system. Friction loss is controlled by allowing only a 2.5 cm water column pressure drop per 30.5 m before pipe diameter is increased. The commenter (IV-D-26) stated that this allows the gas extraction system's ability to collect gas to be the controlling factor, not a "guess" at the landfill's ability to produce gas.

One commenter (IV-D-26) contended that Method 2E assumes a uniform, isotropic, fully developed, concentric vacuum pattern around the well, however, this does not occur in actual practice. The commenter stated that it is entirely predictable that a 50-acre landfill with an HDPE cap and 0.9 m final cover can be covered by a single vertical gas well.

Another industry commenter (IV-D-27 and IV-F-5) urged that greater flexibility be allowed in establishing the area of influence used for well-spacing. The commenter (IV-D-27) suggested that engineering equations are just as effective for calculating the area of influence and are much less expensive. The commenter requested that engineering equations be allowed in lieu of Method 2E testing for establishing the area of lnfluence. Two commenters (IV-D-25, IV-D-34) agreed that Method 2E is only one of several methods that can be used as a guide for gas collection design.

One commenter (IV-D-27) faulted the three methods provided in the proposal, noting that two of them are based on expensive field testing procedures, and that the third is based on theoretical modeling utilizing only two site-specific values. The commenter suggested that experts in the field could better determine an effective area of influence.

One commenter (IV-F-4) faulted area-of-influence methods of determining the well spacing because these methods have been demonstrated primarily at large landfills and may be misleading or inappropriate for all sizes of landfills. The commenters (IV-D-25, IV-D-34) also stated that Method 2E would result in an overly large area of influence in deep landfills, causing the system to miss as much as 85 percent of the LFG.

One commenter (IV-D-26) recommended that all references to radius of influence and Method 2E be deleted and be replaced with the general recommendation that the LFG extraction system be designed by a competent and qualified registered professional engineer and that such plans be submitted and approved by the local regulatory agency. Another commenter (IV-F-6) stated that Method 2E is not necessary to determine the area of influence; it is only necessary to determine if there is no gas in the perimeter monitoring probes and that there is less than 50 ppm methane in the surface emissions.

Response: In response to the many comments requesting a simpler approach for determining the area of influence for purposes of collection system spacing, the EPA has removed the specific methods for determining ROI or any other area of influence determination from the requirements of the regulations. Instead, as mentioned earlier, the final regulations require a professional engineer to prepare collection system design plans with gas collection systems of sufficient density to achieve uniform control of surface gas emissions and address gas migration.

Method 2E is no longer required, but can still be performed to determine the appropriate area of influence for a given landfill. Method 2E has been used before and generates useful data (see Docket No. A-88-09, Categories II-C and II-D and the response in section 2.11.2 for further discussion of the development of Method 2E). The EPA developed Method 2E with input from industry representatives. Industry provided experience on techniques that the EPA then developed into Method 2E. The EPA believes that Method 2E can be used effectively to estimate the area of influence.

As mentioned in previous responses, quarterly monitoring of the surface methane concentration has also been added to the rule to help ensure cover integrity and effectiveness of well spacing.

Comment: Three commenters (IV-D-30, IV-D-39 and IV-F-3, IV-F-4) stated that the curves prescribed in the regulation for use in well spacing, which are based on landfill depth and blower vacuum, are not field-tested curves and will result in wells spaced too closely. In addition, the commenter (IV-D-39) remarked that the graph entitled "Estimated radius of influence as a function of blower vacuum" needs to account for pressure drops associated with header losses in the piping.

One commenter (IV-D-26 and IV-F-6) stated that "radius of influence" is a relative term with little actual meaning, because the calculations are theoretical and have not been reliable for predicting actual flow conditions in the real world. Another commenter (IV-D-55) contended that a simple mathematical formula that can be used on all landfills for the placement of collection wells does not exist.

Another commenter (IV-D-7) suggested that the proposed method of calculation for the spacing of gas wells and vacuum contradict the commenters experience and should be revised. The commenter claimed that wells have been spaced at much greater distances within landfills with no air infiltration and that well spacings of 46 to 76 m can be operated successfully. The commenter recommended that landfills be allowed to use greater well spacing if they can demonstrate collection of 80 percent of the calculated or Method 2E measured gas production.

Response: The EPA determined that the curves given in the proposal regulation did not adequately address field situations. The curves were developed using theoretical methods and did not have all of the many factors influencing radius of influence factored into them. The curves were removed from the regulation. The regulation no longer specifies the method that must be used to determine the area of influence for well spacing.

The EPA determined that a performance based standard for collection systems was not feasible to prescribe and enforce, and that a collection system meeting the criteria in § 60.759 (or equivalent) represents BDT (See section 2.7). Eighty percent collection of the Method 2E measured gas production would not be equivalent in all cases and is not a feasible format for the standard. The BDT for controlling LFG was determined to be a well-designed collection system routed to a control system achieving 98 percent reduction of NMOC. A landfill owner or operator can use any method they choose for determining the sufficient density of their collection system, as long as the system meets the criteria provided in § 60.759 and is submitted to the Administrator for review. In addition, surface emission monitoring provisions have been incorporated into the final regulation to ensure adequate collection of LFG.

2.13 OPERATIONAL STANDARDS

Comment: Three commenters (IV-D-27, IV-D-39, IV-F-6) contended that the regulation was overly specific in requiring the use of an orifice meter to measure gas flow rate at the collection header, and argued that other devices, such as pitot tubes and texture flow tubes would be just as effective.

Response: The orifice meter referred to in the proposed regulation is just one device used to measure gas flow. Other types of flow measurement devices may be used in its place. Regardless of the type of meter used, the meter must be calibrated using the procedures outlined in section 4 of Method 2, appendix A to 40 CFR part 60.

Comment: One commenter (IV-D-7) suggested that the process to be used for correcting for excess air intrusion around the well-head should be left to the discretion of the owner or operator. The commenter further stated that the current language of the proposed regulations seems to discourage methods of adjustment (increasing blower speed, repairing leaks, etc.) other than those in the proposal.

A second commenter (IV-D-29) warned that issues such as LFG leaks in equipment, air emission aspects of storage, and treatment of leachate and/or condensate were not addressed under the proposed regulation. This commenter provided information on how their State addressed these issues. Another commenter (IV-D-55) also pointed out that various additional operational criteria are needed, such as flame-outs, pipe leaks, landfill movement, air injection, sampling ports, etc.

One commenter (IV-D-55) recommended that the design standards require the installation of backup fuel supplies to maintain minimum combustion temperatures and ensure proper combustion of the NMOC and toxic air contaminants.

Response: The final regulation has been revised to incorporate the suggested flexibility for correcting excess air intrusion. Any method can be used to correct for excess air intrusion as long as it does not adversely affect the integrity of the gas collection system, or the ability or effectiveness of the gas collection system to collect landfill gas.

The treatment of leachate and condensate is addressed under RCRA (subtitle D). Landfill gas leaks in equipment and air emissions from storage were not part of the focus of this

NSPS. It is assumed, however, that operable and well maintained equipment will be used which will reduce air emissions through leaks in equipment.

Requirements for downtime caused by equipment malfunction, flame outs, pipe leaks, etc., have been added to the regulation (see section 2.14.2, System Shutdown). All combustion devices are required to pass a performance test and/or monitor parameters to ensure proper operation. Some devices may need auxiliary fuel to meet these requirements and other devices may not. The EPA considers these requirements to be adequate without mandating backup fuel.

Comment: One commenter (IV-D-27) requested that the regulation should clearly discuss the subject of pressure at the wellhead during start-up, since some systems do have positive pressure at the wellhead during the start-up phase.

Another commenter (IV-D-55) recommended the requirement to have negative wellhead pressure requirement be eliminated and a performance standard for all points on the surface of the landfill be established. The commenter stated that LFG generation typically surges about 2 weeks after a rainfall which causes the pressures in the collection wells to be positive. The commenter also stated that the negative pressure requirement limits the operations ability to shutdown part of the collector's system (see section 2.14.2, "System Shutdown," for more detail on this comment).

Another commenter (IV-D-39) asserted that the requirement to have negative pressure at the gas collection wellhead cannot always be met because a well may be overstressed or may be experiencing condensate problems, and, therefore, may need to be cut back. Also, the commenter stated that immediate installation of an additional well is not always permissible under State law. The commenter recommended that a minimum 90-day time period over which a well can be brought back into compliance be incorporated in order to satisfy the negative pressure requirement. The commenter also recommended that, instead of requiring installation of a new well, that the regulations allow an owner or operator to restore a well's function, require the owner or operator to submit a plan to the State for correcting the function if not restorable, and to require the operator to comply with such a plan once it is approved by the State.

One commenter (IV-D-7) stated that the requirement to install an additional well if negative pressure cannot be achieved through valve adjustment at the wellhead is vague. A second commenter (IV-D-27) suggested that a time schedule needed to be added to the provisions for installing additional wells when a negative pressure at all wells cannot be achieved. The commenter said that in some States, a lengthy permit process is required before installing additional wells, and further noted that sometimes specific wells actually need to be removed from a system, although no reasons for such removal were provided.

Response: In the interim between proposal and promulgation, the EPA sought to improve the provisions of these regulations regarding both maintenance of negative pressure at the wellhead, and the addition or replacement of wells. As mentioned in the previous response, any operational adjustments the operator can make to restore the well to proper function are not precluded by these regulations.

After initial installation of the collection system, owners and operators will be expanding the collection system over time to provide adequate coverage for all areas in which waste has been deposited for 2 years if the area will be closed or at final grade, or 5 years if the area is still active. In the case of system expansion, the EPA assumes that landfill owners and operators will include these wells in their overall management scheme, including interaction with State authorities, as necessary, to allow timely installation.

Given that these wells are added by design, the NSPS requires that they be installed within 60 days of the waste reaching the specified age (2 years for closed areas, 5 years for active areas). The 60 days were included, even though the installation is likely planned and materials ought to be on-site, to allow for potential delays due to weather or availability of drilling rigs, which are often hired under contract.

The final regulations now provide three exceptions to the requirement for negative pressure at each wellhead. The first is the occurrence of fire or a significant increase in well temperature. In this case, the owner or operator must report the positive pressure occurrence in the annual report. The second exception is if the source uses a geomembrane or synthetic cover. If a geomembrane or synthetic cover is used, the owner or operator must develop and include acceptable pressure limits in the design plan. The final exception is when a well is decommissioned to accommodate for declining gas flows. In this case the well may experience static positive pressure after shutdown, as long as the changes made to the system are incorporated into the design plan and approved.

There are two cases in which wells must be added that were not included in the design plan: when negative pressure cannot be restored at a given wellhead within 15 days (exceptions noted above), and when surface methane levels of 500 ppm or more have been recorded at a location 3 times within a quarterly monitoring period. In the first case, 15 calendar days are allowed to restore negative pressure at the wellhead and thereby avoid installation of an additional well. The principal reason positive pressure is likely to occur is that the collection system capacity in the locale of the well is less than the production in the locale. Either capacity can be increased through adjustments to the vacuum, or system expansion is warranted. If adjustments are adequate, the pressure recorded at the next required monitoring (15 days) should be negative. The 15 days allows time for a surge in generation after significant rainfall to subside, as mentioned by commenter IV-D-55. This also allows time to resolve the problems mentioned by commenter IV-D-39. If negative pressure cannot be restored within this 15-day period, and the area is producing more gas than the system in that area is able to handle, then the installation of an additional collection device within 120 days is warranted. Also, if rainfall results in increased generation on a regular basis, additional capacity is also warranted.

In the case when methane concentrations are monitored at 500 ppm or more, two 10-day monitoring periods are allowed to reduce methane concentrations below 500 ppm. There are two reasons likely to contribute to excessive methane levels: cover failure, or ineffective area of influence at the adjacent wells. When excessive methane concentrations are recorded, 10 days are allowed for personnel to evaluate the problem. If the cover has been disturbed, maintenance will likely reduce surface levels of methane. On the other hand, if the area of influence is ineffective for the gas production level in the vicinity, adjustment of the vacuum may extend the effective area of influence, and cause methane concentrations to decrease. An increase in vacuum cannot always be used, however, because there is a trade-off between increasing the vacuum and avoiding excessive air infiltration.

If a second exceedance occurs, the location must be remonitored within 10 days. If the methane concentration meets or exceeds 500 ppm three times within a quarterly monitoring period, the source must install an additional collection component within 120 days of the original exceedence. Therefore, if the vacuum is increased as much as possible without excessive infiltration, and the third monitoring of surface methane concentration still reaches or exceeds 500 ppm, installation of an additional well is warranted.

Because disturbance of the cover can coincide with an ineffective area of influence, the EPA has allowed an additional 10 days after the occurrence of the second exceedance. The EPA believes it would be possible for landfill personnel to locate and repair cracks or other flaws in the landfill cover that were detected after an exceedance was recorded. Such exceedances may have resulted, at least in part, from an ineffective area of influence. If this occurs, excessive methane concentrations may be monitored in the subsequent monitoring period in spite of the repairs to the cover. In this case, an adjustment to the vacuum at adjacent wells may still restore surface methane concentrations to acceptable levels. Therefore, 30 days are allowed to attempt to reduce surface methane concentration to below 500 ppm before the installation of an additional well would be required.

In both cases of unscheduled system expansion (i.e., when negative pressure cannot be maintained or when methane concentrations exceed 500 ppm), 120 days are allowed for the installation of the required well or other collection device. More time is allowed than for scheduled expansions because the availability of materials, drilling rigs or contract personnel on short notice is less certain.

Comment: One commenter (IV-D-19) warned that a variety of operational considerations may affect the installation and operation of collection and control systems. The considerations the commenter mentioned were: equipment traffic, settlement of landfill cover surfaces, effects of bailed waste, changing topography, weather, barometric pressure, on-site structures, gas generation rate, maintenance and repair, and existing passive venting systems.

Response: The EPA agrees that these considerations will have an affect on the installation and operation of collection and control systems, as they do with many systems in various industries. All of these considerations, however, vary from site to site, and are best addressed by the local operator. The final standards have been revised to require owners and operators to submit site-specific design plans, prepared by a professional engineer, to the Administrator for approval.

2.14 COMPLIANCE

Comment: One commenter (IV-D-45) stated that all landfills should be addressed under the proposed regulation and requested provisions allowing coordinated emission control between new and existing landfills within close proximity to each other.

Response: The regulations require that the control device used for either new or existing landfill emissions be demonstrated to achieve 98 weight-percent efficiency. Co-control among landfills is allowed as long as 98 weight-percent efficiency is achieved. However, the EPA does not plan to promulgate specific provisions to address co-control among landfills. Furthermore, not all landfills require control. See section 2.4.1 for rationale for the selected design capacity and emission rate cutoffs.

Comment: One commenter (IV-D-7) indicated that they had designed a gas collection well equipped with a 48-in diameter well from the bottom up beginning at the liner level, and the commenter questioned whether this successful design would be allowed under the proposed regulation. The commenter indicated that the proposed regulations will be a burden on landfills with active gas collection systems already installed. The commenter suggested exempting these landfills under the BDT definition or else exempting them if they are below the EPA's proposed significance level of 40 tons/yr of NMOC.

Response: Specific prescriptive designs have been eliminated from both the NSPS and the EG, and a design plan meeting the conditions of § 60.752(b)(2)(i) or § 60.33c(b) must be submitted to the Administrator for approval. Thus, as long as the system meets the criteria in the rule and the design plan is approved, a well of any design may be included.

For an existing system, the owner or operator may continue to use the existing system as long as the system is effectively collecting LFG from all gas producing areas of the landfill, and negative pressure can be maintained at each wellhead without excess air infiltration. Quarterly Monitoring must also show surface methane concentrations below 500 ppm. The adequacy of the system must be demonstrated to the State regulatory agency.

Collection and control systems are required only if the landfill design capacity exceeds 2.5 million Mg or 2.5 million m^3 and the annual NMOC emissions exceed 50 Mg/yr, calculated by procedures specified in the rule. Landfills below these cutoffs do not need to submit a collection system design plan or install a system.

Comment: One commenter (IV-D-2) stated that collection systems have been estimated to be 60-percent efficient on average, and that landfills near residential areas should be required to have a 95 percent efficient collection system and a 99.99 percent efficient treatment system.

One commenter (IV-D-19) stated that a 98 weight-percent effective gas collection system efficiency is often not achieved because of variability of gas generation, decomposition rates, and gas distribution resulting in efficiencies of 40 to 80 percent. Therefore, they suggested that the regulations reflect that existing gas control systems in place at established landfills should be allowed to continue operation if they collect gas at a reasonable rate.

Response: The 98 weight-percent referred to in the regulation is a 98-percent reduction of collected emissions not a 98 percent emission collection efficiency. A percent reduction standard is not specified for gas collection systems because it is difficult and impractical to quantify the performance of a gas collection system. Therefore, a design and work practice standard has been set for gas collection. Site-specific risk factors such as location are not addressed by the NSPS program which is intended to provide uniform national minimum standards based on BDT. State and local programs can address site-specific problems.

2.14.1 Compliance--Schedule

Comment: Several commenters (IV-D-19, IV-D-20, IV-D-27, IV-D-29, IV-D-56) contended that more time would be required to come into the various phases of compliance. One commenter (IV-D-56) requested that additional time be allowed in order to spread out the costs of designing and installing the control system. Another commenter (IV-D-19) said administrative delays at municipally run landfills, such as mandatory requirements to obtain competitive bids before ordering equipment, may often warrant more flexibility in the time schedule.

Another commenter (IV-D-27) anticipated that there would be significant delay in adequate review and approval of submitted designs, due mostly to lack of expertise with LFG collection system design within the State offices. The commenter recommended that owners and operators experiencing such delays should be granted an extension on the time allowed for installation of the system, rather than being required to install the system prior to approval in order to meet the 1-1/2 year deadline within the proposed regulation.

Another commenter (IV-D-17) was concerned that the technical expertise needed to meet the requirements of the regulation are beyond most of the municipal landfill operators capabilities.

One commenter (IV-D-32) questioned whether § 60.752(b)(2)(ii) of the proposed rule, which requires the installation of a collection and control system within 1-1/2 years of submittal of a design plan or notification of intent, refers to the final or initial stages of installation. Furthermore, the commenter stated that the time period of 1-1/2 years may be too lengthy. The commenter recommended that the time period be reduced to 1 year if the design plan submitted is modeled after the specifications and 6 months to begin the installation of a collection and control system.

One commenter (IV-D-39) suggested that the requirement that gas collection systems be installed at landfills not meeting the proposed 150 Mg/yr emission rate cutoff within 30 months of the effective date of a State emission standard be changed to allow for the phasing in of the program based on calculated NMOC emissions at each landfills. The commenter provided an example in which landfills with emission rates greater than 300 Mg/yr could be required to be in compliance within 30 months, those with rates at or between 200 and 300 Mg/yr could have 48 months, and those with less than 200 Mg/yr could have 5 years. The commenter maintained that this phased approach would allow the regulatory burden to be spread out, since only a limited number of qualified contractors exist to perform the work and would target the efforts of the regulatory agency on those facilities with the greatest impact on the environment.

One commenter (IV-D-45) requested that the proposed period of 1 year to submit notification of intent to install collection and control systems be reduced to 3 months.

Response: As was explained in the proposal preamble, the EPA has established the compliance times for the submittal of the notice of intent to install a collection system designed in accordance with proposed § 60.758, now § 60.759, for review on the assumption that all site-specific testing that could be performed to exempt the landfill from control would be performed. A 3-month period between exceeding the regulatory cutoff and notification or plan submittal, as recommended by one commenter, would not be sufficient for those owners and operators electing to perform site-specific testing to verify that the regulatory level has been exceeded or demonstrate that emissions are below the regulatory cutoff. Although the EPA does not believe that all owners and operators would perform all the site-specific testing, it does not want to penalize those owners and operators who commit to install a system based on the earlier, more conservative, tier calculations either.

As was also discussed in the proposal preamble, the EPA expects that owners and operators would likely consult vendors and suppliers at the time of system design, which occurs within the first year after the regulatory cutoff is reached. This leaves an additional year and 9 months for the resolution of permitting difficulties. In the case of new MSW landfills, the EPA recommends that the initial permit include provisions addressing the installation of a collection system, should it become necessary.

In the case of existing MSW landfills, the first NMOC emission rate report would be submitted 90 days after promulgation of the State emission standard. The States will be required to submit their plans for Agency review and approval 9 months from promulgation of the final EG. The EPA must approve or disapprove the State plan within 4 months of submittal. Therefore, more than a year will likely pass before an existing MSW landfill would submit an NMOC emission rate report. Owners or operators of existing landfills might elect to perform the Tier 1 calculation ahead of time, in order to evaluate what future requirements might apply to the existing landfill. Finally, if permitting or other administrative hurdles cannot be overcome in a timely manner, the State may provide a longer compliance schedule pursuant to the provision of § 60.24(f)(3), based on "other factors specific to the facility (or class of facilities) that make application of a less stringent standard <u>or final compliance time</u> significantly more reasonable" (emphasis added).

<u>Comment</u>: One commenter (IV-D-21) recommended that 5 years be given for control compliance for energy recovery, instead of 3 years, because of the additional commercial and regulatory considerations.

<u>Response</u>: As provided in the regulation, the EPA feels that 3 years is adequate to install a collection and control system. No special provisions will be provided to use an energy recovery system. Using an energy recovery system is at the discretion of the landfill owner/operator and is not required by the regulation. An energy recovery system can be installed at a date after an initial control system is installed, but it is at the discretion of the landfill owner/operator and is not required by the regulation.

<u>Comment</u>: Two commenters (IV-D-18, IV-D-45) proposed that landfills close to exceeding the regulatory emission rate cutoff should not be allowed to accept additional waste until the collection and control system has been approved (IV-D-18) or installed (IV-D-45).

<u>Response</u>: The EPA views the regulatory emission rate cutoff as a threshold initiating the process of system design and installation, rather than a limit above which an unacceptable risk exists. This is why a landfill is considered to be "controlled" once a design plan has been submitted. The EPA recognizes that the process of system design and installation takes time, but does not agree that prohibiting waste acceptance until system approval and

installation is warranted, as long as the owner or operator is proceeding through the process.

2.14.2 Compliance--System Shutdown

Comment: One industry commenter (IV-D-27) recommended that integrated surface sampling be required during collection system shutdown to demonstrate "safe" surface emission levels. The commenter further recommended that owners and operators be required to keep records on each of these events.

A second commenter (IV-D-55) recommended that all flare systems be required to have automatic blower shutdown and valves to instantly stop the flow of LFG to the flare when there is a flame-out. The commenter also recommended that flares be required as backup systems where energy recovery systems are installed because downtime is more frequent with turbines and I.C. engines.

The commenter also stated that the negative pressure requirement limits the operator's ability to shutdown part or all of the collection system on a temporary basis for maintenance, repairs, and changes in gas flow (see also section 2.13, for more detail on changes in gas flow rate).

Response: In response to these commenters, the EPA has provided specific provisions regarding system start-up, shutdown, and malfunction in § 60.755 of the final NSPS which reads as follows:

> "(e) The provisions of this subpart apply at all times, except during periods of start-up, shutdown, or malfunction, provided that the duration of start-up, shutdown, or malfunction shall not exceed 5 days for the collection systems, and shall not exceed 1 hour for treatment or control devices."

The various provisions recommended by the commenters were considered; however, the EPA wanted to avoid adding provisions that are not directly linked to compliance. Compliance with the standards for collection systems is the installation and operation of a properly designed system. The surface emission limit added as part of the surface emission monitoring was included under the operational standards. The EPA is using it to verify that the system is adequately operated and maintained, and not to ensure an emission limit, surface or otherwise, as normally required under section 111. For example, surface sampling may demonstrate that emission levels are increasing when the collection system is shut down, but a shut-down system cannot possibly meet a standard requiring that a collection system be actively collecting LFG. Therefore, in this case, getting the system back on line is the primary concern.

The 5-day period for collection systems was selected in recognition that a major problem with a collection system will likely take longer than an hour to locate and solve but also that the landfill is not going to stop generating LFG. Localized problems with crushed pipes, etc., may be resolved through adjustments to the draw from other wells in the vicinity until repair is effected. If the blowers need to be repaired or replaced, the collection/control system may be able to function temporarily as a passive system while repairs are effected. However, the EPA has no data upon which to base how long such an arrangement would be feasible. Therefore, owners and operators should take care to plan for such contingencies. A 5-day initial attempt at repair has been required in other regulations requiring that VOC-laden gas be routed to a control device. Absent any clear data to support a different time-period, the EPA has adopted that repair period for this NSPS.

Similarly, requiring a backup flare when an energy recovery device is used for control is one method of ensuring that LFG can be routed to a backup device while such systems are down. It could be argued that backup flares should also be required for those sites electing to use flares for controls. In practice, however, most sites currently collecting landfill gas have multiple control devices, whether multiple flares, I.C. engines or turbines or combinations of the above. Therefore, only a short period of time would be necessary to relight a flare or reroute the collected gas to an alternative device. For purposes of these regulations, the issue is that the gas is routed to a control device, not what specific provisions the owner or operator has made to ensure that control is achieved. Whether the owner or operator has arranged with vendors for quick turnaround on replacement parts, has spared system components on site, or has multiple devices on line so that the flow may be distributed among them, compliance may be maintained without the EPA specifying a particular strategy. Therefore, the EPA has elected to specify a downtime that is acceptable under these regulations, and leave the strategy on how to comply to the owners and operators to negotiate with the appropriate regulatory agency.

After consideration of the comment regarding automatic blower shutdown, the EPA has included provisions requiring that the gas mover system be shutdown and all valves to the collection and control system closed whenever the control device is inoperable. The provisions also require that the control device be operated at all times when LFG is routed to the device. Again, in an effort to avoid requiring that landfill owners and operators comply with the NSPS in only one of many alternative means of compliance, the EPA is not requiring that this be accomplished through the use of automatic devices. While these devices may be appropriate in many cases, there may be very small systems that could be just as easily shut down manually. If landfill emissions were routed to the atmosphere through the collection and control system for some portion of an hour, this would still be a relatively small emission event.

2.14.3 Compliance--System Expansion

Comment: One commenter (IV-D-17) stressed that requiring gas collection in areas that continue to accept waste is too costly for operators because these collection systems will be deserted within a short time after the area reaches capacity. The commenter suggested that only those parts of a landfill which have received the final cover should be required to install emission controls. Another commenter (IV-D-29) stated that the criteria for installing wells should be based on emission potential in a given area rather than a 2-year requirement.

A third commenter (IV-D-22) added that it often takes more than 2 years for a given area to achieve final grade and to be closed with the application of a final cover. The commenter said that the appropriate time for installing wells needed to be determined on a site-specific basis. The commenter asked if "area" was defined.

Three commenters (IV-D-20, IV-D-29, IV-D-39 and IV-F-3) advised that the 2-year time frame requirement for installing extraction systems is not reasonable and/or does not appear to coincide with common operational practices at MSW landfills. One of the commenters (IV-D-20) recommended that all landfills be required to achieve final grades in a given phase as soon as possible and to close those portions thereof annually. The commenter further recommended that the owner or operator be required to incrementally extend the extraction well field to all recently closed areas every 2 years after filling begins in a phase. Another of the commenters (IV-D-29) said control in an active landfill should be determined by specific criteria instead of a time limit.

One commenter (IV-D-27) requested that owners and operators be allowed the flexibility to demonstrate that additional wells are not necessary due to low gas production levels in a given area, and not have to install additional wells within 2 years of waste deposition, as required by the proposed regulation. The commenter suggested that greater clarity about when collection must commence in each new cell is needed.

Response: As a result of further analysis in response to commenters' concerns, the EPA has modified the final NSPS to require installation of wells or other collection devices within 60 days of the date in which the initial solid waste has been in place for a period of 2 years or more for areas closed or at final grade, or 5 years or more for active areas.

The 5 year period is believed to be more reasonable and consistent with common landfill practices than the proposed 2-year period for active areas of the landfill. Landfill areas are typically active for more than 2 years. If collection system wells were required for all areas within 2 years, they would likely be covered over. The covering of these wells would either decrease their operational life, or require extension of the well upward, significantly increasing costs. A period longer than 5 years is not allowed because emissions from a given block of waste will decline over time, so it is important to install collection and control systems as soon as reasonably practical. For areas that are closed or at final grade, collection systems must be installed within 2 years, as at proposal.

The final provisions allow the exclusion of "nonproductive" areas in § 60.759(a)(3)(ii). This provision may be used to exclude areas from control, so long as the aggregate emission potential of all areas excluded under this provision is less than 1 percent of the landfill's overall emission potential. (Segregated areas of asbestos or nondegradable waste may also be excluded and are not subject to the 1 percent criteria.)

As discussed in chapter 3 and appendix D of the proposal BID (EPA-450/3-90-011a), the gas generation rate model used in the development of these regulations assumes that after a negligible lag time, the gas production rate is at its peak for a discrete mass of waste, and decreases exponentially thereafter as the organic fraction of the refuse decomposes. Although the lag time is characterized as negligible, according to the gas generation rate model used, it can vary from several weeks to a few years. This peaking rate followed by rapid decline is the basis for the 2-year collection requirement at closed areas. The 5-year period for active areas was added to be in keeping with current operational practices at MSW landfills and to reduce costs and inefficiencies that would be associated with installing wells in active areas and then covering them over as more refuse is deposited. The EPA considers this 2-year/5-year split a common sense approach to ensure that all gas producing areas are being appropriately controlled.

Since the calculation of the overall emission rate involves summing the emission rate from each yearly submass of refuse, and the rates will vary inversely with age, the maximum production from an area for purposes of these regulations will occur close to the time of its deposition, and its contribution to overall emissions will decline continuously thereafter. It is important, therefore, to install collection wells into refuse as soon as possible.

The same calculation that establishes overall emissions can be used to calculate emissions from discrete segments of waste, provided that the age of the refuse is known. Since the model takes into account the age of the refuse, theoretically, the individual annual fills can be ranked by productivity and the least productive excluded from control (up to 1 percent of total emissions).

It is important to note that the exclusion of refuse from collection does not extend to the determination of applicability. All waste present in the entire landfill must be included in the calculation of the overall NMOC emission rate for purposes of determining whether gas collection and control is required, except for segregated, documented masses of nondegradable refuse such as cement or nondegradable demolition wastes.

2.15 RECORDKEEPING AND REPORTING

Comment: Several commenters (IV-D-17, IV-D-27 and IV-F-5, IV-D-36) requested that the EPA provide additional clarification about the reporting and recordkeeping requirements. Three commenters (IV-D-20, IV-D-27, IV-D-36) said that the reporting and recordkeeping requirements were too administratively burdensome. One of the commenters (IV-D-27) contended that the recordkeeping and reporting provisions of the proposed regulations were too burdensome to the State agencies responsible for reviewing them and that annual instead of semiannual submissions should be required. The commenter also suggested that greater clarity about the various elements necessary in each report is needed. However, three commenters (IV-D-36, IV-F-5, IV-F-6) proposed that if the reporting and recordkeeping effort was in support of data base development, even landfills below the proposed design capacity exemption should participate.

Response: The recordkeeping and reporting requirements of the NSPS include only those records and reports necessary under the provisions of section 111 to verify applicability under or exemption from the standards, that control equipment is properly operated and monitored, and to verify compliance.

The design capacity report alerts the regulatory authorities to the presence of a landfill subject to the standard, whether or not that landfill is subject to control. The NMOC emission rate reports track the increase in emissions at subject landfills and indicate when control will be necessary. The closure report is necessary to indicate that either an uncontrolled source will never be subject to control, or that removal of controls at a controlled source is approaching. The equipment removal report allows the authority to review the basis for equipment removal and to verify that all three criteria are met.

The purpose of the proposed semiannual report was to verify that the collection and control system was operated in compliance with the standards and to provide information on the frequency and duration of noncompliance periods. The regulations list the information to be included in each report.

After considering the comments and the Agency's initiative to reduce recordkeeping and reporting burdens, the frequency of the semiannual report has been changed to annual. By reducing the frequency, the cost burden of generating reports will be reduced. Information on noncompliance periods will still be reported within a year of their occurrence, which is sufficient to allow timely enforcement of the rule. An annual reporting period is consistent with other NSPS and with the Title V permit program requirement for annual compliance certification.

All of the records required under the NSPS are necessary so that the design, installation, and performance of the system can be shown to comply with the NSPS. The reports submitted by landfills above the design capacity exemption provide substantial amounts of data for review. Requiring calculation of emission rates and reports by MSW landfills below the design capacity exemption would be an unwarranted burden and is not necessary to ensure that the regulations are met.

Comment: Two industry commenters (IV-D-27, IV-D-32) requested that the EPA clarify the information required for the closure report referenced in § 60.756 of the proposed NSPS. The commenters also said that the compliance report required in § 60.756(e) of the proposed NSPS only addresses vertical well systems, and needs to be expanded to cover any approved design, such as is allowed in § 60.752.

Response: The closure report in § 60.757 of the final NSPS must certify that waste deposition has ceased at the landfill, and that additional waste deposition will not occur without permit modification as described under § 60.7(a)(4). Since the gas-generation model used results in a decreasing NMOC emission rate for each unit of landfilled waste over time, once waste deposition has ceased, the calculated NMOC emission rate would continually decrease after closure.

In response to the commenters concern about compliance reporting for alternative designs, the EPA reanalyzed the requirements. The final rule no longer provides specific design specifications. Instead, it provides criteria for active gas collection systems (see § 60.759). Design plans for systems meeting these criteria must be prepared by a professional engineer and approved by the Administrator. In addition, § 60.752(b)(2) of the final rule allows for design plans for collection and control systems that do not meet the criteria in § 60.759. These provisions will allow use of any type of active or passive system as long as it meets the general criteria in § 60.752(b)(2) and an adequate design plan is submitted and approved. In addition to design information, design plans must include any alternatives to the operational standards, test methods, compliance procedures, monitoring, recordkeeping or reporting provisions and a demonstration to the Administrator's satisfaction of the equivalency of the alternative provisions.

Comment: One commenter (IV-D-18) suggested that if it appears that at any time in the future a landfill will meet the proposed emission rate cutoff of 150 Mg/yr and a collection and control system will need to be installed, then a notification of intent to install a collection system should be submitted immediately.

Response: The notification of intent to install a collection or control system design plan must be submitted within 1 year of the report of the determination that the emission rate exceeds 50 Mg/yr. The timeframe for submittal of the design plan was developed after careful consideration of typical testing and reporting intervals, and with a sensitivity to the variability inherent in landfill operations.

Landfill emissions vary substantially over time. Designing collection and control systems requires considerable resources, and design plans should not be required unless it is evident that control will actually be required. Waste acceptance rates, landfill practices, and local regulations change frequently enough that a design plan that seems appropriate today for a need anticipated in the future may actually be infeasible when the time comes to install. In some cases, waste acceptance rates may even decrease resulting in lower emissions than predicted. For example, rates might decrease if a given community were to prohibit the acceptance of yard waste. Some landfills may close down before the anticipated emission rate is reached. The EPA is not prepared to require landfill owners and operators to expend resources developing a collection and control plan before it is reasonably certain that the system will, in fact, be required.

Comment: Three commenters (IV-D-20, IV-D-51, IV-D-54) argued that the proposed 100,000 Mg design capacity exemption for reporting requirements is too low in relation to the proposed 150 Mg/yr rate of NMOC emissions required to install controls (IV-D-51 included model parameter information). Two of the commenters (IV-D-20, IV-D-54) cautioned that this will burden small landfills and State regulatory agencies. They claim that proper cutoffs for periodic reporting for emission rate cutoffs of 150 and 100 Mg/yr of NMOC are 550,000 Mg of waste and 375,000 Mg of waste, respectively.

One commenter (IV-D-44) stated that due to difficulties of estimating the lifetime and design capacity of landfills, the cutoffs for reporting for levels of 150 Mg/yr of NMOC apply only to landfills within an acceptance rate exceeding 35,000 Mg/yr.

Another of the commenters (IV-D-20) suggested that design volume, and not waste mass as proposed by the EPA, be used in deciding the reporting cutoff level. The commenter (IV-D-20) presented data on waste compaction density and advised that data on design volume is easier to compile and will be less of a burden on States to regulate.

Response: The design capacity exemption was reevaluated in the interim between proposal and promulgation, and has been revised to 2.5 million Mg or 2.5 million m^3. This level was chosen because it significantly reduces the reporting and recordkeeping burden on the landfills as well as the State and local agencies, while only about 15 percent of the potential NMOC emission reductions are lost. Setting a reporting requirement based on annual acceptance rate does not take into account that the landfill could have large amounts of refuse in place emitting more than 50 Mg/yr. Section 2.4.1 of this chapter, "Design Capacity Exemption," includes further discussion on this topic.

Comment: One commenter (IV-D-32) stated that § 60.753(b) of the proposed regulation, which discusses the calculation of the NMOC emission rate after a gas collection system is installed, is unclear about whether the calculated NMOC emission rate should be reported, and if so, how often and to whom. The commenter also questioned what should be done if calculated emissions exceed 150 Mg/yr and whether this NMOC calculation will be the basis for collection system modifications.

The commenter (IV-D-32) recommended that § 60.756(a)(1) of the proposed regulation specify the scale of the map which the regulation requires to be submitted. The commenter also suggested that § 60.756(d)(1)(iii) of the proposed regulation include a reference to the correct method and equation to be used in calculating NMOC emissions reports required by the collection equipment removal report.

Response: Section 60.754(b) of the final NSPS provides an equation to calculate the NMOC emission rate after a collection system has been installed. This calculation is necessary to determine the NMOC emission rate for a pre-existing system and for system removal. A landfill is exempt from the requirement to calculate and report an annual NMOC emission rate [see §§ 60.752(b)(2) and 60.757(b)(3)] while complying with the provisions for collection and control. The NMOC emission rate must, however, be calculated in order to meet the conditions for system removal in § 60.752(b)(2)(v). Since better information for estimating the NMOC emission rate would be available from the system, the EPA is requiring the use of procedures including this information as a condition for system removal. The final regulation does not specify the scale of the landfill map, but leaves this decision up to the discretion of the landfill owner or operator. Different scales may be appropriate to present different configurations.

Comment: One commenter (IV-D-32) stated that the regulation does not distinguish between isolated units of a landfill that may have been closed years ago and units that are still accepting waste. The commenter pointed out that the older portions would be used to calculate NMOC emissions and this would not represent the NMOC emissions of the newer portions. The commenter recommended that these issues be resolved and that a registered civil engineer or certified engineering geologist certify that the site is closed before it is considered closed.

Response: The equation for estimating NMOC emissions in § 60.754(a)(1)(i) of the final NSPS accounts for reduced emissions from older portions of a landfill by utilizing the actual year-to-year waste acceptance rate. If the year-to-year waste acceptance rate is not known, the equation presented in § 60.754(a)(1)(ii) of the final NSPS must be used.

Comment: One commenter (IV-D-18) requested that the EPA revise the provisions for compliance reports to include immediate documentation of equipment malfunctions. In addition, the commenter argued that semiannual reports should be made public. Another commenter (IV-F-6) stated that flare flame outages should be reported if they exceed 1 hour.

Response: Since proposal, the semiannual reports have been changed to annual reports in order to reduce the reporting burden. As specified in the final rule, annual reports must contain the following information:

(1) Value and length of time for exceedance of monitored parameters.

(2) Description and duration of all periods when the gas stream is diverted from the control device or has no flow rate.

(3) Description and duration of all periods when the control device was not operating for a period exceeding 1 hour and length of time the control device was not operating.

(4) All periods when the collection system was not operating in excess of 5 days.

(5) The location of each exceedance of the 500 parts per million methane concentration and the concentration recorded at each location for which an exceedance was recorded in the previous month.

(6) The date of installation and the location of each well or other collection device added to the collection system pursuant to § 60.755.

As stated under (3) above, flare flame outages of less than one hour are not required to be reported in the annual report. However, all periods exceeding one hour must be included in the report. The 1-hour time period assures that significant emission events are reported, while allowing for short-term problems that are rapidly corrected. There are unavoidable circumstances that will cause short term problems in the operation of flares and other control devices. The 1-hour time period is reasonable to allow operators time to discover the problem and correct it or route emissions to a back-up control device. The amount of emissions released in a period shorter than 1 hour would be relatively small.

The public may obtain copies of annual reports by contacting the government agency or landfill operator responsible for the reports. The availability of information to the public is discussed in 40 CFR 60.9.

Comment: Two commenters (IV-D-18, IV-D-45) requested that landfills be required to submit annual reports and not be allowed to submit the 5-year estimates allowed under the proposed regulations because of the negative health affects of NMOC.

Response: The report submitted with the 5-year estimates is the same report as the annual report except emission estimates are reported for 5 years instead of one. The only factor affecting the accuracy of the 5-year report that does not influence the 1 year report, is the difficulty in predicting acceptance rates in the future.
Section 60.757(b)(1)(ii) of the final NSPS requires the owner or operator to submit a revised 5-year report if the acceptance rate exceeds the estimated waste acceptance rate in any year reported in the 5-year estimate. The EPA considers

the 5-year report as effective as 5 annual reports in tracking NMOC emission potential.

2.16 REGULATORY OVERLAP

Comment: One commenter (IV-D-19) voiced concern about the regulatory overlap due to differing regulatory requirements between local, State, and Federal agencies. The commenter suggested creating provisions to increase coordination among the various agencies to aid in permitting, and other administrative duties. Another commenter (IV-D-39) commented on the statement, "the State, county, or Administrator may request other reasonable information as may be necessary to verify the maximum design capacity of the landfill" and "reported NMOC emission rate." The commenter stated that the inclusion of three separate governmental bodies in the requirement is unworkable and will place undue burdens on the landfill owners/operators in responding to information requests. Also, the commenter was concerned with the fact that the term "reasonable" is undefined and since no authority has been granted to a regulatory agency to determine "reasonableness," it would be possible that allowing this provision could be used to delay operations at a landfill. The commenter recommended that "State, county, or Administrator" be deleted from the requirements and be replaced with "Administrator." The term "Administrator is defined in the General Provisions to 40 CFR 60 as the Administrator of the EPA or his authorized representative. In most cases, the States have been authorized to implement NSPS.

Response: The EPA shares the commenters concerns over regulatory overlap and encourages States to increase coordination among agencies responsible for issuing permits. In order to reduce ambiguity, the term "reasonable" will not be included in the final regulation as it is not referred to in the General Provisions. As requested by the commenter, references to State, county, or Administrator will be replaced by the term "Administrator." The term "Administrator" is defined in the General Provisions to 40 CFR 60 as the Administrator of the EPA or his authorized representative. In most cases, the States have been authorized to implement NSPS.

Comment: One commenter (IV-D-2) stated that the standard was inconsistent with Federal RCRA regulations. The commenter explained that MSW landfills normally contain an unregulated amount of RCRA waste as household toxics, and, therefore, the landfill should be subject to a greater level of control, such as 99.99 percent instead of 98 percent.

Response: The EPA disagrees with the comment that the regulations are inconsistent with RCRA and that the presence of household wastes warrants greater control. This rule is based on BDT. As explained in the proposal preamble and in section 2.6.3, the best demonstrated level of control is 98 percent. There are no demonstrated technologies that are applicable for all landfills that achieve 99 percent or greater reduction at a reasonable cost. Household toxics may be included in household waste, but air emissions resulting from them are not subject to greater control under RCRA than under these regulations. A landfill subject to these regulations is not exempt from any of its RCRA responsibilities. Air emissions from the landfill may also be subject to the BDT of the air criteria under 40 CFR 258.24 of subpart C.

2.16.1 Superfund Interface

Comment: One industry commenter (IV-D-27) supports the designation of BDT under these regulations as "applicable or relevant and appropriate requirements" for Superfund sites, noting that properly designed passive systems should also be permitted for Superfund sites without synthetic liners, due to the short-term nature of many of these projects.

One commenter (IV-D-48) stated that Superfund sites already address most of the factors (ozone production, carcinogenic risk, threat of fire and explosion) listed in the proposed standards in support of gas collection and control systems. The commenter explained that the majority of Superfund landfills contain only about 10 percent industrial wastes, yet the financial burdens of control will be absorbed by industry as the regulation is currently written.

Response: A Superfund site that is also a former MSW landfill that would otherwise be covered by these regulations presents identical concerns to those presented by a non-Superfund MSW landfill. The applicability of these regulations is based on NMOC emission rate. If the Superfund landfill emits NMOC above the emission rate level, installation of a collection system is appropriate and relevant, as well as applicable. The collection system must meet the minimum design requirements in the EG which are essentially equivalent to those of the NSPS. Generally, passive systems with add-on control for the collected gases may not be as practical or economical as active systems, but the regulations allow the use of them as long as they have liners and equivalency is demonstrated as discussed in § 60.752(b)(2) of the final NSPS.

2.16.2 Prevention of Significant Deterioration Interface

Comment: One commenter (IV-D-23) requested clarification of whether the BDT in the proposed regulations will satisfy the BACT requirements under the PSD program and when further control measures should be implemented as part of BACT decisions.

Response: The BACT decision under the PSD program is made on a site-specific basis when the landfill is permitted in order to address a broader range of site-specific concerns than under section 111. The BDT establishes a minimum control level for new landfills, and BACT decisions cannot be less stringent than BDT. The BDT may serve as BACT in many cases. However, a PSD review is still required for individual new or modified landfills that meet PSD applicability criteria, and BACT will be determined during the review based on the considerations required under the PSD program. The PSD program is separate from the NSPS; the NSPS regulation will not address BACT determinations.

Comment: One commenter (IV-D-17) suggested that estimating ambient air contaminant levels using a screening method (they mentioned Air Guide 1, NYSDEC) would help determine the effects of NMOC on sensitive receptors within the surrounding landfill area. The commenter requested that air review parameters (i.e., location of sensitive parameters, site wind rose, etc.) should be included under § 60.756 in the proposed regulation.

Response: These regulations are being developed and promulgated under section 111, which requires the application of BDT, not modeling of ambient concentrations at "sensitive receptors," as required under the PSD program.

Comment: One commenter (IV-D-54) stated that no changes would need to be made to the PSD provisions in 40 CFR 51.166 and 40 CFR 52.21 if LFG is regulated as VOC. The commenter explained that regulating MSW landfills under PSD would not be useful since new landfills are now covered under the NSPS which requires that BDT be used for the control of LFG. The commenter stated that since PSD increments or NAAQS have never been proposed for MSW emissions or NMOC, ambient air quality impact analysis for LFG or VOC would have no significance. The commenter noted that they have not come across any unit risk factor data for LFG. The commenter also stated that LFG is generated as fugitive emissions and it is unlikely that a new or modified landfill would need to undergo pre-construction review since fugitive emissions would not be counted for applicability purposes under the existing federal PSD provisions.

Two commenters (IV-D-26, IV-D-39) recommended that PSD review be based on existing PSD criteria and not on the new "_de minimis_" level for NMOC. The commenters stated that there is no need to impose stricter PSD review standards on landfills for NMOC than those currently applicable to other industries and other sources which emit the similar compound, VOC, at equivalent or greater rates.

Response: The EPA is designating MSW landfill emissions as a designated pollutant under sections 111(b) and (d) on the basis of both health and welfare impacts. The MSW landfill emissions consist of a composite of pollutants including methane and NMOC. The constituent pollutants that make up the MSW landfill emissions can vary significantly both within a landfill and from landfill to landfill. Thus, to reduce the burden of measuring all components of MSW landfill emissions, the EPA is designating NMOC as a measurement surrogate for MSW landfill emissions. The NMOC are designated because NMOC include VOC as the commenter has recommended, as well as photochemically nonreactive compounds, including both toxic and nontoxic compounds, that are of concern under this rulemaking.

A consequence of this action is that the PSD regulations would now apply to all MSW landfills defined as major sources which would have "significant" increases in this pollutant (MSW landfill emissions measured as NMOC). Absent any significance levels in the PSD regulations to exempt _de minimis_ situations, PSD review would be triggered by any increase in MSW landfill emissions. Thus, to maintain a manageable review process, MSW landfill emissions need to be added to the part 51 and 52 list of PSD pollutants and a significance level established. The EPA proposed to establish 40 tons/yr (measured as NMOC) as the significance level for MSW landfill emissions. However, in consideration of public comments, the final rule establishes a significance level of

45 Mg/yr (50 tons/yr) of NMOC. Given the typical composition of landfill gas, a 50 tons/yr NMOC level is comparable to the previously established PSD significance level of 40 tons/yr of VOC. Under NSR regulations, a PSD review would be required for increases in MSW landfill emissions at major sources at or above this significance level.

While it is true that the PSD regulations state that fugitive emissions are not counted toward the potential to emit of a source category which is not specifically listed, the PSD regulations define fugitive emissions as those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening." It is feasible for a landfill to install a gas collection system, as is required for some sources under these regulations. Therefore, MSW landfill emissions, which can be collected, are not fugitive emissions for PSD purposes. Thus, the commenters' assertion that the emissions would not be counted to determine applicability is not valid. These regulations also establish methods by which NMOC emissions from MSW landfills can be calculated and compared to the lists in parts 51 and 52, for PSD applicability purposes.

Comment: One commenter (IV-L-1) suggested that 40 tons per year of NMOC emissions be added to the definition of significance for nonattainment NSR at 40 CFR 51.165(a)(1)(x) in addition to those changes proposed to the PSD regulations at 40 CFR 51.166 and 52.21.

Response: Under the final rule, 40 CFR 51.166 and 52.21 have been amended to include 50 tons per year of NMOC. Nonattainment new source review at 40 CFR 51.165 covers only those pollutants for which NAAQS have been established. Since NAAQS for NMOC have not been established, NMOC cannot be added to the definition of significance for nonattainment new source review. However, because VOC are a significant portion of NMOC and a significance level for VOC (related to the ozone

NAAQS) is included in 40 CFR 51.165(a)(1)(x), landfills are sources that must be considered for nonattainment NSR.

Comment: Two commenters (IV-D-26, IV-D-39) said that clear guidelines for PSD review should be established so that timely, objective decisions can be made as to whether either PSD permits will be required or determinations of nonsignificant impact will be granted to the landfill. Further, the commenter suggested that the EPA should decide whether there is a need for PSD review of new or modified landfills since open and/or enclosed flares are BACT, and no other practical methods of reducing methane and NMOC emissions exist. One of the commenters (IV-D-39) asserted that under the NSPS, proper landfill capping, reducing leachate, and other landfill operational factors have no bearing on the calculation of the NMOC emission rate.

Response: The New Source Review Workshop Manual provides guidance on the process by which new sources and major modifications are evaluated for applicability to the PSD regulations. This manual was published in draft form in October of 1990. In addition, for MSW landfills, the definition of a major source (in 40 CFR parts 51 and 52) establishes the size at which emissions from a landfill are considered in determining whether or not the landfill is major. Further, the definition of "significant" in those regulations will include the threshold level at which an emissions increase is significant.

The CAA, in section 165(a), requires that all major stationary sources and major modifications proposed for attainment areas be subject to PSD review. A PSD permit review is a case-by-case evaluation of a proposed major new source or major modification. A BACT determination is one of the requirements of a PSD permit review [see section 165(a)(4)], and BDT may or may not equate with BACT. The EPA is currently selecting properly designed gas collection and combustion devices achieving 98 percent NMOC emission reduction as BDT for landfills emitting greater than 50 Mg/yr of NMOC under these rules. However, States may decide to consider other, or more stringent, control systems as BACT, or require controls on landfills emitting less than 50 Mg/yr of NMOC. Thus, PSD review would still be needed for new or modified landfills.

Comment: Two commenters (IV-D-18, IV-D-45) wanted the standards to include provisions stating that MSW air emissions from landfills on National Park or Forest lands will not be allowed to negatively affect the air quality of these National Park or Forest lands. In addition, one of the commenters (IV-D-18) suggested that lowest achievable emission reduction (LAER) be used in place of BDT if any forms of waste are accepted from outside of the National Park or Forest or if any Federal park or forest land is exchanged for the purpose of creating a landfill.

Response: The PSD program provides for the protection of air quality in those National Parks and National Forests designated as Class I areas. Major new sources and major modifications in PSD areas are required to apply BACT and to model air quality impacts, including whether the proposed source would cause or contribute to exceedances of NAAQS or increments. There are no NAAQS or increments for "MSW landfill emissions," but other provisions of the PSD regulation specifically designed to protect Class I areas still apply. Concerned Federal land managers may, for example, use the air quality impact analyses to determine whether there will be an adverse impact on AQRVs. If the reviewing agency agrees with a Federal land manager's adverse impact determination, the agency must deny the permit.

For National Parks and other federal lands not classified as Class I, the PSD program still offers protection from MSW landfill emissions through the additional impacts analysis, which is an assessment each PSD permit applicant must make of the impact the proposed source or modification will have on soil, vegetation, and visibility. The Federal land manager can argue that there will be unacceptable impacts based on these studies.

Finally, there is no regulatory authority for requiring LAER for MSW landfill emissions because LAER applies only to major sources of a nonattainment area pollutant, and there are no attainment areas for MSW landfill emissions. New or modified landfills may, however, be subject to nonattainment area major source review (or to PSD review) if the VOC emissions from the landfill exceed the threshold levels for major status. In attainment areas, the threshold for major sources is 250 tons/yr. (For certain listed categories, the threshold is 100 tons/yr, but landfills are not one of the categories listed in the PSD rules, so the 250 tons/yr threshold applies.) Fugitive emissions are not included in determining whether the 250 tons/yr threshold is exceeded, but collectable emissions must be included. Because this NSPS and EG have found collection systems to be feasible, most landfill emissions are considered collectable for PSD purposes. The EPA estimates that approximately 70 percent of NMOC emitted by MSW landfills is VOC as presented in the memorandum "Estimating the percentage of non-VOC constituents in Municipal Solid Waste Landfill Nonmethane Organic Compound Emissions" (Docket No. A-88-09, Item No. II-B-39). If the VOC emission rate exceeds 250 tons/yr in attainment areas or the major source threshold in nonattainment areas (from 100 down to 10 tons/yr, depending on the severity of the nonattainment area), then the landfill constitutes a major source and is subject to the PSD or nonattainment area provisions regardless of its NMOC rate.

2.16.3 Subtitle D Interface

Comment: Two commenters (IV-D-7, IV-D-26 and IV-F-6) expressed concern for the cost, handling, and treatment of gas condensate, sometimes classified as a hazardous material, resulting from gas collection and energy recovery systems. One commenter (IV-D-7) requested that the EPA keep in mind the outcome of having all future subtitle D landfills regulated partly as subtitle C (hazardous waste) landfills because the required gas collection system will produce gas condensate. Another commenter (IV-D-26) suggested that gas condensates be either specifically excluded from or specifically included under subtitle C.

Response: The liquid from gas condensate is only a hazardous waste if it is tested and determined to be a characteristic hazardous waste. A subtitle D landfill which generates a hazardous waste would not become a subtitle C landfill. However, the hazardous condensate would have to be handled at an appropriate TSDF.

Comment: One commenter (IV-D-15) wanted the EPA to discourage landfill siting in areas that already exhibit heavy pollution or that would add to deforestation. The commenter further said that the siting of a landfill requiring the removal of trees should be given an emissions rating prior to receiving any waste because it has already degraded air quality by removing trees, whereas the siting of a landfill on land already void of trees could be given a zero emissions rating.

Response: These regulations apply to air emissions from landfills. The siting of landfills is covered by RCRA subpart D, part 258, finalized on October 9, 1991 (56 FR 50978).

2.17 STATE PROGRAM SUBMITTALS

Comment: One commenter (IV-D-17) indicated that the requirement to submit a State program for implementing the EG to the EPA by the ninth month after promulgation was not reasonable because of the lack of revenues and resources needed to develop and implement a regulatory program such as this in such a short time period.

Response: The 9-month interval is mandated by section 111(d) of the CAA, and has been previously incorporated into the NSPS/EG program in 40 CFR 60.23.

Comment: One industry commenter (IV-D-27) recommended that the EPA develop a standard form for Tier 1 calculations. Two commenters (IV-D-27 and IV-F-5, IV-F-4) requested that the EPA provide guidance and oversight to the States in implementing the proposed regulations, especially in the areas of the Tiers and system design. The commenters were concerned that alternative designs would be difficult to get approved by review personnel.

One commenter (IV-D-51) requested clarification of the regulated pollutant for the collection of fees under the air permit program required by the CAA. In particular, the commenter requested specification of whether only NMOC, or all landfill emissions, are required to pay the air emissions fee.

Response: The EPA has developed a computer program, available on disk, to perform the Tier Calculations. The computer program called the Landfill Air Emissions Estimation Model (or LAEEM), can be obtained from NTIS, (703) 487-4650. Government Agencies can also acquire the program from the CTC, (919) 541-0800 within ESD of OAQPS. The program can also be down-loaded from the OAQPS CTC bulletin board system, (919) 541-5742. The bulletin board system operator can be reached at (919) 541-5384. The computer program was revised and will be available when the regulations are promulgated.

The EPA will publish guidance materials to assist in the implementation of and compliance with these NSPS and EG. An enabling document focusing on assisting the agencies who will be responsible for implementing the regulations will be available soon after the regulations become final. These materials would also be useful to landfill owners and operators. Additional enabling materials may also be available in the future to provide guidance to landfill owners and operators complying with the NSPS and EG. The enabling documents may include forms for completing the calculations for Tiers 1, 2, and 3 to assist the landfill owner/operator and the implementing agency.

Alternative collection and control system design plans are allowed under § 60.752 and require a demonstration to the Administrator's satisfaction of the equivalency of the alternative provisions to the criteria in § 60.759. The rule has been changed since proposal to remove the prescriptive design specifications in § 60.759 and to require site-specific design plans for active collection systems that meet the criteria in § 63.759 as well as those that do not. Thus, any design will require approval, and unique designs will not be discouraged.

The recently promulgated Title V program includes provisions for the collection of fees from all sources of CAA pollutants. This fee assessment was mandated by the CAA amendments of 1990 in order to provide relief to States in complying with CAA-mandated activities.

2.18 POLICY ISSUES

2.18.1 Consideration of Methane

Comment: Four commenters requested that methane emissions be considered to some degree in the development of the NSPS and EG. One commenter (IV-D-24) contended that methane reductions should have been considered directly in the selection of BDT because of methane's global climate change impacts, which the commenter considered a public welfare effect warranting attention under section 111 of the CAA. The commenter recommended using monetary values for CO_2 and methane established by several utility regulatory bodies in the selection process, noting that not to do so would be to arbitrarily assign methane's harmful effects a value of zero. The commenter reported that Massachusetts has assigned methane a value of $220/ton for similar kinds of analyses.

The commenter presented a brief history of the growing expertise on global climate change and the current view of the potential for climate change. Additionally, the commenter presented a range of strategies from various national and international bodies to address the issue. The commenter included a quote from the Bush Administration's National Energy Strategy which listed the proposed regulations as recent U.S. activities aimed at reducing greenhouse gas emissions. The commenter concluded that clear scientific consensus exists about the severity of the impact of greenhouse gases and global climate change. The commenter disagreed with the EPA's decision that the uncertainty as to the rate and magnitude of possible climate change was a reason not to regulate methane. The commenter argued that the EPA had inappropriately not considered recent NOAA experiments indicating that the role of methane in global climate change has been understated by approximately 25 percent. The commenter cited a paper which proposed that "MSW landfill methane reduction is one of the potentially most economical ways to...reduce greenhouse gas problems..."

Another commenter (IV-F-6) recommended that the control of landfill emissions should be based on methane, which would allow for establishing tax credits for recovery equipment, force utilities to pay a reasonable price for alternative energy, and allow for a methane recovery tradeable credit system to be developed.

One industry commenter (IV-D-27) supported the Agency's decision not to consider methane reduction directly in the selection of BDT, noting, however, that the methane reductions occurring indirectly from the proposal are significant. The commenter said that the EPA is currently investigating methane reduction, and will be in a better position to determine if additional control of MSW landfills is warranted after these investigations are completed.

Another commenter (IV-D-29) wanted only the ancillary benefits of methane to be considered since NMOC are the real focus of the proposed regulation.

Two commenters (IV-D-26, IV-D-33) wanted a separate methane standard to be developed to more completely address the health and environmental effects of methane. One of these commenters (IV-D-26) stated that a methane standard would help to control both the individual and aggregate effects of methane from landfills and help to address concerns such as global warming. Another commenter (IV-D-33) argued that NMOC are not an adequate surrogate for methane emissions and that methane merits its own standard according to section 111 of the CAA, which states that standards be established for sources which may endanger public health or welfare. The commenter cited several reasons methane poses a danger to humans and to the environment, including methane's role in global warming, ability to form ozone in the troposphere, ability to explode and emit odors, ability to transport toxic NMOC to the air and landfill surface, and negative effects on soil and vegetation. The commenter suggested using the same tier system approach for determining when controls need to be applied that is used for NMOC under the proposed regulation. The commenter advised the EPA to disregard the scientific uncertainties associated with the effects of methane on global warming and to formulate a separate methane standard to the final regulation.

Response: In setting standards and EG which reflect BDT under section 111 of the CAA, the EPA considered reductions of NMOC directly and methane reductions as an ancillary benefit. The NMOC was selected as a surrogate for MSW landfill emissions because NMOC contains the landfill air pollutants posing more concern, due to their adverse health and welfare effects. In addition, reducing NMOC concentrations in LFG will significantly reduce the amounts of methane contained in LFG. It is estimated that the NSPS will reduce methane emissions by 3.9 million Mg on a NPV basis and the EG will reduce methane emissions by 47 million Mg on a NPV basis. The U.S. Climate Change Action Plan, released in October 1993, contains a series of actions to reduce emissions of methane from landfills and other sources. The Climate Change Action Plan forms the cornerstone of the U.S. National Action Plan required by the Framework Convention on Climate Change, which the U.S. signed in 1992. The EPA actions to reduce emissions of methane and other greenhouse gases will be guided by the directives contained in the Action Plan. Therefore, the EPA maintains that no separate BDT for methane is needed at this time.

Methane reductions have been quantified and considered as an ancillary benefit of NMOC reductions within these regulations. Furthermore, the nationwide impacts analysis was revised for the final regulations to incorporate the economic effects of the use of combustion devices that achieve energy recovery to comply with the standards. Since the feasibility of energy recovery is dependent on methane, incorporating energy recovery into the national impacts analysis does increase the influence of methane on the selection of the final NSPS and EG. The use of energy recovery did not change the final decision, however, because on a national basis it was not more cost effective than flares. See section 2.18.2 for a discussion of this decision. The details of the revised analysis are presented under section 1.3.2, "Revisions to the Modeling Methodology" in chapter 1 of this document. The EPA has developed a Landfill Methane Outreach Program to lower barriers to landfill gas energy recovery and to encourage more widespread utilization of landfill gas as an energy source. Information regarding the program can be obtained by calling the Landfill Outreach Program Hotline at (202) 233-9042.

Comment: One commenter (IV-D-17) felt the regulation should focus on reducing methane emissions from larger landfills while encouraging reuse, recycling, and composting in order to reduce methane emissions from smaller MSW landfills.

Response: These regulations focus on large emitters, and although these are often larger landfills, some smaller MSW landfills may warrant control based on NMOC emission rates. These regulations, although based on NMOC emissions, will achieve significant reductions in methane emissions. The EPA is encouraging the use of source reduction methods such as reuse, recycling and composting through various programs, and such programs are being adopted at the State level as part of an overall waste reduction strategy. Because of the variability of economic impacts resulting from source reduction activities, the EPA considers the State and local level the appropriate place to make decisions on recycling and composting at this time. See the report, "The Solid Waste Dilemma: An Agenda for Action," (EPA/530-SW-89-019; February 1988) for a more thorough discussion of the EPA's overall solid waste policy. As discussed in the preamble to the final RCRA regulation (56 FR 50978; October 9, 1991), the EPA has begun a number of initiatives to expand recycling efforts, including: market studies, federal recycling procurement guidelines, the development of training materials for State and local recycling coordinators, publications (i.e., composting), and the establishment of a National Recycling Institute. The institute is comprised of business and industry representatives and will address recycling issues.

2.18.2 Consideration of Energy Recovery13

Comment: One commenter (IV-L-3) contended that the cost analysis did not consider that many areas of the country have strict air regulations which would require air emission control equipment to be installed on an energy recovery system, rendering an energy recovery project uneconomical.

Response: The cost analysis estimated the cost of installing flares at all landfills above the design capacity and emission rate cutoff, as well as the cost of energy recovery devices. There are many factors that play a role in the use of energy recovery that were not considered in the nationwide impacts analysis because of limited resources and because the impact of many of these factors cannot be accurately quantified. The selection of energy recovery is a site-specific economic decision, and therefore, the EPA will not mandate energy recovery within these standards. An owner or operator will have to consider whether applicable rules will render an energy recovery project uneconomical for their particular landfill.

Comment: One commenter (IV-D-24) asserted that the EPA should attribute some value to energy recovery in the selection of the emission rate cutoff. The commenter argued that not to give energy recovery a value is to arbitrarily assume it will have no cost impact. The commenter further recommended that some specific provisions addressing energy recovery (e.g., requirements to perform feasibility studies if control is required) be included in the final regulations.

Two commenters (IV-D-21, IV-D-33) suggested that energy recovery technologies also be defined as BDT, and at the very least that additional language be added to the regulation and guideline to strongly endorse and encourage energy recovery. One commenter (IV-D-21) further suggested that the cost analysis be revised to incorporate the role of energy recovery.

Several commenters wanted energy recovery to be promoted through this NSPS in some form. Three commenters (IV-D-18, IV-D-20, IV-D-50) supported some form of the "Energy Recovery Option 2" discussed in the proposal preamble. Two of these commenters (IV-D-20, IV-D-50) suggested elimination of the public meeting provisions requirement. One of these commenters (IV-D-20) claimed Option 1 fails to explore energy recovery or to encourage pollution prevention at MSW landfills. The commenter supported a modified Option 2 which would require landfill operators to examine pollution prevention cost-effectiveness in hopes of compelling all MSW landfills to consider energy recovery systems. The commenter recommended including an energy recovery analysis with the permit application as an alternative. The commenter stated that publicly-owned landfills may overlook the benefits of energy recovery in order to save money now instead of investing in the future.

The second commenter (IV-D-50) also supported Option 2, provided that the public hearing was eliminated, but cautioned that any specific energy recovery requirement could result in a relatively inefficient, higher cost energy conversion technology replacing a more efficient, lower cost energy technology (i.e., natural gas-fired generation).

Another commenter (IV-D-33) suggested that a combination of energy recovery Options II and III be adopted. The commenter recommended that landfill operators perform energy recovery potential analyses as required in Option III and that they be required to install an energy recovery system if the analysis produces at least the potential for the owner to break even. The commenter suggested that if the analysis is found to be conflicting, the analysis should be discussed at a public meeting to see whether installation of an energy recovery system should be required. The commenter asserted that energy recovery would offset control costs, decrease fossil fuel use, and reduce global warming and acid rain effects. The commenter noted that many landfills already have gas collection infrastructures in place to aid in energy recovery and they urged the EPA to consider these factors in the cost evaluation of energy recovery.

One commenter (IV-D-26) expressed support for the EPA's selection of Energy Recovery Option I. The commenter agreed with the EPA that energy recovery can be a financial risk due to the variability of markets for gas use, the difficulty of predicting reliable gas production rates, and discrimination against the use of LFG by utilities. The commenter urged the EPA to pursue energy recovery by reviewing State and Federal tax laws and regulations, and by expanding methane recovery "credit systems."

One industry commenter (IV-D-27) supported the Agency's decision to leave the evaluation of energy recovery up to the owners and operators of each site, and not to consider the cost impacts of energy recovery in selecting the level of the standard.

One commenter (IV-D-50) asserted that important topics such as system availability and reliability and backup flare systems for use during outages had been excluded from the proposal BID discussion of energy recovery. The commenter disagreed with the EPA's turbine operation estimate and noted that LFG is very highly corrosive with a high potential to contaminate lubricants. The commenter did, however, support the requirement of the analysis, noting that if energy recovery is economic, it should proceed under local laws and regulations.

Other commenters suggested energy recovery should be encouraged through tax incentives (IV-D-11), ease of permitting (IV-D-19), requiring utilities to purchase recovered energy at retail prices (IV-D-11, IV-D-36) or compliance extensions for MSW landfills with energy recovery systems in place (IV-D-43). One of these commenters (IV-D-43) said the proposed regulation (which requires a gas collection system that reduces NMOC by 98 percent) acts to discourage gas mining as an energy recovery option. The commenter suggested that the regulation be amended to include a more flexible guideline for those landfills with gas recovery systems. The commenter also suggested that landfills that employ gas control systems which recover the gas for use should be given a less stringent air emissions reduction standard.

In response to the EPA's request for comments regarding incorporating climate change considerations in the cost analysis and proposals, one commenter (IV-D-21) recommended that the EPA include methane and CO_2 emissions reductions obtained through energy recovery under the regulation and guideline. Another commenter (IV-D-19) indicated that some form of incentive for energy recovery in the regulations would be advantageous. Still another commenter (IV-D-17) supported the evaluation of methane collection for energy recovery.

Another commenter (IV-D-29), stated that the EPA was correct in leaving the decision to pursue energy recovery to the owner or operator and not to include energy recovery in the BDT decision because of the difficulty in knowing how much LFG will be generated and whether a market for it will be available.

One commenter (IV-D-17) indicated that EPA-funded contracts should be awarded to research methods for removing CO_2 from MSW landfills to have purer methane gas. Another commenter (IV-D-19) suggested resource recovery facilities as another viable form of energy recovery.

One commenter (IV-D-21) was concerned about the quality of gas leaving the landfill site for sale. The commenter stated that untreated LFG in a pipeline could pose a human health risk and that pipeline systems would be subject to rigorous permitting and operational requirements. The commenter also stated that not all LFG will have the necessary properties for efficient combustion. Because of these concerns, the commenter recommended that the EPA provide guidelines on the gas quality necessary for LFG to be transported in pipeline systems. At the very least, the commenter requested that the EPA require landfill owners and operators to be subject to RCRA since they are hazardous waste generators. The commenter asserted that this would safeguard natural gas companies and end-users.

Response: The EPA continues to consider that the use of energy recovery should be a site-specific decision. Such a decision should be made after the landfill owner or operator considers the potential savings given the uncertainty and risk for that particular landfill. Many variables come into play when considering energy recovery, such as gas market fluctuations, gas production rates, and the quality of the gas. For this reason, the EPA will not mandate energy recovery within these standards. The use of resource recovery facilities is a solid waste issue, and the focus of this regulation is on air emissions from landfills.

The EPA is not requiring an energy recovery feasibility analysis because the EPA does not consider such an analysis appropriate as part of an NSPS. The EPA still considers the selection of energy recovery to be a site-specific economic decision, rather than a pollution control decision within the purview of section 111 of the CAA. The EPA can, however, promote energy recovery by discussing it in the preamble and showing its benefits by including the use of energy recovery in the nationwide impacts analysis. The potential for cost savings via energy recovery for those landfills subject to this regulation is discussed in section 1.3 of chapter 1 of this document, and outreach efforts are described in section 1.2.1.4 of chapter 1.

The EPA decided to incorporate energy recovery in the nationwide impacts analysis by adding an energy recovery analysis to the original flare analysis upon which the selection of BDT is based. For this second analysis, the nationwide impacts analysis was modified to select the least-cost of three control options for each model landfill: flares, I.C. engines, or turbines.

It was determined that using energy recovery systems is generally more cost effective at larger landfills; however, on a nationwide basis energy recovery did not prove to be significantly more cost effective than flares. The reason for this is that it was estimated that most landfills using energy recovery systems will do so in the absence of the regulation, and such landfills were not included in the nationwide impacts analysis. The revised nationwide impacts are detailed in the memorandum "Revised Nationwide Impacts for Development of Regulatory Alternatives," June 4, 1993, (Docket No. A-88-09, Item No. IV-M-7).

Comment: One commenter (IV-D-11) provided data on fuel cell operation and stated that the regulation should promote energy recovery by requiring that the methane captured with NMOC be used for electricity by using fuel cells (not combustion). Because fuel cells emit only low levels of air pollutants, the commenter suggested that the fuel cell be listed as BACT. The commenter maintained that the proposed standard should require energy recovery equipment to meet air emissions standards comparable to those of SCAQMD Regulation 1110.2 and SCAQMD proposed regulation 1135. The commenter also suggested that the regulations should require that methane be converted to electric power on government lands.

One commenter (IV-G-2) supported all comments submitted by Commenter IV-D-11. The commenter agreed that the EPA's regulations should require that methane collected in conjunction with the collection of NMOC not be combusted, but be used for electric power production. The commenter supported listing the fuel cell as BACT noting that this would allow energy recovery at MSW landfills in the most efficient and environmentally safe manner.

Response: The use of fuel cells is currently being investigated by the AEERL of the EPA. While this technology looks promising, the EPA's investigation will not be completed in time to evaluate whether fuel cells could be listed as BDT within these regulations. As more information becomes available, however, an owner or operator could submit a collection and control plan incorporating the use of fuel cells. The EPA considers the selection of energy recovery to be a site-specific economic decision and will not mandate energy recovery within these standards. The EPA encourages the use of energy recovery methods, including fuel cells, where it is feasible and cost-effective.

Comment: One commenter (IV-L-2) recommended that energy recovery be required under the NSPS and that the offsetting of utility emissions by the generated energy be included in the economic analysis of the NSPS.

The commenter (IV-L-2) included a figure showing that greenhouse gas emissions are higher at a facility using energy recovery compared to a waste-to-energy facility and are higher when no energy recovery is used. The commenter (IV-L-2) also said the figure disregards the offsetting of emissions from utilities or other sources that would be reduced because of energy recovery at landfills which can amount to a significant abatement of utility emissions. The commenter also referred to Titles I and IV as subjects of Congressional attention regarding significant abatement of utility emissions.

Response: The EPA continues to consider the use of energy recovery a site-specific decision, and will not mandate it within these standards. For further information on comments received on this subject in response to the proposed rule and the EPA's response, see the memorandum "Analysis on Landfill Gas Utilization for the Soon-to-be Promulgated Clean Air Act Regulations for Municipal Solid Waste Landfills," September 14, 1993 (Docket No. A-88-09, Item No. IV-B-5).

Comment: One commenter (IV-L-7) disagreed with the regulation's failure to credit the value of avoided environmental externalities (reducing global warming, local air pollution problems, and dependance on foreign suppliers of fuel) associated with energy recovery in the comparison between energy recovery and flaring. The commenter (IV-D-7) compared energy recovery and flaring, stating that energy recovery avoids the need to use costly fossil fuel to produce energy and does so without adding additional pollution to the atmosphere. The commenter (IV-D-7) contended that these benefits can not be ignored and an emission standard should be judged by how well it prevents total pollution, not solely by how cost effective it is to install a technology relative to less effective alternatives. The commenter (IV-D-7) stated that the EPA should require energy recovery so long as it is cost effective when compared to avoided energy and capacity costs of the electric system along with the associated environmental costs.

Response: There are many factors that play a role in the use of energy recovery that were not considered in the nationwide impacts analysis; some are site specific while others, those mentioned by the commenter, are national factors. A more rigorous review of these factors was not performed because of limited resources and because the impact of many of these factors cannot be accurately quantified. However, the reduction in fuel usage at electric utilities was reflected to varying degrees in the buy-back rates used in the energy recovery modeling. Also, the purpose of the least cost option in the nationwide impacts analysis was to estimate the number of landfills that would potentially choose energy recovery because of economics and then estimate nationwide impacts based on the control devices predicted to be applied. Requiring energy recovery as the control device is not appropriate because it is a site-specific decision. There is an element of risk that owners or operators take to use energy recovery and it is not successful in all cases. Although there are national benefits that may occur when a facility uses energy recovery, it is not in the best interest of landfill owners or operators, or the nation to require facilities to use energy recovery and face the economic risk of a nonproductive landfill. These decisions are better made on a site-specific basis. The NSPS emission limits in the standard are based on use of BDT as required by section 111 of the CAA. The owner or operator should have the flexibility to use any control technique that can meet the specified control levels. Section 1.3 of this document estimates some of the national benefits of using energy recovery, such as reducing the fuel used by utilities.

Comment: One commenter (IV-L-3) maintained that the cost of a flaring system should have been included in the energy recovery system cost. The commenter (IV-L-3) stated that an energy system does not operate for the full gas generation life span and flares are needed at the beginning and at the end of landfill operation when gas generation is lower. The commenter (IV-L-3) stated that flares are needed as excess flow control systems. The commenter (IV-L-3) also stated that flares are also needed at least 20 percent of the total control time when gas production levels decrease and energy recovery systems are inefficient at partial loads.

Response: The EPA agrees that energy recovery will most likely not be used throughout a landfill's gas generation life; however, this assumption was made in order to simplify the analysis for the least cost option. Therefore, the cost estimated for a landfill using energy recovery is overestimated since it was assumed that energy recovery equipment (I.C. engine or turbine) would be used from the beginning to the end of the control period at the landfill. In reality, as the commenter pointed out, a less costly flare would most likely be used at the beginning and the end of the control period. The effect of this cost overestimate is that fewer landfills are estimated to use energy recovery than the actual number of landfills that could benefit from using energy recovery if the control system was switched during the control period of the landfill.

The flare system used at the beginning and the end of the control period would also be used as a backup in times of low gas flow and partial loads to the energy recovery system, and in times when there is excess flow. The overestimated cost due to assuming that the landfill would use energy recovery for the full control period is assumed similar to the cost of a back-up flare system throughout the control period with energy recovery control devices.

Comment: One commenter (IV-L-3) supported the EPA's attempt to eliminate the bias of landfills that would develop gas to energy systems in the absence of the rule. However, the commenter (IV-L-3) maintained that the data base still contained anomalies other than those specifically identified by the EPA. The commenter (IV-L-3) further stated that it is impossible to eliminate all biases and that future gas to energy projects may be influenced by factors similar to those the EPA is attempting to remove. For these reasons, the commenter (IV-L-3) recommended that the data base not be modified and that it include all projects. The commenter (IV-L-3) stated that the increase of the energy buyback rate in New Jersey, New York, and Pennsylvania brings in a potential bias.

The commenter (IV-L-3) stated that the EPA has deleted California gas-to-energy projects in the data base to reduce bias. The commenter (IV-L-3) stated that the bias is attributed in part to ISO No. 4 contracts from California utilities in 1984 and 1985, creating a favorable energy sales base. The commenter (IV-L-3) contended that a number of energy projects would have likely proceeded even without the contracts and the fact that the contracts were withdrawn does not necessarily indicate that the trend would not continue.

The commenter (IV-L-3) also stated that the EPA attributes bias in California to the SCAQMD landfill emission rule. The commenter (IV-L-3) asserted that the effect of the landfill emission rule is unclear because it falls within the same period that ISO No. 4 were in effect. The commenter (IV-L-3) noted that 11 facilities implemented gas to energy projects in a similar number of years prior to either rule.

The commenter (IV-L-3) concluded that deleting California projects will reduce bias and that eliminating them may introduce a new bias into the data base and make it less representative of future trends.

Response: The commenter has confused the analysis to predict how many energy recovery projects will be in place in the future in absence of the rule (138 landfills; as described in the memorandum entitled "Landfill Rule Energy Recovery Cost Analysis, December 16, 1992, Docket No. A-88-09, Item No. IV-M-2) with the deletion of the landfills estimated to use energy recovery in absence of the rule from the landfill data base. The attempt to eliminate bias discussed by the commenter was actually done in two analyses; however, the commenter confuses it as being one analysis. The intent was to eliminate the bias of landfills that would develop energy recovery systems in absence of the rule from the landfill data base. See the memorandum "Changes to the Municipal Solid Waste Landfills Nationwide Impacts Program Since Proposal," April 28, 1993, (Docket No. A-88-09, Item No. IV-M-3). In order to obtain this goal, an analysis had to be performed to determine how many landfills would develop the energy recovery systems in absence of the rule. In this analysis the National trends in landfill energy recovery were reviewed. The EPA determined that, in order to use the trends as a predictor of the future, bias had to be eliminated for special projects in California, such as ISO No. 4 and the SCAQMD rule. The energy recovery projects associated with ISO No. 4 were deleted from this analysis as a reasonable estimate for the bias from both ISO No. 4 and the SCAQMD rule, because some of the ISO projects would have been developed anyway. The increase in energy buyback rates in New Jersey, New York, and Pennsylvania, mentioned by the commenter, does not introduce a bias because these rates will fluctuate over time as they did in the timeframe used to predict the future energy recovery projects. Also the increased buyback rates will continue to affect future energy recovery projects. This analysis concluded that a yearly average of 138 landfills would apply energy recovery in the absence of an NSPS.

As a separate step, because 138 landfills would apply energy recovery in the absence of the rule, the 138 most profitable landfills in the data base were removed from the analysis to estimate the national cost and emission reduction impacts. As explained in a previous response, it would be inaccurate to attribute costs and emission reductions for these landfills to the rule.

Comment: In regards to the analysis to determine the number of gas to energy sites in the future, one commenter (IV-L-3) asserted that a few operators of many landfills dominate gas to energy projects and could be viewed to bias the data base. The commenter (IV-L-3) maintained that 60 percent of all landfill gas is recovered for energy purposes by just three operators. The commenter (IV-L-3) stated that the large operators achieve a large economy of scale because of their size and expenditures with vendors and service companies.

Response: The commenter implies that there is a bias due to landfill owners or operators that have developed a large economy of scale for energy recovery equipment and service, and that this bias affects the analysis used to determine the number of landfills that would use energy recovery in the absence of the standard. If there is such a bias, the number of landfills predicted to install energy recovery in absence of the standard would be overestimated and the current nationwide impacts would be underestimated. On the other hand, if in reality fewer owners and operators would develop energy recovery systems in the absence of the standard, then more energy recovery systems would be developed because of the standard and the cost-effectiveness of the standard would be lower. In this scenario, the current nationwide impacts would be overestimated.

Since the cost information for energy recovery operations was obtained from several sources, the likelihood of either scenario has been minimized. In other words, the cost estimates were based on cost data associated with operators of many landfills as well as operators of few landfills. Since the operators that maintain the majority of energy recovery systems also own a greater number of landfills, it can be assumed that these operators will continue to develop more energy recovery systems at their other landfills than smaller landfill operators. Therefore, bias in the number of landfills installing energy recovery and the nationwide impacts should be minimized.

2.18.3 Consideration of Materials Separation

Comment: Two commenters (IV-D-18, IV-D-33) supported the inclusion of materials separation in the NSPS. One commenter (IV-D-33) stated that reducing the amount of waste landfilled, especially organic wastes, would decrease LFG emissions. However, materials such as glass, metal, and plastics, which contribute less to gas emissions, may be better regulated under RCRA. Six commenters (IV-D-19, IV-D-22, IV-D-26, IV-D-27, IV-D-29, IV-D-39) agreed with the EPA's decision not to include such provisions. Seven commenters (IV-D-25, IV-D-26 and IV-F-6, IV-D-27, IV-D-29, IV-D-34, IV-D-39 and IV-F-3, IV-D-50) noted that RCRA was the proper authority for such requirements. One of these commenters (IV-D-27) included the arguments it had prepared in opposition to proposed materials separation provisions for MWC's.

One commenter (IV-D-26) suggested that the EPA wait for the RCRA reauthorization before proposing any type of municipal landfill materials separation requirement. The commenter recommended that the EPA take into consideration the widespread changes a national materials separation regulation will cause to the economy and the industrial sector. In addition, the commenter urged the EPA only to consider the issue of materials separation as it relates to landfill air emissions, and to explore ways to manage nonhazardous solid waste in a more comprehensive way.

One commenter (IV-D-19) stated that some method of segregating toxic substances (such as batteries) in the waste stream needed to be implemented. A second commenter (IV-D-12), representing a trade association, stated that 80 percent of lead produced in the U.S. is used in lead-acid batteries and that 90 percent of these batteries are recycled. A third commenter (IV-D-17) recommended the evaluation of reuse and recycling programs. Another commenter (IV-D-39) stated that there are no data that they are aware of that quantify emission reductions afforded by a materials separation and removal requirement.

Response: The EPA continues to consider RCRA the appropriate regulatory framework for material separation. The final RCRA preamble identified an array of initiatives designed to expand recycling efforts (56 FR 50980; October 9, 1991). These initiatives include market studies, federal recycling procurement guidelines, the development of training materials for State and local recycling coordinators, publications, and the establishment of a National Recycling Institute.

2.19 MISCELLANEOUS

Comment: One commenter (IV-D-9) requested that the EPA form a technical advisory group to assist in the writing of "more realistic" regulations. The commenter reported that such groups are being used successfully in Florida.

Response: In developing the proposed standards, the EPA worked closely with organizations such as NSWMA, SWANA, SCAQMD, WMA, BFI and other government and industry representatives. Information regarding meetings and correspondence with these participants is documented in the docket (A-88-09). The proposed regulation is the result of the knowledge, expertise and data provided to the EPA by those organizations directly affected by the standards. Comments on the proposed standards submitted by these groups and other commenters have been carefully considered and the EPA has made appropriate changes to the final regulations. Therefore, the EPA believes the regulation is realistic and has not formed a technical advisory group for use in writing these regulations.

Comment: One commenter (IV-D-9) was in agreement with all the public hearing comments. The commenter stated that there are major problems in all areas of the draft regulation: cost/benefit, health risk, field management of migration and surface emissions versus empirical modeling, design specifications versus performance standards, operational requirements, and other aspects.

Response: The EPA response to specific comments from the public hearing are provided in section 2.2.1 on health concerns, section 2.8.3 for discussion of the cost-benefit analysis, sections 2.10 and 2.11 for modeling issues, 2.12 for design specifications, and 2.13 for operational standards.

Comment: Five commenters (IV-D-1, IV-D-13, IV-D-15, IV-D-40, IV-D-57) requested that the comment period be extended an additional 30 to 90 days to allow time for additional comments on the proposed regulation.

Response: The typical comment period for an EPA rulemaking involving complex subjects under the CAA is 60 days. The Administrator determined that a longer comment period was not necessary, but stated that the EPA would consider all comments received in a timely manner.

3.0 ECONOMIC IMPACTS

This chapter evaluates the economic impacts of the §111(d) Guidelines and §111(b) Standards under the Clean Air Act (CAA) that EPA has proposed for closed/existing and new landfills. We have reviewed and made changes in our analysis since the original draft report, "Economic Impact Analysis of Air Emissions Controls on Municipal Solid Waste Landfills" submitted November 1989.

The following topics are addressed in this chapter:

- waste generation and disposal as it is now practiced;
- requirements of promulgation and recordkeeping;
- characteristics and control periods of affected landfills under present assumptions and engineering models;
- net present value (NPV) of enterprise costs and the costs per megagram (Mg) and per household;
- costs to society (annualized and net present value);
- emissions reductions and cost effectiveness; and
- summary of analysis, comparison of final rule options with proposed rule options, and conclusions.

In addressing these topics, we have revised some of the underlying assumptions concerning quantities of waste to give better estimates of the waste flow going to landfills. Impacts computed for the proposed rule options analysis were estimated based on data reported in the Office of Solid Waste (OSW) Landfill Survey.[1,2] The 1986 waste flow going to landfills reported in the survey was a particularly important variable in determining compliance costs and emission reductions. However, using the OSW landfill data to analyze impacts under the proposed rule options posed two problems. First, some landfills reported their waste acceptance rate in cubic yards, thereby creating a conversion problem from cubic yards to tons. We had to assume a density factor for cubic yards of waste accepted by these landfills to standardize these values to tons of waste landfilled. The second difficulty involved differences between the reported historical acceptance rates (pre-1986) and the 1986 acceptance rate. The resolution of these problems for the analysis of the proposed rule resulted in a total municipal solid waste (MSW) acceptance rate that was a substantial overestimate of the national MSW generation. For the analysis of the final rule options, we computed impacts using a revised (lower) estimate of the landfill acceptance rate.

In addition, several changes were made to the engineering model to give better estimates of the costs of the proposed regulation. We also incorporated these changes into the economic impacts analysis of the final rule options. The following sections discuss the results from the revised models and cost calculations.

3.1 OVERVIEW OF MUNICIPAL SOLID WASTE MANAGEMENT

3.1.1 Waste Generation

MSW is generated as a by-product of consumption and production. Generated waste is collected and transported to a centralized location. After collection, MSW is either directly landfilled, incinerated in a municipal waste combustor, or sent to a centralized recycling facility. Most recycling and combustion residues are also sent to landfills.

MSW management uses two types of landfills: hazardous waste landfills that receive both hazardous and nonhazardous wastes and sanitary landfills. Sanitary landfills receive nonhazardous wastes from residential, commercial, and industrial sources and small amounts of hazardous waste generated by small quantity generators. In this report, we are concerned with sanitary landfills.

EPA's Office of Air Quality Planning and Standards is developing air emissions for closed/existing landfills under §111(d) and new municipal landfills under §111(b) of the CAA.[3] The CAA regulations will limit air emissions of nonmethane organic compounds (NMOC), air toxics, odors, carbon dioxide, methane, and other explosive gases from landfills. The regulation will require the active collection and disposal of air emissions.

3.1.2 Waste Disposal

Waste is disposed in sanitary landfills through a three-step process that includes

- spreading collected waste into thin layers in the landfill,
- compacting the layers into the smallest practical volume, and
- covering the compacted waste with soil on a daily basis.[4]

After waste is deposited in the landfill, it immediately begins to decay, producing several gaseous by-products in the process. Landfill waste digestive processes are aerobic (i.e., they occur in the presence of free oxygen) until nearly all the oxygen in the waste is consumed. Waste decomposition then changes to an anaerobic process (i.e., a process that occurs in the absence of free oxygen). Gases produced by decomposition migrate through landfilled waste and disperse into the atmosphere unless emission controls are implemented.

Methane gas generated by MSW is a greenhouse gas. It is not addressed in this report because it is not a volatile organic compound (VOC) precursor and is not considered hazardous to human health in the same manner as a carcinogen.

Methane is counted in the benefit-cost analysis, but the impetus for the proposed guidelines and standards was VOCs and hazardous air pollutants (HAPs). Therefore, we will only address nonmethane organic compound (NMOC) generation in this report. These compounds are VOC precursors or HAPs.

Throughout this report, we discuss both new and closed/existing landfills. New landfills are assumed to be exactly like comparable landfills that closed during the time period of this study. For the purposes of this study, we assumed that, for every landfill that closed during the time period, one exactly like it opened.

As Figure 3-1 illustrates, NMOC generation begins slowly as soon as waste is deposited in landfills and increases over several years. Gas generation continues for an extended period of time after landfills are closed and then begins to taper off. Emission controls are required when NMOC emissions reach a specified cutoff level. Controls must remain operational until gas emissions decline again to the cutoff level as gas production tapers off.

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Figure 3-1. Affected model landfill: Length of control period under three stringency levels.

The control option discussed in this report is flares (combustion without energy recovery). We assumed all affected landfills choose to control their emissions in this manner, although we expect many, if not most, of them would choose control options that have some sort of energy recovery feature to offset the costs of controlling emissions. This assumption overestimates the actual costs of the regulatory alternatives because the flare option assumes there are no offsetting revenues. The flare option is, therefore, the most conservative assumption.

3.1.3 Requirements of Alternatives for Promulgation

The requirements of alternatives for promulgation of the regulation consist of a size cutoff, an emissions cutoff, and recordkeeping requirements. Landfills affected by the regulation are those with 1 million or more megagrams of permitted capacity. Landfills below that size cutoff are not expected to be subject to emissions control requirements.

In this report, EPA has evaluated three potential emissions cutoff levels: 50, 75, and 100 Mg per year of NMOCs. "Affected landfills" are those meeting the emissions cutoff levels either in pre- or post-closure periods. In the most stringent alternative, EPA will require emissions controls on all landfills emitting 50 Mg of NMOCs per year. Less stringent alternatives require controls at 75 Mg and 100 Mg per year levels, respectively. High emissions cutoff levels mean that more landfill-generated gas can be released before emission controls must be installed and maintained.

3.2 CHARACTERISTICS OF AFFECTED LANDFILLS

3.2.1 Design Capacity

Design capacity refers to the amount of waste that landfills are designed to accommodate per year. Landfills affected by the regulations vary considerably by design capacity. Significantly fewer landfills are projected to be affected in the final rule option than were projected in the proposed rule option (see conclusions). Since 1989, a permitted design capacity cutoff limit of 1 million Mg per year has been instituted, and certain engineering parameters and assumptions have been revised, resulting in a much smaller affected population (see Appendix A).

Of the 7,437 landfills subject to §111(d) Guidelines, between 4 and 8 percent would be affected depending on the stringency level. As mentioned above, the three possible stringency levels examined are releases of 50, 75, and 100 Mg NMOC per year. If the most stringent 50 Mg per year alternative were selected, 572 existing and closed landfills would be affected. If the 75 Mg per year cutoff were selected, 415 landfills would be affected while only 305 existing and closed landfills would be affected if the 100 Mg per year cutoff were selected (see Table 3-1).

TABLE 3-1. SUMMARY INFORMATION FOR AFFECTED CLOSED AND EXISTING LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
Number of affected landfills	**572**	**415**	**305**
(Percent of total closed and existing landfills)	(8)	(6)	(4)
Distribution of affected landfills by design capacity (10^6 Mg)			
5	**379**	**253**	**161**
	(66)	(61)	(53)
5 to 10	**104**	**76**	**65**
	(18)	(18)	(21)
>10	**89**	**85**	**79**
	(16)	(21)	(26)
Total	**572**	**415**	**305**
	(100)	(100)	(100)
Privately owned affected landfills	**154**	**121**	**104**
(Percent of affected landfills)	(27)	(29)	(34)
Existing	**130**	**103**	**88**
Closed	**24**	**18**	**16**

Note: The numbers in parentheses are percentages. Details may not add to totals due to rounding.

The §111(b) Standards apply to landfills constructed and opened after the regulation takes effect. In this study, we assumed these new landfills replace other landfills that closed. Specifically, we assumed that every landfill that closes after 1992 is replaced by an identical landfill serving the same area. Recycling and pollution prevention efforts may cause reduced local requirements for landfill space while increasing and shifting populations may increase needs. We

realize that our assumption concerning new landfills may not hold true in every case.

New landfills would also be subject to the regulation. Of the approximately 944 new landfills nationwide, 89 would be affected by the flare option if the most stringent 50 Mg per year alternative were selected. If the 75 Mg per year cutoff were selected, 56 landfills would be affected while only 33 landfills would be affected if the 100 Mg per year cutoff were selected (see Table 3-2).

TABLE 3-2. SUMMARY INFORMATION FOR AFFECTED NEW LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
Number of affected landfills (Percent of total new landfills)	**89**	**56**	**33**
Distribution of affected landfills by design capacity (10^6 Mg)			
5	**73** (82)	**46** (82)	**25** (76)
5 to 10	**8** (9)	**4** (7)	**4** (12)
>10	**8** (9)	**6** (11)	**4** (12)
Total	**89** (100)	**56** (100)	**33** (100)
Privately owned affected landfills (Percent of affected landfills)	**20** (22)	**10** (18)	**6** (18)

Note: The numbers in parentheses are percentages. Details may not add to totals due to rounding.

Tables 3-1 and 3-2 also show affected landfills distributed according to design capacity. In both closed/existing and new categories, the greatest number of affected landfills are those with the smallest design capacity (accepting   5 Mg per year of waste). At the 50 Mg per year level, 66 percent of the affected closed/existing landfills are in the smallest size category. At the 75 Mg per year level, 61 percent are below this size; 53 percent are this size at the 100 Mg per year level. Of new landfills, 82 percent are in the smallest size category (accepting   5 Mg per year of waste) at the 50 level, 82 percent at the 75 level, and 76 percent at the 100 Mg per year level.

Under all stringency levels, closed and existing private landfills constitute a slightly larger percentage of affected landfills than was the case before the size cutoff was instituted (27 to 34 percent versus 22 to 31 percent). Of the total closed/existing landfills, 104 are private at the 100 level, 121 are private at the 75 level, and 154 are private at the most stringent emission cutoff level, 50 Mg/yr. Privately held affected new landfills are smaller percentages of the total affected landfills at the 75 and 100 Mg per year levels and about the same at the 50 Mg per year level. At the 50 Mg level of stringency, 20 of the affected new landfills are privately owned (Appendix A and Table 3-2), 10 at the 75 level, and 6 at the 100 Mg/yr level. As previously stated, landfills expected to have the greatest difficulty paying for NMOC controls are those that are privately owned and already closed. As shown in Table 3-1, at both the 50 and 75 Mg/yr stringency levels, 4 percent of the affected landfills are in this category while 5 percent of the affected landfills are closed and privately owned at the 100 level.

3.2.2 Control Periods for Affected Landfills

Landfills will be required to operate emissions controls as long as their emissions exceed the selected cutoff level. Individual affected landfills will reach the selected emissions cutoff level in different years, depending on waste deposited. Similarly, the number of years that emissions will exceed the cutoff level will vary from landfill to landfill; therefore, the year that controls may be removed will also vary. The longer emissions must be controlled, the greater the compliance costs and the greater the economic impacts of the regulation (see Figure 3-1).

Tables

TABLE 3-3. LENGTH OF CONTROL PERIOD FOR AFFECTED CLOSED AND EXISTING LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
Average length of control period (years)	**52.9**	**50.9**	**51.8**
Distribution of affected landfills by design capacity (years)			
25	**215** (38)	**145** (35)	**75** (25)
26 to 50	**122** (21)	**115** (28)	**116** (38)
51 to 100	**169** (30)	**94** (23)	**73** (24)
101 to 150	**37** (7)	**51** (12)	**37** (12)
>150	**29** (5)	**10** (2)	**4** (1)
Total	**572** (100)	**415** (100)	**305** (100)

Note: The numbers in parentheses are percentages. Details may not add to totals due to rounding.

3-3 and 3-4 present the length of control period for

TABLE 3-4. LENGTH OF CONTROL PERIOD FOR AFFECTED NEW LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
Average length of control period (years)	**42.1**	**37.9**	**38.6**
Distribution of affected landfills by design capacity (years)			
25	**35** (39)	**25** (45)	**21** (64)
26 to 50	**33** (37)	**19** (34)	**2** (6)
51 to 100	**17** (20)	**10** (18)	**8** (24)
101 to 150	**4** (5)	**2** (4)	**2** (6)
Total	**89** (100)	**56** (100)	**33** (100)

Note: The numbers in parentheses are percentages. Details may not add to totals due to rounding.

closed/existing landfills and for new landfills, respectively. Average lengths of control periods do not vary significantly across stringency levels in either table. However, the distributions of landfills by length of control period do vary widely from less than 25 years to greater than 150 years. However, at all stringency levels, half to three-quarters of the landfills have control periods of 50 years or less.

The ease with which landfills will be able to recapture costs of installing and operating controls will decrease after each landfill closes. Until that time, the landfill may increase its user fees to offset some of its increased costs. After closure, landfill owners must find some other way of raising revenues. Public landfill owners may raise taxes. Private landfills can only raise revenues through increased user fees while they are still operating and accepting MSW.

Thus, the shorter the length of time between the start of controls and landfill closure, the greater the financial burden of a given control on a landfill especially if it is privately owned.

3.2.3 Control Periods Prior to Closure

Tables

TABLE 3-5. LENGTH OF CONTROL PERIOD PRIOR TO CLOSURE FOR AFFECTED EXISTING LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
Average length of control period prior to closure (years)	**19.7**	**19.3**	**21.0**
Distribution of affected landfills by length of control period prior to closure (years)			
5	**95** (20)	**101** (28)	**41** (15)
6 to 10	**98** (20)	**37** (10)	**54** (20)
11 to 20	**157** (33)	**115** (32)	**93** (34)
21 to 50	**73** (15)	**73** (20)	**49** (18)
>50	**55** (12)	**36** (10)	**36** (13)
Total	**478** (100)	**362** (100)	**273** (100)

3-5 and 3-6 show the length of control periods prior to

TABLE 3-6. LENGTH OF CONTROL PERIOD PRIOR TO CLOSURE FOR AFFECTED NEW LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
Average length of control period prior to closure (years)	**12.1**	**11.5**	**12.7**
Distribution of affected landfills by length of control period to closure (years)			
5	**25** (28)	**19** (34)	**10** (29)
6 to 10	**27** (30)	**13** (24)	**4** (12)
11 to 20	**27** (31)	**14** (25)	**17** (53)
21 to 50	**10** (11)	**10** (17)	**2** (6)
Total	**89** (100)	**56** (100)	**33** (100)

Note: The numbers in parentheses are percentages. Details may not add to totals due to rounding.

closure for existing and new landfills respectively. Existing landfills average 19.7 years of control prior to closure at the 50 stringency level, 19.3 years at the 75 level, and 21 years at the 100 level. New landfills average 12.1 years at the 50 level, 11.5 years at the 75 level, and 12.7 years at the 100 level.

Landfills with the shortest periods of control before closure (5 years) are those with the greatest economic impacts under the regulation because they have the shortest time to recover control costs by raising user fees. Affected existing landfills in this category represent 20, 28, and 15 percent of the total affected at the 50, 75, and 100 Mg per year levels, respectively. Affected new landfills in the   5 years category are 28, 34, and 29 percent at the three respective control levels (see Table 3-6).

Table

TABLE 3-7. LENGTH OF CONTROL PERIOD PRIOR TO CLOSURE FOR AFFECTED EXISTING LANDFILLS: PRIVATE LANDFILLS ONLY

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
Average length of control period prior to closure (years)	**23.9**	**25.4**	**27.5**
Distribution of affected landfills by length of control period prior to closure (years)			
5	**21** (17)	**21** (21)	**10** (11)
6 to 10	**12** (9)	**10** (10)	**8** (9)
11 to 20	**60** (46)	**37** (36)	**35** (40)
21 to 50	**10** (8)	**8** (8)	**8** (9)
>50	**27** (21)	**27** (26)	**27** (31)
Total	**130** (100)	**103** (100)	**88** (100)

3-7 shows that affected private existing landfills average 23.9, 25.4, and 27.5 years of control period prior to closing at the three stringency levels. Of this subset of existing landfills that are presumed to be the most severely affected by the regulation, 17 percent have a control period prior to closure of 5 years at the 50 stringency level, 21 percent are in this category at the 75 level, and 11 percent at the 100 level.

3.3 IMPACTS OF THE REGULATION

We analyzed the economic impacts of the regulation on existing and new landfills. Measures of these impacts include enterprise costs (the costs to each facility), social costs (the costs to society), recordkeeping costs, and emissions reductions and cost effectiveness.

3.3.1 Enterprise Costs

In this discussion of enterprise costs, we address the following:

- NPV of enterprise costs,
- annualized enterprise costs,
- costs per Mg of waste and costs per household, and
- recordkeeping costs.

3.3.1.1 NPV of Enterprise Costs. One measure of the cost of complying with the regulatory alternatives under consideration is the NPV of enterprise costs. This measure is computed by discounting the flow of capital and operating costs to arrive at a measure of the current value of the costs that will be incurred throughout the control periods of the various landfills. Because most landfills will begin and end controls at different times, using an NPV measure of costs is an appropriate way to compare costs between landfills.

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Closed/Existing Landfills. Table

TABLE 3-8. NET PRESENT VALUE OF ENTERPRISE COSTS FOR AFFECTED CLOSED AND EXISTING LANDFILLS

Net present value	Stringency levels (Mg NMOC/yr) 50	75	100
National enterprise costs ($\$10^6$)			
Capital	1,151	947	785
Operating	953	739	535
Total	2,103	1,686	1,370
Average total enterprise cost per affected landfill ($\$10^6$)	3.68	4.07	4.49
Distribution of affected landfills by net present value of enterprise costs ($\$10^6$)			
5	38	17	10
	(7)	(4)	(3)
0.5 to 1.0	17	17	0
	(3)	(4)	(0)
1.0 to 3.0	303	201	136
	(53)	(49)	(45)
3.0 to 5.0	103	89	84
	(18)	(21)	(28)
5.0 to 10.0	87	71	59
	(15)	(17)	(19)
>10.0	24	20	16
	(4)	(5)	(5)
Total	572	415	305
	(100)	(100)	(100)

3-8 presents NPV of enterprise costs for closed/existing landfills. The interest rates faced by public owners of landfills differ from those faced by private owners, so we discounted the stream of capital and operating costs using a different discounted rate for each ownership group. We discounted the capital and operating compliance costs incurred by public landfill owners using a 4 percent rate, and we discounted costs incurred by private landfill owners to their NPV using an 8 percent rate. Table 3-8 presents these costs, along with a distribution of the number of affected landfills in several enterprise cost categories for each of the three stringency levels.

The maximum NPV of enterprise costs incurred by any closed/existing landfill is $50.3 million under the 50 Mg stringency level, $50.1 million under the 75 Mg stringency level, and $49.8 million under the 100 Mg stringency level. When summed across all landfills affected by controls under each stringency level, the national total NPV of enterprise costs ranges from $1.37 billion under the 100 Mg stringency level to $2.10 billion under the 50 Mg stringency level.

NPV of enterprise costs varies from less than $500,000 to more than $10 million at all stringency levels. At the 50 Mg NMOC/yr level, 63 percent have an NPV of $3 million or less while 57 percent and 48 percent of the landfills at the 75 level and 100 level, respectively, fall in this category.

New Landfills. Table

TABLE 3-9. NET PRESENT VALUE OF ENTERPRISE COSTS FOR AFFECTED NEW LANDFILLS

	Stringency levels (Mg NMOC/yr)		
Net present value	50	75	100
National enterprise costs ($\$10^6$)			
Capital	112	83	66
Operating	100	67	48
Total	212	150	114
Average total enterprise cost per affected landfill ($\$10^6$)	2.39	2.68	3.44
Distribution of affected landfills by net present value of enterprise costs ($\$10^6$)			
0.5	8 (9)	0 (0)	0 (0)
0.5 to 1.0	19 (22)	14 (24)	8 (23)
1.0 to 3.0	44 (50)	36 (65)	19 (59)
3.0 to 5.0	16 (18)	4 (7)	4 (12)
>5.0	2 (2)	2 (4)	2 (6)
Total	89 (100)	56 (100)	33 (100)

3-9 presents NPV of enterprise costs for affected new landfills. As shown in the table, 89 new landfills affected by the 50 Mg level of control have total enterprise costs of $212 million, while the 56 new landfills affected by the 75 Mg level of stringency have an aggregate NPV of enterprise costs of $150 million, and the 33 new landfills affected by the 100 Mg stringency level have aggregate NPV of enterprise costs of $114 million. While the aggregate NPV of enterprise costs are highest at the 50 Mg stringency level, the average NPV enterprise cost per facility for this level, $2.39 million, is lower than for the other two stringency levels because so many more landfills with lower costs are affected by the 50 Mg stringency level. At the 75 Mg stringency level, the average NPV enterprise cost per new facility is $2.68 million, while the average NPV enterprise cost per facility is $3.44 million at the 100 Mg stringency level.

The frequency distribution of affected new landfills by NPV of enterprise costs in Table 3-9 indicates that a higher proportion of affected landfills under the more stringent control alternatives experience a relatively low NPV of enterprise costs. For example, under the 50 Mg stringency level, 31 percent of affected facilities have an NPV of enterprise costs of $1 million or less. Under the 75 Mg stringency level, 24 percent have a NPV of enterprise costs of $1 million or less, and only 23 percent have a NPV of enterprise costs of $1 million or less under the 100 Mg stringency level.

3.3.1.2 Annualized Enterprise Costs. The annualized enterprise control cost per Mg of MSW and the annualized cost per household for affected existing landfills are based on each landfill's NPV of enterprise costs. These costs are annualized using the following formula:

$$\begin{matrix} \textit{Annualized NPV of} \\ \textit{Enterprise Costs} \end{matrix} = \frac{\text{NPV (enterprise costs)}}{(1 - (1+r)^{-t})/r}$$

where r is the interest rate and t is time.

The interest rate and the length of time over which costs are annualized depend on the ownership of the landfill. As explained previously, publicly owned landfills are annualized using a 4 percent interest rate over the time period during which controls will be in place. Privately owned landfills, on the other hand, will not be able to recapture their compliance costs after they stop accepting MSW. The enterprise costs for privately owned landfills, therefore, are annualized over the period from 1993 until the landfill closes, using an 8 percent interest rate.

3.3.1.3 Cost per Mg of MSW. To compute the annualized enterprise cost per Mg of MSW for affected existing landfills, the annualized cost was divided by the quantity of waste accepted by the landfill in 1986.[a] One measure of the average annualized cost per Mg of waste accepted is the national annualized cost per Mg of MSW, which is computed for each stringency level by summing the annualized enterprise costs for all the affected landfills at that level, and then dividing by the summed quantities of waste accepted by all the affected landfills in 1986. The national annualized costs per Mg of MSW presented in Table

[a] As noted in Section 3.3, the historical annual average amount of MSW accepted by the landfill is substituted for the quantity of MSW received in 1986 for some landfills.

TABLE 3-10. ANNUALIZED ENTERPRISE CONTROL COST PER Mg OF MSW FOR AFFECTED EXISTING LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
National annualized cost per Mg MSW ($/Mg MSW)	**1.27**	**1.25**	**1.22**
Distribution of affected landfills by annualized cost per Mg MSW ($/Mg MSW)			
0.50	**41** (9)	**22** (6)	**19** (7)
0.50 to 1.25	**147** (31)	**139** (39)	**101** (37)
1.25 to 3.00	**227** (48)	**146** (40)	**113** (41)
3.00 to 10.00	**63** (13)	**55** (15)	**40** (15)
Total	**478** (100)	**362** (100)	**273** (100)

3-10 range from \$1.22 per Mg at the 100 Mg stringency level to \$1.27 per Mg at the 50 Mg level. Although these numbers are greater than those reported in the proposed rule option, they are not radically different and do not vary significantly across stringency levels.

Table 3-10 also contains a frequency distribution of affected landfills by annualized cost per Mg of MSW accepted in 1986. At the 50 Mg stringency level, about 40 percent of landfills experience annualized costs of $1.25 per Mg or less. The maximum annualized cost at this level of stringency, however, is $8 per Mg. At the 75 Mg stringency level the maximum annualized cost falls to $7 per Mg of MSW, and the proportion of landfills that experience costs of $1.25 per Mg or less increases to 45 percent. Finally, at the 100 Mg stringency level, 44 percent of affected landfills experience annualized costs per Mg of MSW of $1.25 or less, and the maximum annualized cost experience is only $6 per Mg.

Privately Owned Closed/Existing Landfills. The enterprise costs for privately owned landfills were annualized over a period beginning in 1992 and ending when the landfill closes. Privately owned landfills can only recapture their costs through increased user fees while they are still accepting MSW. The shorter the period of time between 1992 and the year the landfill closes, therefore, the greater the potential burden of a particular amount of control costs on the landfill's owners. Tables

TABLE 3-11. ANNUALIZED ENTERPRISE CONTROL COST PER Mg OF MSW FOR AFFECTED EXISTING LANDFILLS WITH DATE OF CLOSURE BEFORE 1998: PRIVATE LANDFILLS ONLY

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
National annualized cost per Mg MSW ($/Mg MSW)	**4.79**	**4.20**	**5.42**
Distribution of affected landfills by annualized cost per Mg MSW ($/Mg MSW)			
0.50	**0** (0)	**0** (0)	**0** (0)
0.50 to 1.25	**0** (0)	**2** (17)	**0** (0)
1.25 to 3.00	**2** (17)	**0** (0)	**0** (0)
3.00 to 10.00	**10** (83)	**10** (83)	**10** (100)
Total	**12** (100)	**12** (100)	**10** (100)

Note: The numbers in parentheses are percentages. Costs for privately owned landfills are annualized at 8 percent from 1992 to the year of closure. Details may not add to totals to rounding. Excludes closed landfills.

TABLE 3-12. ANNUALIZED ENTERPRISE CONTROL COST PER Mg OF MSW FOR AFFECTED EXISTING LANDFILLS DATE OF CLOSURE BETWEEN 1998 AND 2002: PRIVATE LANDFILLS ONLY

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
National annualized cost per Mg MSW ($/Mg MSW)	**1.79**	**1.75**	**1.62**
Distribution of affected landfills by annualized cost per Mg MSW ($/Mg MSW)			
0.50	**0** (0)	**0** (0)	**0** (0)
0.50 to 1.25	**0** (0)	**0** (0)	**0** (0)
1.25 to 3.00	**4** (100)	**4** (100)	**4** (100)
3.00 to 10.00	**0** (0)	**0** (0)	**0** (0)
Total	**4** (100)	**4** (100)	**4** (100)

Note: Numbers in parentheses are percentages. Costs for privately owned landfills are annualized at 8 percent from 1992 to the year of closure. Details may not add to totals due to rounding. Excludes closed landfills.

3-11 and 3-12 give the same information as Table 3-10, but for privately owned landfills that have 5 or fewer years until closure to 10 years until closure, respectively. Table 3-11 shows that the national annualized enterprise cost per Mg of MSW accepted for private landfills with 5 years or less until closure is more than three times the national annualized costs for all affected landfills at each stringency level. Specifically, at the 100 Mg stringency level, the national annualized enterprise cost is at the 100 Mg stringency level, the national annualized enterprise cost is $5.42 per Mg of MSW; it is $4.20 per Mg of MSW at the 75 Mg level, and it is $4.79 per Mg at the 50 Mg stringency level. At the 75 Mg stringency level, 83 percent of the 12 affected landfills that are expected to close before 1998 experience annualized costs between $3.00 and $10.00 per Mg of MSW.

For private landfills closing between 1998 and 2002, unit control costs are not nearly as high as the unit control costs of private landfills closing before 1998 (see Table 3-12). The national average measure is $1.79 per Mg of MSW at the 50 Mg stringency level, $1.75 per Mg of MSW at the 75 Mg stringency level, and only $1.62 per Mg at the 100 Mg stringency level. At the 100 Mg stringency level, only four landfills affected are expected to close between 5 and 10 years after 1993, and these landfills incur costs less than $1.62 per Mg of MSW. At the 75 Mg stringency level, only four affected landfills are expected to close between 1998 and 2002, and these landfills experience annualized enterprise costs between $1.25 per Mg and 3.00 per Mg. At the 50 Mg level, four landfills are expected to close between 1998 and 2002, with annualized costs between $1.25 per Mg and $3.00 per Mg.

New Landfills. The national annualized enterprise cost per Mg of MSW for new landfills, presented in Table 3-13, is $0.62 at the 50 level. At the 75 level, the enterprise control cost per Mg is $0.58, and the cost per Mg at the 100 level is $0.59. Table

TABLE 3-13. ANNUALIZED ENTERPRISE CONTROL COST PER Mg OF MSW FOR AFFECTED NEW LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
National annualized cost per Mg MSW ($/Mg MSW)	**0.62**	**0.58**	**0.59**
Distribution of affected landfills by annualized cost per Mg MSW ($/Mg MSW)			
0.25	**4** (5)	**4** (7)	**0** (0)
0.25 to 0.50	**6** (7)	**8** (14)	**6** (18)
0.50 to 1.00	**47** (53)	**21** (38)	**19** (59)
1.00 to 3.00	**32** (36)	**23** (41)	**8** (23)
Total	**89** (100)	**56** (100)	**33** (100)

Note: The numbers in parentheses are percentages. Costs for publicly owned landfills are annualized at 4 percent over the control period. Costs for privately owned landfills are annualized at 8 percent over the life of the landfill. Details may not add to totals due to rounding.

3-13 also provides a frequency distribution of affected new landfills by the annualized enterprise cost per Mg of MSW accepted. This distribution reveals that the higher the stringency level, the higher the proportion of affected landfills incurring annualized costs greater than $1.00 per Mg of MSW accepted. At the least stringent 100 Mg cutoff level, only 23 percent of the 33 affected landfills have costs of $1.00 per Mg or higher, and no affected landfill experiences annualized costs exceeding $1.39 per Mg. At the 75 Mg stringency level, however, over 40 percent of the 56 affected landfills have annualized costs over $1.00 per Mg; at this stringency level, the maximum annualized cost is $1.41 per Mg of MSW. Finally, at the most stringent 50 Mg level, 36 percent of the 89 affected landfills have annualized costs of $1.00 per Mg or higher, and the maximum annualized cost is $1.44 per Mg.

3.3.1.4 Cost per Household. This calculation attempts to assess the annualized cost that will be borne by households served by affected landfills. To compute this measure, the annualized enterprise costs are divided by an estimated number of households served by the affected landfills. The national annualized enterprise cost per household for each stringency level is computed by summing the annualized enterprise costs incurred by all affected landfills at that stringency level, and then dividing by an estimate of the total number of households served by those landfills in 1986.

Existing Landfills. Table

TABLE 3-14. ANNUALIZED ENTERPRISE CONTROL COST PER HOUSEHOLD FOR AFFECTED EXISTING LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
National annualized cost per household ($/household)	**5.02**	**4.95**	**4.84**
Distribution of affected landfills by annualized cost per household ($/household)			
3.50	**112** (23)	**86** (24)	**59** (22)
3.50 to 7.00	**174** (36)	**108** (30)	**95** (35)
7.00 to 15.00	**159** (33)	**135** (37)	**86** (31)
15.00 to 30.00	**33** (7)	**33** (9)	**33** (12)
Total	**478** (100)	**362** (100)	**273** (100)

3-14 presents the annualized enterprise cost per household for affected existing landfills. The national annualized enterprise cost ranges from $4.84 per household at the 100 Mg stringency level to $5.02 per household at the 50 Mg stringency level. At the intermediate 75 Mg stringency level, the national annualized enterprise cost is $4.95 per household.

The frequency distribution of affected landfills by annualized enterprise cost per household, also shown in Table 3-14, indicates that 23 percent of affected landfills at the 50 Mg stringency level will incur annualized enterprise costs of $3.50 per household or less. At the 75 Mg stringency level, 24 percent of the affected landfills will incur annualized costs of $3.50 or less per household. At the 100 Mg stringency level, 22 percent of the affected landfills experience annualized costs of $3.50 or less per household.

New Landfills. Table

TABLE 3-15. ANNUALIZED ENTERPRISE CONTROL COST PER HOUSEHOLD FOR AFFECTED NEW LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
National annualized cost per household ($/household)	**2.45**	**2.30**	**2.32**
Distribution of affected landfills by annualized cost per household ($/household)			
0.75	**2** (2)	**2** (4)	**0** (0)
0.75 to 1.50	**2** (2)	**2** (4)	**0** (0)
1.50 to 3.00	**32** (35)	**18** (32)	**14** (42)
3.00 to 10.00	**53** (60)	**34** (61)	**19** (58)
Total	**89** (100)	**56** (100)	**33** (100)

Note: The numbers in parentheses are percentages. Costs for publicly owned landfills are annualized at 4 percent over the control period. Costs for privately owned landfills are annualized at 8 percent over the life of the landfill. Details may not add to totals due to rounding.

3-15 assesses the potential impact of the regulatory alternatives on the households that will be served by new landfills based on the annualized enterprise cost per household. The national cost per household varies from $2.32 at the 100 Mg stringency level to $2.30 at the 75 Mg stringency level to $2.45 at the 50 Mg stringency level.

3.3.1.5 Recordkeeping Costs. All regulations impose administrative and recordkeeping costs on affected facilities. All facilities, including those below the size cutoff, must file reports concerning the amount of waste they accept. We

assumed the minimal reports done by facilities below the size cutoff does not contribute significantly to the total recordkeeping costs, so their costs are not included here.

For facilities that must install controls, recordkeeping costs include tracking quantities of waste received, installing monitoring devices and tracking emissions levels, and issuing the appropriate reports to the regulating agency. This regulation would require many landfills to incur costs of keeping track of the quantities of waste landfilled and the quantities of emissions generated whether they eventually needed to install controls or not.

EPA has established a progressive Tier System for determining whether a particular facility is covered by the regulation under review.[5] In essence, any facilities not exempted by the size cutoff have to ascertain by a series of tests whether they must install controls. If testing indicates a facility must install controls at Tier 1, additional reporting, testing, and recordkeeping requirements occur at Tier 2. If the facility must still control emissions at Tier 2, additional requirements occur at Tier 3, and so on. At each level, a facility may be exempted from controls and further testing; however, it has already incurred the recordkeeping costs at that level (see Table

TABLE 3-16. NET PRESENT VALUE OF TOTAL RECORDKEEPING COSTS

NPV	Industry	Agency	Total
Controlled landfill recordkeeping costs	29,213,903	5,297,036	34,510,939
Total costs for landfills exempted at Tier 1	131,187	23,787	154,974
Total costs for landfills exempted at Tier 2	15,204,274	2,756,824	17,961,098
Total costs for landfills exempted at Tier 3	12,324,050	2,234,584	14,558,634
Total recordkeeping costs	56,873,414	10,312,231	67,185,645

NET PRESENT VALUE AVERAGE COMPLIANCE/RECORDKEEPING COSTS PER LANDFILL[b]

Status	Number of landfills	Industry costs	Cost per landfill
Controlled	477	29,213,903	61,245
Exempted by size cutoff	5,552	a	a
Cost/landfill exempted at Tier 1	204	131,187	643
Cost/landfill exempted at Tier 2	1,001	15,204,274	15,189
Cost/landfill exempted at Tier 3	202	12,324,050	61,010

3-16).

EPA also incurs recordkeeping costs in tracking and monitoring facilities. Table 3-16 presents these record-keeping costs as the agency cost. In the second half of this table, the total cost per landfill excludes agency costs.

The table presents the recordkeeping costs for the 100 Mg/year stringency level only. The number of facilities that must install controls is estimated to be 477 rather than 305 as stated in Table 3-1. The main reason for the difference is that some landfills have already installed controls for a variety of reasons. These landfills would incur no capital or operating compliance costs as a result of the regulation, and, therefore, would have only additional recordkeeping costs. We also assumed in Table 3-16 that all controlled facilities would incur all of the recordkeeping costs whereas, in reality, that may not be necessary. Some facilities, correctly assuming that they must install controls, may skip directly to Tier 3.

Recordkeeping costs are expected to be only about 3.5 percent of the total enterprise costs per landfill. Therefore, they have been addressed separately and are not included in the estimated impacts presented in other sections of this report.

3.3.2 Social Costs

Social costs are those costs borne by society as a whole. They include investment and consumption foregone in the private sector by virtue of using private sector resources for public purposes. This analysis presents an estimate of social costs of the final rule for landfills. Note that these estimates do not reflect the benefits to society resulting from a change in air quality. We used social costs in our estimates of cost effectiveness.

3.3.2.1 NPV of Social Costs. A measure of the potential cost to society of complying with the regulatory alternatives is the NPV of social costs. This measure is computed by first annualizing capital costs and then discounting the flow of capital and operating costs. The resulting figure is a measure of the present value of the costs that will be incurred throughout the control periods for the various landfills. A net present value measure of costs is the appropriate way to compare costs between landfills because most landfills will begin and end controls at different times. The NPV of social costs presented below are computed using a 7 percent discount rate.

Closed/Existing Landfills. When summed across all affected landfills under each stringency level, the national total NPV of social costs ranges from $1.085 billion under the 100 Mg stringency level to $1.662 billion under the 50 Mg stringency level (see Table

TABLE 3-17. NET PRESENT VALUE OF SOCIAL COSTS FOR AFFECTED CLOSED AND EXISTING LANDFILLS

	Stringency levels (Mg NMOC/yr)		
Net present value	**50**	**75**	**100**
National social costs ($$10^6$)			
Capital	**966**	**793**	**652**
Operating	**696**	**546**	**433**
Total	**1,662**	**1,388**	**1,085**
Average total social cost per affected landfill ($$10^6$)	**2.91**	**3.23**	**3.56**
Distribution of affected landfills by net present value of social costs ($$10^6$)			
0.5	**38** (7)	**25** (6)	**10** (3)
0.5 to 1.0	**49** (9)	**31** (7)	**19** (6)
1.0 to 3.0	**300** (52)	**204** (49)	**146** (48)
3.0 to 5.0	**106** (19)	**88** (21)	**78** (26)
5.0 to 10.0	**63** (11)	**55** (13)	**40** (13)
>10	**16** (3)	**12** (3)	**12** (4)
Total	**572** (100)	**415** (100)	**305** (100)

Note: The numbers in parentheses are percentages. Net present value of social cost is computed using a 7 percent discount rate. Details may not add to totals due to rounding.

3-17). Although more landfills are affected under the more stringent 50 Mg level than under the other two stringency levels, a larger proportion of affected landfills incurs relatively lower NPV of social costs ($3 million or less) under the 50 Mg level than under the 75 Mg level or the 100 Mg level. The mean NPV of social costs per affected landfill under the 100 Mg stringency, $3.56 million, exceeds the mean NPV of social costs for the other two stringency levels.

New Landfills. Table

TABLE 3-18. NET PRESENT VALUE OF SOCIAL COSTS FOR AFFECTED NEW LANDFILLS

	Stringency levels (Mg NMOC/yr)		
Net present value	50	75	100
National social costs ($\$10^6$)			
Capital	77	56	44
Operating	58	39	28
Total	134	95	72
Average total social cost per affected landfill ($\$10^6$)	1.51	1.69	2.19
Distribution of affected landfills by net present value of social costs ($\$10^6$)			
0.5	15 (17)	10 (17)	8 (23)
0.5 to 1.0	21 (24)	19 (34)	2 (6)
1.0 to 3.0	49 (55)	23 (42)	19 (59)
3.0 to 5.0	2 (2)	2 (4)	2 (6)
5.0 to 10.0	0 (0)	0 (0)	0 (0)
>10	2 (2)	2 (4)	2 (6)
Total	89 (100)	56 (100)	33 (100)

Note: The numbers in parentheses are percentages. Net present value of social cost is computed using a 7 percent discount rate. Details may not add to totals due to rounding.

3-18 presents the NPV of social costs for affected new landfills. Total social costs increase as the level of stringency increases. At the most stringent 50 Mg cutoff level, the aggregate total NPV of social costs, $1.34 billion, is about twice the aggregate total NPV of social costs at the 100 Mg level, $72 million. The aggregate total NPV of social costs at the 75 Mg level, $95 million, lies between the cost of the other stringency levels. The number of affected landfills increases substantially as the stringency level increases, and the average NPV of social costs per landfill decreases as the level of stringency increases. The frequency distribution in Table 3-18 shows that 96 percent of new landfills have an NPV of 3 million or less at the 50 Mg/yr level, while 93 percent have social costs of this size at the 75 level and 88 percent at the 100 level.

3.3.2.2 Annualized Social Costs.

Closed/Existing Landfills. Annualizing the NPV of social costs provides another measure of the cost to society of the regulatory alternatives under consideration. We annualized the NPV of the social cost of each affected landfill over the years from 1992 to the end of the landfill's control period using a 7 percent discount rate; then we summed these individual annualized values to get the total annualized social cost. The resulting total annualized social cost for affected closed and existing landfills for each stringency level is the following:

- $128 million for the 50 Mg stringency level,
- $103 million for the 75 Mg stringency level, and
- $83 million for the 100 Mg stringency level.

Thus, the annualized social cost of the 75 Mg stringency level is 24 percent higher than the annualized social cost of the 100 Mg stringency level. The annualized social cost of the 50 Mg stringency level is 24 percent higher than the annualized social cost for the 75 Mg stringency level.

New Landfills. The total annualized social cost for affected new landfills for each stringency level is the following:

- $10 million for the 50 Mg stringency level,
- $7 million for the 75 Mg stringency level, and
- $5 million for the 100 Mg stringency level.

As expected, the least stringent regulatory alternative (the 100 Mg stringency level) has the lowest annualized social cost, and the most stringent regulatory alternative (the 50 Mg stringency level) has the highest annualized social cost.

3.3.3 Emissions Reduction and Cost Effectiveness

Although we are considering the costs of complying with the §111(d) and 111(b) final rule options, we must also consider the cost effectiveness of these alternatives. Cost effectiveness is measured as the annualized compliance cost per Mg of reduction in the emission of NMOCs. We express cost-effectiveness ratios as national figures. The sum of all compliance costs for all affected landfills is divided by the sum of emissions reductions for all affected landfills. In addition, we calculated the incremental cost effectiveness or the change in cost effectiveness as the stringency level increases.

3.3.3.1 Emissions Reduction of Closed/Existing Landfills. Table 3-19

TABLE 3-19. NET PRESENT VALUE OF EMISSIONS REDUCTIONS FOR AFFECTED CLOSED AND EXISTING LANDFILLS

	Stringency levels (Mg NMOC/yr)		
Net present value	**50**	**75**	**100**
Undiscounted NMOC emission reduction (10^3 Mg)	**5,348**	**4,823**	**4,396**
Discounted NMOC emission reduction (10^3 Mg)	**1,361**	**1,273**	**1,181**
Average discounted NMOC emission reduction per affected landfill (Mg)	**2,381**	**3,071**	**3,873**
Distribution of affected landfills by discounted NMOC emission reduction per affected landfill (Mg)			
1,000	**388** (50)	**162** (39)	**75** (25)
1,000 to 2,000	**133** (23)	**114** (27)	**94** (31)
2,000 to 5,000	**102** (18)	**90** (22)	**86** (28)
5,000 to 10,000	**29** (5)	**29** (7)	**30** (7)
>10,000	**20** (4)	**20** (5)	**20** (7)
Total	**572** (100)	**415** (100)	**305** (100)

Note: The numbers in parentheses are percentages. Net present value of emission reductions is calculated using a 3 percent discount rate. Details may not add to totals due to rounding.

shows the emissions reductions resulting from the three regulatory alternatives under the flare option. Total undiscounted NMOC emissions reductions range from 4.4 million Mg at the 100 Mg stringency level, to 4.8 million Mg at the 75 Mg stringency level, to 5.3 million Mg at the 50 Mg stringency level. The emissions reductions are spread over the period of time during which the affected landfills are using the flare emission controls. In order to compare emissions reductions with the costs from Section 3.3.2.1, we discounted the NMOC emissions reductions using a 7 percent rate of discount. The discounted NMOC emissions reductions range from 1.2 million Mg at the 100 Mg stringency level to 1.3 million Mg at the 75 Mg stringency level to 1.4 million Mg at the 50 Mg stringency level. The average discounted NMOC emission reduction decreases as the stringency level increases, because the number of affected landfills increases faster than the NMOC emissions reductions. Thus, the average NMOC emission reduction per affected landfill is 3,873 Mg at the 100 stringency level, 3,071 Mg at the 75 Mg stringency level, and 2,381 Mg at the 50 Mg stringency level.

Cost Effectiveness of Closed/Existing Landfills. We combined measures of NMOC emissions reductions with the discounted NPV of social costs presented in Table 3-17 to estimate the cost effectiveness of the flare option for closed/existing landfills. At the top of Table

TABLE 3-20. COST EFFECTIVENESS FOR AFFECTED CLOSED AND EXISTING LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	75	100
National cost effectiveness ($/Mg NMOC)	1,220	1,051	918
Distribution of affected landfills by cost effectiveness ($/Mg NMOC)			
1,000	97 (17)	97 (23)	97 (32)
1,000 to 2,000	183 (32)	156 (38)	124 (41)
2,000 to 5,000	246 (43)	140 (34)	74 (24)
5,000 to 10,000	40 (7)	20 (5)	8 (3)
>10,000	6 (1)	2 (1)	0 (0)
Total	572 (100)	415 (100)	303 (100)
Incremental cost effectiveness ($/Mg NMOC)	3,655	2,755	—

3-20 is the national cost effectiveness of each stringency level, computed by dividing the aggregate NPV of total social cost by the total discounted NMOC emissions reduction. The national cost effectiveness of the flare option at the 100 Mg stringency level is $918 per Mg of NMOC reduced. At the 75 Mg stringency level, the national cost effectiveness is $1,051 per Mg of NMOC reduced, and the national cost effectiveness is $1,220 per Mg of NMOC reduced at the most stringent 50 Mg level.

The frequency distribution of affected landfills by cost effectiveness (Table 3-20) demonstrates that as the stringency level decreases, an increasing proportion of landfills has a cost effectiveness under $1,000 per Mg of NMOC reduced. At the 50 Mg stringency level, only 17 percent of affected landfills have cost-effectiveness measures that low, while 23 percent of affected landfills fall below $1,000 per Mg of NMOC at the 75 Mg stringency level. Finally, 32 percent of the affected landfills have a cost effectiveness less than $1,000 per Mg of NMOC at the 100 Mg stringency level. At the bottom of the table, incremental cost effectiveness measures the change in national cost effectiveness experienced as the stringency level increases first from 100 Mg to 75 Mg and then from 75 Mg to 50 Mg. As the stringency level increases from 100 Mg to 75 Mg, the incremental cost effectiveness is $2,755 per Mg of NMOC reduced. Moving from 75 Mg to 50 Mg results in an incremental cost effectiveness of $3,655 per Mg of NMOC reduced.

Emission Reduction of New Landfills. Table

TABLE 3-21. NET PRESENT VALUE OF EMISSIONS REDUCTIONS FOR AFFECTED NEW LANDFILLS

	Stringency levels (Mg NMOC/yr)		
Net present value	**50**	**75**	**100**
Undiscounted NMOC emission reduction (10^3 Mg)	**580**	**487**	**419**
Distribution NMOC emission reduction (10^3 Mg)	**94.1**	**81.7**	**72.6**
Average discounted NMOC emission reduction per affected landfill (Mg)	**1,060**	**1,455**	**2,196**
Distribution of affected landfills by discounted NMOC emission reduction per affected landfill (Mg)			
1,000	**77** (87)	**44** (79)	**21** (64)
1,000 to 2,000	**4** (5)	**4** (7)	**4** (12)
2,000 to 5,000	**4** (5)	**4** (7)	**4** (12)
5,000 to 10,000	**2** (2)	**2** (4)	**2** (6)
>10,000	**2** (16)	**2** (21)	**2** (26)
Total	**89** (100)	**56** (100)	**33** (100)

Note: The numbers in parentheses are percentages. Net present value of emission reductions is calculated using a 7 percent discount rate. Details may not add to totals due to rounding.

3-21 shows the emissions reductions for new landfills under the flare control option. The first line shows the total undiscounted NMOC emissions reductions at each stringency level. These measures, showing the total emissions reductions achieved throughout the control period for all affected new landfills, range from 0.42 million Mg at the 100 Mg stringency level, to 0.49 million Mg at the 75 Mg stringency level, to 0.58 million Mg at the 50 Mg stringency level.

The discounted NMOC emission reduction, when summed across all affected landfills, ranges from 0.73 million Mg at the 100 Mg stringency level to 0.82 million Mg at the 75 Mg stringency level to 0.94 million Mg at the 50 Mg stringency level.

The average discounted NMOC emission reduction per affected landfill is much higher at the 100 Mg stringency level than at the 50 Mg stringency level because the number of affected landfills falls faster than discounted NMOC reduction as the stringency level decreases. At the 100 Mg stringency level, the average discounted NMOC emission reduction is 2,196 Mg of NMOC, more than two times the average discounted NMOC emission reduction per landfill at the 50 Mg stringency level (1,060 Mg of NMOC). At the 75 Mg stringency level, the average discounted NMOC emission reduction, 1,455 Mg of NMOC per affected landfill, falls between the average emission reduction values of the other two stringency levels. The frequency distribution of affected new landfills by discounted NMOC emission reduction shows that the proportion of landfills achieving relatively greater NMOC emissions reduction increases as the stringency level decreases.

Cost Effectiveness of New Landfills. We can construct cost-effectiveness measures for affected new landfills by combining information about emission reductions (presented in Table 3-21) for new landfills with information about the NPV of social costs (Table 3-18). As presented in Table

TABLE 3-22. COST EFFECTIVENESS FOR AFFECTED NEW LANDFILLS

	Stringency levels (Mg NMOC/yr)		
	50	**75**	**100**
National cost effectiveness ($/Mg NMOC)	**1,427**	**1,160**	**997**
Distribution of affected landfills by cost effectiveness ($/Mg NMOC)			
1,000	**8** (9)	**8** (14)	**8** (24)
1,000 to 2,000	**17** (19)	**13** (24)	**13** (41)
2,000 to 5,000	**52** (58)	**33** (58)	**12** (35)
5,000 to 10,000	**8** (9)	**2** (4)	**0** (0)
>10,000	**4** (16)	**0** (21)	**0** (26)
Total	**89** (100)	**56** (100)	**33** (100)
Incremental cost effectiveness	**3,184**	**2,460**	**—**

3-22 this value ranges from $997 per Mg of NMOC reduced at the 100 Mg stringency level, to $1,160 per Mg of NMOC at the 75 Mg level, to $1,427 per Mg of NMOC at the 50 Mg stringency level. The frequency distribution demonstrates that, as with closed/existing landfills, the proportion of affected new landfills having cost-effectiveness measures less than $2,000 per Mg of NMOC increases as the degree of stringency decreases. At the 50 Mg stringency level, only 28 percent of landfills have a cost effectiveness under $2,000 per Mg of NMOC, while at the 75 Mg stringency level, 38 percent have a cost effectiveness of $2,000 per Mg or less. At the 100 Mg stringency level, 65 percent of affected landfills have a cost effectiveness under $2,000 per Mg.

The last line of Table 3-22 shows incremental cost effectiveness for new landfills (i.e., the change in cost effectiveness experienced as one moves from the 100 Mg stringency level to the 75 Mg level, and then from the 75 Mg stringency level to the 50 Mg stringency level). As the stringency level decreases from 100 Mg to 75 Mg, the incremental cost effectiveness is 2,460 per Mg of NMOC reduced. The incremental cost effectiveness of moving from the 75 Mg stringency level to the 50 Mg stringency level is 3,184 per Mg of NMOC reduced.

Analysis of Distributional Impacts. The Regulatory Flexibility Analysis of 1980 requires Federal agencies to determine if regulations will have a "significant economic impact on a substantial number of small entities." EPA guidelines on determining whether a regulatory flexibility analysis is required defines a "substantial number" as 20 percent of all affected entities. Neither the proposed rule options nor the final rule options will affect a substantial number of small entities under these guidelines. Nevertheless, an analysis of the impacts on households and government jurisdictions was performed for the proposed rule options. The cost per household and the cost per Mg computed for the final rule options are not significantly different from those presented for the proposed rule. Consequently, a revised distributional analysis is not warranted.

3.4 COSTS OF REGULATIONS AFFECTING LANDFILLS

Landfills and their close substitutes municipal waste combustors (MWCs) are both subject to regulations that are in the final stages of development. In particular, the municipal waste combustor regulation, which will regulate the incineration of municipal solid wastes (MSW), increases the costs of providing MWC services. The air pollution regulation for landfills, analyzed in this report, is similarly expected to increase the costs of providing landfill services.

Because the regulations are still under development, we do not know their final form or the exact costs that will be associated with them. However, we expect the MWC regulatory costs to be higher than the landfill air emission costs. Therefore, we expect the share of waste going to MWCs to decline and the share of waste going to landfills to rise.

Based on the expected relative magnitudes of the compliance costs of the two regulations, the expected market adjustments resulting from the interaction of these regulations are illustrated in Figures 3-2 and 3-3. In each figure, D_1 and S_2 show the demand and supply for the waste disposal service in the absence of the regulation. D_2 and S_2 show the demand and supply with the regulations in effect.

Demand and supply for MWC services is presented in Figure 3-2. The supply curve, S_1, is expected to shift upwards substantially to S_2 due to increased MWC regulatory costs.

Contains Data for

Postscript Only.

Figure 3-2. Expected impacts of costs of regulations on municipal waste combustors.

Contains Data for

Postscript Only.

Figure 3-3. Expected impacts of costs of regulations on sanitary landfills.

This shift results in an increase in price (P_2) and a decrease in quantity of MWC services (Q_2). Sanitary landfills (Figure 3-3) also are expected to experience a decrease in supply due to the costs of air emission controls (S_1 to S_2), but this shift is expected to be smaller than that experienced by MWCs because the compliance costs are thought to be lower. The shift results in an increase in price (P^2) and a corresponding decrease in quantity of landfill services demanded (Q_2).

Demand for a good or service depends, among other things, on the prices for substitutes. MWC and sanitary landfill services are considered to be close substitutes. Generators of MSW may choose to either landfill their solid waste or to incinerate it. However, because of transportation costs, legal restrictions on shipments of solid wastes, and the geographical distribution of MWC and sanitary landfill facilities, they are not perfect substitutes. Because they are close substitutes, the increased prices described above result in changes in demand for the substitute services. The increased price of landfill services is expected to increase the demand for MWC services and vice versa. The increased demand for MWC services (D_2 in Figure 3-2) results in another increase in price and a small relative increase in quantity (P_3 and Q_3). The increased price of MWC services results in increased demand for landfill services. This increased demand will result in both higher prices and higher quantities for landfill services (Q_3 and P_3 in Figure 3-3).

Overall, both the MWC regulations and the landfill regulations increase the cost of disposing of MSW. The overall quantity of waste disposal is expected to decline, other things being equal. Because the compliance costs associated with the MWC regulation are expected to be larger than the compliance costs associated with the landfill regulations, the relative share of waste sent to MWCs is expected to fall and the relative share of waste landfilled is expected to increase. In the illustrations presented here, the absolute quantity of landfill services with both regulations in effect is greater than it was at baseline. Whether the absolute quantity will in fact be greater or less is an empirical issue, but the share of waste being sent to landfills should increase.

3.5 SUMMARY AND CONCLUSIONS

We focused our economic analysis on the flare option for controlling NMOC emissions from closed/existing and new landfills. The flare option assumes that all affected landfills will control NMOC emissions using flares, which overestimates the actual cost of the regulatory alternatives because some landfills will choose a cheaper energy recovery option.

As discussed in Section 3.1, two features of the engineering costing model are noteworthy for the economic analysis. First, the model assumes that landfills that close between 1987 and 1997 are replaced by an identical landfill serving the same area, even though recent evidence indicates that the number of U.S. landfills is actually declining. The model also uses relatively high MSW acceptance rates, which are important parameters in determining NMOC emissions rates and the cost of emissions controls. These features lead to overestimates of the number of affected landfills, compliance costs, and emissions reductions.

In summary, the actual economic impacts of the §111(d) and 111(b) regulatory alternatives under consideration are probably less than the economic impacts presented in this chapter. Nevertheless, our analysis of these regulatory alternatives leads to several specific conclusions:

- The regulatory alternatives will affect only a small fraction of the closed/existing and new landfills (generally less than 10 percent), and most of the affected landfills are small (less than 5 million Mg capacity).

- The number of affected closed private landfills, which have no way of generating revenues to cover compliance costs, is small under the flare option.

- The national NPV of enterprise costs decreases substantially as the stringency level decreases under both control options for affected closed/existing and new landfills, but the average enterprise cost rises as the stringency level decreases.

- The national annualized enterprise control cost per Mg of MSW is below $1.30 per Mg for all stringency levels under the flare option for affected existing and new landfills.

- The costs of the regulatory alternatives are very low for most households--the majority of affected existing landfills have compliance costs under $6.00 per household per year and the majority of affected new landfills have compliance costs under $2.50 per household per year.

- Although the national cost effectiveness of all the stringency levels under the flare option is less than $1,500 per Mg of NMOC emissions reduction, cost effectiveness varies greatly among affected landfills--much more than is typical for EPA regulations.

- The regulatory alternatives under consideration for closed/existing and new landfills will not affect a substantial number of small entities, so a Regulatory Flexibility Analysis is not required for either the §111(d) or 111(b) rulemakings. Nevertheless, the analysis of the proposed rule options included a distributional analysis of the impacts on affected households and government entities. The cost per household and the cost per Mg computed for the final rule options are not significantly different from those presented for the proposed rule. Consequently, a revised distributional analysis is not warranted.

- The social costs of the regulatory alternatives for affected closed/existing and new landfills are very sensitive to the discount rate because of the long control periods under stringency levels for both the flare and energy recovery control options.

In general, the economic impacts of the §111(d) and 111(b) regulatory alternatives on households and municipalities are too small to significantly influence the choice among these alternatives. Privately owned landfills that are already closed and must install emissions controls may be significantly affected by the regulatory alternatives because they have no way of recovering their compliance costs.

However, very few closed, privately owned landfills are affected under any of the regulatory alternatives. The control costs of the regulatory alternatives at affected landfills will probably not lead to a significant shift in MSW flows from landfills to municipal waste combustors. Finally, all of the regulatory alternatives will stimulate the adoption of energy recovery technologies at affected landfills.

Table 3-23

TABLE 3-23. SUMMARY OF DIFFERENCES BETWEEN THE PROPOSED RULE AND FINAL RULE OPTIONS AT THE 100 MG PER YEAR STRINGENCY LEVEL

Category	Proposed Rule Option	Final Rule Option
Number of Affected Landfills:		
closed/existing	853	305
new	104	33
Average Control Period (years):		
closed/existing	66.3	51.8
new	59.6	38.6
Total NPV of Average Enterprise Costs for Affected Landfills ($/landfill):		
closed/existing	$4,260,000	$4,490,000
new	$3,920,000	$3,440,000
Annualized Control Cost per Household ($ per household):		
closed/existing	$4.90	$4.84
new	$2.78	$2.32
National Emissions Reductions (Mg NMOC per year):		
closed/existing	28,600,000	4,396,000
new	2,330,000	419,000
National Cost Effectiveness ($/Mg NMOC):		
closed/existing	$640	$918
new	$1,081	$997
National NPV of Total Enterprise Cost ($):		
closed/existing	$3,634,000,000	$1,370,000,000
new	$407,000,000	$114,000,000
National NPV of Total Social Costs ($):		
closed/existing	$7,157,000,000	$1,085,000,000
new	$896,000,000	$72,000,000

compares the estimated impacts computed for the proposed rule and those computed for the final rule. Note that the emission cutoff levels evaluated under the proposed rule option (25, 100, and 250 Mg NMOC) differ from those under the final rule option (50, 75, and 100 Mg NMOC). Since the 100 Mg stringency level is the only one analyzed for both the proposed and final rule options, it is the level presented and compared in Table 3-23. Consequently, comparisons of the impacts under the proposed and final options should be made with the understanding that the stringency levels evaluated are different under the two analyses. Four of the measures presented in Table 3-23 are particularly relevant for comparison of impacts under the two analyses: number of affected landfills, total compliance cost, total emission reduction, and cost effectiveness.

The estimated number of potentially affected landfills is lower under the final rule than the proposed rule. This difference results from the revised waste flow estimates and revised engineering assumptions used to compute impacts for final rule (see discussion in Section 3.1). Furthermore, the size cutoff for landfills with an acceptance rate below 1 million Mg of MSW per year excludes some landfills from the analysis of impacts under the final options that were affected under the proposed rule. The difference in the number of affected landfills results in differences in the estimated compliance costs and the estimated emission reductions as described below.

This analysis presents two measures of total compliance costs: NPV of social costs and NPV of enterprise costs.

Under both cost measures the impacts estimated for the final rule are lower than those estimated for the proposed rule. Enterprise costs are lower because fewer landfills are affected under the final rule.

Social costs are lower for two reasons. As is true for the estimate of enterprise costs, social costs are lower because fewer landfills are affected under the final rule. Second, the NPV of social costs under the final rule is computed based on a 7 percent discount rate while the corresponding measure for the proposed rule was computed using a 3 percent discount rate. Using a higher discount rate results in an NPV of social costs that is substantially lower, even on a per-landfill basis. We used a different discount rate for our analysis of social costs under the final rule to reflect recently revised OMB guidance on the appropriate social discount rate.

Emission reductions are lower under the final rule than under the proposed rule. The difference in undiscounted emission reductions is attributable to the difference in the number of affected landfills. Discounted emission reductions are lower under the final rule because fewer landfills are affected and the discount rate used is higher.

Finally, cost effectiveness is computed as the NPV of social costs divided by the discounted emission reduction. Because both costs and emission reductions are proportionately lower under the final options, cost effectiveness is not significantly different.

3.6 REFERENCES

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