

Potential Revisions to the Land Disposal Restrictions

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ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 268

[FRL-6351-4]

RIN-2050-AE54

Potential Revisions to the Land Disposal Restrictions Mercury
Treatment Standards

AGENCY: Environmental Protection Agency.

ACTION: Advance notice of proposed rulemaking (ANPRM).

SUMMARY: The Environmental Protection Agency (EPA or Agency) is considering publication of a proposed rule to revise the 40 CFR part 268 Land Disposal Restrictions (LDR) treatment standards applicable to mercury-bearing wastes. This ANPRM is intended to give advance notice of EPA's comprehensive reevaluation of the treatment standards for mercury-bearing hazardous wastes as well as various options, issues, and data needs related to potential mercury treatment standard revisions. The Agency requests additional data and comments on these issues and options.

DATES: Written and electronic comments in response to this ANPRM must be received on or before July 27, 1999.

ADDRESSES: Commenters should submit an original and two copies of their comments referencing Docket No. F-1999-MTSP-FFFFF to: the RCRA Information Center (RIC), U.S. Environmental Protection Agency Headquarters (5305W), 401 M Street, SW, Washington, D.C. 20460. Courier deliveries of comments should be submitted to the RIC at the address listed below. Comments may also be submitted electronically through the Internet to:

RCRA-docket@epamail.epa.gov. Comments in electronic format should also be identified by the docket number F-1999-MTSP-FFFFF. Submit electronic comments as an ASCII file and avoid the use of special characters and any form of encryption. If possible, EPA's Office of Solid Waste (OSW) would also like to receive an additional copy of the comments on disk in WordPerfect 6.1 file format.

Commenters should not submit electronically any confidential business information (CBI). An original and two copies of the CBI must be submitted under separate cover to: Regina Magbie, RCRA CBI Document Control Officer, Office of Solid Waste (5305W), U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460.

The Agency will consider the public comments during development of any proposed rule related to this action. The Agency urges commenters submitting data in support of their views to include with the data evidence that appropriate quality assurance/quality control (QA/QC) procedures were followed in generating the data.

Data that the Agency cannot verify through QA/QC documentation may be given less consideration or disregarded in developing regulatory options for proposal and final rules.

\1\ For guidance, see Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance/Quality Control Procedures and Methodology; USEPA, October 23, 1991.

Public comments and supporting materials are available for viewing in the RIC, located at Crystal Gateway One, 1235 Jefferson Davis Highway, First Floor, Arlington, Virginia. The RIC is open from 9 a.m. to 4 p.m., Monday through Friday, except for Federal holidays. To review docket materials, the public must make an appointment by calling 703-603-9230. The public may copy a maximum of 100 pages from any regulatory docket at no charge. Additional copies cost \$0.15 per page. The docket index and notice are available electronically. See the Supplementary Information section for information on accessing it.

FOR FURTHER INFORMATION CONTACT: For general information, contact the RCRA Hotline at 800-424-9346 or TDD 800-553-7672 (hearing impaired). In the Washington, D.C., metropolitan area, call 703-412-9810 or TDD 703-412-3323.

For information on specific aspects of this document, contact Rita

Chow, Office of Solid Waste (5302W), U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460, 703-308-6158, e-mail address: chow.rita@epa.gov.

SUPPLEMENTARY INFORMATION: The docket index and the notice are available on the Internet. From the World Wide Web (WWW), type <http://www.epa.gov/fedrgstr>. For the text of the notice, choose: Year/Month/Day. The document may also be obtained using File Transfer Protocol (FTP) at: <ftp://epa.gov>.

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Glossary of Acronyms

APCD--Air Pollution Control Device
ATON--Aid-to-Navigation
ATTIC--Alternative Technology Treatment Information Center
BDAT--Best Demonstrated Available Technology
BIF--Boiler and Industrial Furnace
BRS--Biennial Reporting System
DOE--Department of Energy
IMERC--Incineration of Wastes Containing Organics and Mercury (Specified Treatment Method)
LDR--Land Disposal Restrictions
MACT--Maximum Achievable Control Technology
NESHAP--National Emissions Standard for Hazardous Air Pollutants
NHWCS--National Hazardous waste Constituent Survey
PBT--Persistent, Bioaccumulative, and Toxic
PCB--Polychlorinated Biphenyls
POTW--Publically Owned Treatment Works
PSD--Prevention of Significant Deterioration Permit
RCRA--Resource Conservation and Recovery Act
RMERC--Roasting or Retorting of Mercury-Bearing Hazardous Wastes (Specified Treatment Method)
RREL--Risk Reduction Engineering Laboratory
S/S--Solidification/stabilization
SPC--Sulfur Polymer Cement
TCLP--Toxicity Characteristic Leaching Procedure
TOC--Total Organic Carbon
TRI--Toxic Release Inventory
VISITT--Vendor Information System for Innovative Treatment Technology
WMNP--Waste Minimization National Plan

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I. Introduction

With this document, the Agency marks the beginning of a comprehensive review of existing RCRA waste treatment regulations

applicable to mercury-bearing wastes and of our effort to revise, if necessary and appropriate, these regulations to improve treatment and land disposal methods. We decided to publish an ANPRM at this time because we expect to benefit significantly from early public input on mercury waste generation and treatment, including information on alternative treatment technologies and on source reduction opportunities. The nature and extent of amendments to the mercury treatment standards have not yet been determined. Any potential revisions will ultimately be based on the comments we receive on this ANPRM, as well as data obtained from other sources (e.g., ongoing treatability studies). As warranted, a proposal to amend the current regulations will appear in a future Federal Register document.

A. Agency's Concern for Mercury

As evidenced by EPA's Mercury Study Report to Congress ², mercury is an element that the Agency has studied quite extensively in recent years. Moreover, a recent Agency Federal Register notice identified mercury as one of the '53 persistent, bioaccumulative, and toxic (PBT) chemicals and chemical categories which may be found in hazardous wastes regulated under RCRA' (63 FR 60332, November 9, 1998). In addition, the EPA Action Plan for Mercury ³ lists this ANPRM as one of the twelve 'most significant actions that EPA is undertaking to deal with the problem of mercury exposure.'

\2\ 'Mercury Study Report to Congress,' Volumes I-VIII, EPA-452/R-97-003, December 1997.

\3\ EPA Action Plan for Mercury (Attachment 1 to 'An Agency-wide Multi-media Strategy for Priority PBT Pollutants') can be found at www.epa.gov/opptintr/pbt/pbtstrat.htm.

This ANPRM deals with a small aspect of the overall mercury problem, this being the treatment and disposal of mercury-bearing hazardous wastes. Nevertheless, the potential problems that exist in this area are significant, as mercury can both leach out of hazardous wastes and also be emitted from the various treatment processes.

B. Key Issues Addressed in the ANPRM

This ANPRM focuses on several key issues with the current LDR mercury treatment standards:

Incineration--We are interested in pursuing further the issue of mercury air emissions from incineration units. One of the original premises behind the current mercury treatment regulations was that incineration would be a pretreatment step to mercury recovery, but this

premise should be re-examined at this point, given new information about incineration of mercury wastes as well as the upcoming Hazardous Waste Combustion rule. Also, we currently allow high mercury, low organic wastes to be incinerated, but alternative treatment technologies may be preferable for these wastes. We want to investigate the impacts of reducing the number of waste types allowed or required to be incinerated (e.g., potentially only allow high organic, low mercury wastes, or organomercury wastes).

Retorting--From comments on this ANPRM, we hope to get a better idea of the full environmental impact of our waste treatment standards. Our treatment standards requiring recovery of mercury via retorting are a case in point. For example, air emissions and the disposal of the residues from secondary production (i.e., recycling-oriented processes) ought to be weighed against the diminishing benefits of recovery when such secondary production exceeds demand for the recycled product. In some cases, direct treatment for disposal could have some environmental advantages in certain supply-demand situations that have not previously been fully appreciated. We also want to investigate whether retorting (i.e., thermal recovery) is currently required for wastes that are either not amenable to or are inappropriate for (e.g., mixed wastes) this treatment. Finally, although several factors suggest that retorting emissions are not significant, we still want to determine if there are data that support this suggestion.

Source Reduction Options--EPA developed the current treatment regulations under statutory deadlines that impeded the exploration of potential source reduction technologies that could reduce or eliminate the generation of mercury-bearing wastes from many sources. The ANPRM contains a discussion of this investigation and potential options that might provide additional incentives for decreasing the amount of mercury in hazardous waste.

II. Background

A. Mercury in the Environment

Control of the environmental risks posed by mercury is a complex problem for a number of reasons. First, mercury and its compounds are mobile in the environment. Elemental mercury is volatile under both ambient and combustion temperatures and is released into the environment mostly through air emissions from commercial and industrial sources. It can remain in the atmosphere for up to one year, and hence can be widely dispersed and transported thousands of miles from the source of the emissions. When in the form of mercury salts, mercury air emissions are deposited more locally.

Second, multiple pathways exist for exposure. The risks associated with various exposure pathways depend strongly on the chemical form (i.e., species) of mercury involved. After deposition from the atmosphere, mercury can be methylated (especially in water bodies) to form the more toxic and bioaccumulative methylmercury. Exposure to levels of methylmercury found in fish taken from polluted water bodies

has been associated with neurological and developmental defects in humans, with the developing fetus most at risk. To reduce the risks of exposure to methylmercury over time,

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cost-effective strategies are needed both domestically and internationally to minimize the generation of mercury-bearing hazardous wastes.

Some evidence suggests that, because mercury is a persistent, bioaccumulative, and toxic (PBT) substance, small releases may contribute to the build up of mercury in the environment, especially the aquatic environment, over time, which may increase the potential for environmental and human health impacts. Consequently, EPA is looking at whether we may need to change the LDR mercury treatment standards.

B. The Resource Conservation and Recovery Act

One objective of the Resource Conservation and Recovery Act (RCRA)--the major hazardous waste statute--is to minimize the generation of hazardous waste and the land disposal of hazardous waste by encouraging process substitution, materials recovery, properly conducted recycling and reuse, and treatment (see RCRA section 1003). To further this objective, the Agency has set as goals of its Waste Minimization National Plan (WMNP) ⁴ to:

⁴ Waste Minimization National Plan, USEPA, 1994, EPA530-R-94-045.

- Reduce, as a nation, the presence of the most persistent, bioaccumulative, and toxic (PBT) chemicals in RCRA hazardous wastes 10 percent by the year 2000, and at least 50 percent by the year 2005 (from a 1991 baseline);

- Promote source reduction (and recycling where RCRA PBT chemicals cannot be reduced at the source) over treatment and disposal technologies; and

- Avoid the transfer of RCRA PBT chemicals across environmental media.

Consistent with the goals of RCRA and the WMNP, the Agency seeks to reduce the generation of hazardous wastes containing mercury. When this is not feasible, the Agency wants to look carefully at other opportunities to improve the recycling and treatment of residual mercury-bearing waste to further reduce air emissions, the mobility of mercury species at the time of disposal, and the potential for future biological or chemical conversion to other mobile and bioaccumulative species of mercury.

C. Mercury Treatment Standards

EPA established treatment standards for mercury-bearing wastes as part of two rulemakings. The LDR First Third final rule (53 FR 31166, August 17, 1988) established standards for RCRA hazardous waste code K071 (brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used), and the LDR Third Third final rule (55 FR 22569, June 1, 1990) established standards for five additional RCRA mercury-bearing waste codes: D009, characteristic mercury wastes; K106, wastewater treatment sludge from the mercury cell process in chlorine production; P065, mercury fulminate wastes; P092, phenyl mercuric acetate wastes; and U151, miscellaneous mercury wastes.

For all of these wastes, EPA established two treatment subcategories: a high mercury subcategory, which includes wastes with a total mercury concentration greater than or equal to 260 mg/kg; and a low mercury subcategory, which includes wastes with a total mercury concentration less than 260 mg/kg.

• High mercury wastes are required to be roasted or retorted ('`RMERC''), or incinerated ('`IMERC'') if organics are present. RMERC residues must then meet a numerical treatment standard of 0.20 mg/L prior to land disposal, as measured by the toxicity characteristic leaching procedure (TCLP). IMERC residues must meet a numerical treatment standard of 0.025 mg/L TCLP.

• Low mercury wastes are not subject to a specific technology for treatment but must meet a numerical treatment standard of 0.025 mg/L TCLP.

III. Mercury Hazardous Waste Generation and Management

A. Industries Generating Mercury-Bearing Wastes

Industrial use of mercury in the U.S. has been on the decline in recent years. Also, mercury is no longer produced from mercury ore in the United States, as the last mercury ore mine closed in 1990. However, mercury is still produced as a byproduct from the mining of gold ores and from secondary production. Nearly all of the mercury used in the United States is derived from secondary sources. Common secondary sources include spent batteries, chlor-alkali wastewater sludges, mercury vapor and fluorescent lamps, dental amalgams, electrical apparatus, and measuring instruments. The secondary producers typically use high-temperature roasting and retorting to recover mercury from the materials and distillation to purify contaminated liquid mercury metal.

Data on estimated industrial demand for mercury show a general decline in domestic mercury use since demand peaked in 1964. Table 1 describes the mercury production and consumption in the U.S. for 1990-1997. In 1997, 346 metric tons of mercury were used in industrial processes, 389 metric tons were produced by secondary mercury producers (i.e., producers recovering mercury from waste products), 134 metric

tons were exported, and 164 metric tons were imported. These figures continued the trend since 1995 of secondary production exceeding industrial consumption.⁵ Domestic demand fell by more than 75% between 1988 (1503 metric tons) and 1997 (346 metric tons). Much of this decline can be attributed to the elimination of mercury as a paint additive and the reduction of mercury in batteries. Other reasons for the reduction include the military phase-out of mercury fulminate as a primer in military explosives and the decline in the number of chlor-alkali facilities using the mercury cell method of chlorine production. Use of mercury by other source categories remained essentially the same between 1988 and 1996.⁶ The data suggest that industrial manufacturers who use mercury are shifting away from its use except where mercury is considered essential. However, mercury consumption in the categories of Electrical and Electronic Uses and Instruments and Related Products is still growing, and is expected to continue to grow due to the increase in the manufacture of computers and other electrical equipment.⁷

\5\ Robert G. Reese, Jr, US Geological Survey, Minerals Information, 1997.

\6\ Mercury Study Report to Congress, USEPA, December 1997, Volume I: Executive Summary, page 3-8.

\7\ The Status of Mercury in the United States, Draft 2, September 10, 1996, page A3-6.

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Table 1.--Mercury

Production and Use Statistics
[Metric tons]

	1991	1992	1993	1994	1995	1996	1997	1990 1998E
Mine Production:								
--Principal product \1\.....								448
.....								
--Byproduct from gold mines.....								114
58	64	W	W	W	W	W	W	
Secondary Production:								
--Industrial.....								108
165	176	350	446	534	446	389	400	
--Government \2\.....								193
215	103	

Imports for Consumption.....								15
56	92	40	129	377	340	164		200
Exports.....								311
786	977	389	316	179	45	134		150
Shipments from National Defense Stockpile \3\.....								52
103	267	543	86					
Industry Stocks, year-end \4\.....								197
313	436	384	469	321	446	203		200
Industrial Consumption (reported).....								720
554	621	558	483	436	372	346		400
Price, average dollars per flask:								
D.F. Goldsmith.....								\$249.22
\$122.42	\$201.39	\$186.51	\$194.45	\$247.40	\$261.65		NA	NA
Free market.....								NA
NA	NA	NA	NA	NA	NA	\$159.52		\$180

Source: Robert G. Reese, Jr, US Geological Survey, Minerals Information, 1997, 1999.

E--Estimated. W--withheld for confidentiality. NA--Not available

\1\ Comprises only mercury produced at McDermitt Mine, as reported in Placer Dome Inc. Annual and 10-K reports. The mine was closed in November 1990.

\2\ Secondary mercury shipped from U.S. Department of Energy stocks.

\3\ Shipments from the government stockpile were suspended in 1995.

\4\ Stocks at consumers and dealers only. Mine stocks withheld to avoid disclosing proprietary data.

Table 2 presents estimates of mercury emissions from the EPA Mercury Study Report to Congress (USEPA, December 1997), and national emission estimates for hazardous waste combustors for 1990, 1994, and 1997. The Report to Congress identifies combustion sources, including utility and commercial/industrial boilers, as the major source of mercury emissions. Hazardous waste combustion emissions and emissions from secondary mercury production are estimated to be less than five percent of overall mercury emissions. In 1990 and 1994, mercury emissions from hazardous waste combustion sources totaled approximately 6.4 metric tons per year, and for 1997, these emissions decreased to approximately 6.0 metric tons per year.⁸ Table 2 shows a further breakdown of the mercury emissions contribution from each hazardous waste combustor category.

\8\ When interpreting any apparent data trends in Table 2, you should note that differences in emissions estimates are due to a combination of factors including actual data from performance in the field, revisions to our estimation methodology, and changes in the number of facilities operating within each category. See documents noted as sources for Table 2.

Table 2.--Available Mercury Emissions Data

[Metric Tons]

1994^(b)	1990^(a)	1997^(c)	
Area sources.....	3.1		
Combustion sources.....	125.2		
Manufacturing sources.....	14.4		
Miscellaneous sources.....	1.3		
Total Air emissions.....			
	213	144	
Total HW Combustors ^(d)			
6.4	6.0	6.4	
(% of total emissions).			
		(4.4)	
Secondary Hg Production ^(e)			
		0.7	0.4
(% of total emissions).....			
		(0.3)	

^a Source Category Listing for Section 112(d)(2) Rulemaking Pursuant to Section 112(c)(6) Requirements, USEPA, April 10, 1998; 63 FR 17338, Table 1.

^b Mercury Study Report to Congress, USEPA, December 1997, Volume I: Executive Summary, page 3-6.

^c Note to Laura McKelvey, USEPA, from Frank Behan, USEPA, dated July 1, 1998. This emissions inventory supports the rulemaking to revise the technical standards for hazardous waste combustion facilities and will be included in a technical support document for that rule.

^d Total HW Combustor emissions (6.4 metric tons) are a subcategory of the Combustion source emissions (125.2 metric tons) that appear in the Mercury Study Report to Congress (see note ``b'' above).

^e Secondary Hg Production emissions (0.4 metric tons) are a subcategory of the Manufacturing source emissions (14.4 metric tons) that appear in the Mercury Study Report to Congress (see note ``b'' above).

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B. Generation of Mercury-Bearing Hazardous Wastes

The background document ``Analysis of Current Mercury Waste Generation and Treatment'' in the docket for today's notice includes tables that break down the generation of mercury-bearing hazardous wastes by waste code, waste form, and SIC Code based on the National Biennial RCRA Hazardous Waste Report (BRS) database. While the BRS provides a general idea of how much hazardous waste is generated, the numbers can be misinterpreted. For example, the BRS does not provide mercury concentrations in the waste streams. Therefore, we do not have a good estimate for the total amount of mercury that is treated by non-combustion technologies in the United States.

\\ BRS data can be found at www.epa.gov/epaoswer/hazwaste/data/

Another interpretive issue with BRS data is that some waste quantities can be overestimates of the actual amount of waste produced. For example, some waste streams may be given multiple waste codes, one code being the specific waste code (e.g., K071), and another code being the general characteristic code (e.g., D009). This leads to an overestimate of the actual quantity generated.

According to the 1995 BRS, approximately 12.2 million metric tons of mercury-bearing hazardous waste (wastewater and nonwastewater) were generated. This represents an increase from the 1993 BRS estimate of 11.5 million metric tons. The National Hazardous Waste Constituent Survey (NHWCS), which was designed to correspond with 1993 BRS data, estimated that almost 19 million metric tons of mercury-bearing wastes were managed. This NHWCS was created by EPA's Office of Solid Waste in 1996 and distributed to over 200 of the largest generators and managers of hazardous industrial process wastes in the U.S. These facilities account for over 90 percent of the total waste quantity in the hazardous waste universe as reported in the 1993 BRS.

The NHWCS also included estimates of the total amount of mercury managed by treatment technologies. The three technologies that were listed, and their respective mercury quantities, were ``other treatment,'' 3257 metric tons; ``aqueous inorganic treatment,'' 33 metric tons; and ``landfill,'' 30 metric tons. In the ``other treatment'' category, one facility (DOE/WRSC Savannah River) accounts for approximately 98 percent of the total constituent quantity. Without this facility, the constituent total for ``other treatment'' would be 5.6 tons. Since the survey was voluntary and limited to the largest waste streams, it is likely that it did not include many retorters and incinerators of mercury (especially high subcategory mercury) wastes.

Table 3 presents data from the Toxics Release Inventory (TRI) database. The TRI is an information source about toxic chemicals that are being used, manufactured, treated, transported, or released into the environment. A facility is required to submit a TRI report if it (1) has ten or more full-time employees, and (2) manufactures or processes over 25,000 pounds of the approximately 600 designated chemicals or 28 chemical categories specified in the regulations, or

uses more than 10,000 pounds of any designated chemical or category, and (3) engages in certain manufacturing operations in the industry groups specified in the U.S. Government Standard Industrial Classification Codes (SIC) 20 through 39. Federal facilities also are required to report following an August 1995 Executive Order.

EPA emphasizes that the BRS and NHWCS data presented above and the emissions data in Table 3 are estimates that may overestimate generation. The Agency welcomes any information that may help to construct a more accurate picture of the current mercury waste universe. This would include current data on waste generation (types, quantities, and mercury concentrations in the wastes), current waste management practices, problems and/or constraints on treating or recovering these wastes, as well as information on any waste minimization activities that may have been implemented to reduce or eliminate waste generation.

Table 3.--TRI Data
[Metric Tons]

1994	1995	1996	1993

TRI total production-related waste:			
407.5	459.6	390.1	
55.7	70.6	36.1	
463.2	530.2	426.2	
TRI wastes to recycling:			
390.0	443.7	375.4	
42.6	56.8	21.9	
432.6	500.5	397.3	
TRI mercury + mercury compounds:			
4.43	4.85	5.51	5.28
1.87	2.55	2.24	1.57
0.15	0.15	0.25	0.20
0.003	0.003	0.004	0.007
.061	.046	.024	0.82
17.6	94.4	11.7	15.7
			NA

5.02	2.86	1.87	
Transfers to energy recovery.....			0
0	0.23	0.23	
Transfers to treatment.....			0.79
1.75	7.59	6.55	
Transfers to POTWs.....			0.007
0.007	0.011	0.007	
Other off-site transfers.....			0
0	0.40	0	
TRI total not recycled:			
-Mercury.....			14.7
18.2	17.8	13.7	
-Mercury compounds.....			9.7
13.2	95.7	15.0	

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-Mercury + mercury compounds			
^a.....		24.4	31.4
113.5	28.6		

 ^a totals may not add due to rounding

IV. Current RCRA Regulations Governing Treatment of Mercury-Bearing Hazardous Wastes

A. RCRA Waste Code Classification and Treatment

EPA's hazardous waste classification system identifies six categories of mercury-bearing wastes, each of which has a separate RCRA waste code.

The following is a detailed description of the six mercury waste codes:

D009 Wastes--Characteristic Mercury Wastes. D009 wastes are extremely variable in composition, and depend on the industry and process that generate the waste. Some of the more common types of D009 wastes include miscellaneous wastes from chlor-alkali production facilities (especially cell room trench sludge and activated carbon for liquid or gas purification), used fluorescent lamps, batteries, switches, and thermometers. D009 wastes are also generated in the production of organomercury compounds for fungicide/bactericide and pharmaceutical uses, and during organic chemicals manufacturing where mercuric chloride catalyst is used.¹⁰

 \10\ U.S. EPA, Best Demonstrated Available Technology (BDAT) Background Document for Mercury Wastes, Nov 1989, page 2-18.

Mercury concentrations within D009 wastes may range from 0.20 mg/L TCLP to greater than 75 percent of the total waste composition. D009 wastes may also contain organic compounds, usually when mixed with solvent wastes.

Although characterization data for D009 wastes are limited, some conclusions can be made regarding potential treatment concerns. Wastes with greater than 500 ppm 40 CFR part 261, appendix VIII organics (such as benzene) may be problematic for commercial retorting facilities due to the permitting requirements for boiler and industrial furnaces (BIF) (40 CFR 266.100(c)). At least two facilities are unable to handle wastes with these levels of volatile organics due to the additional permitting that would be required. However, these two facilities are capable of treating non-volatile activated carbons.

K071 Wastes--Brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used. K071 wastes are generated by the chlor-alkali industry in the mercury cell process. In this process, sodium chloride is dissolved to form a saturated brine solution. The brine solution is purified by precipitation, using hydroxides, carbonates, or sulfates. The precipitate is dewatered to form K071 wastes, while the purified brine continues in the process. The depleted solution from the mercury cell is ultimately recycled to the initial step of the process.

Available analytical information for K071 brine purification muds show that these wastes consist primarily of inorganic solids and water. The normal total mercury content of K071 wastes is less than 100 parts per million (ppm) and is normally characterized as metallic mercury or soluble mercuric chloride. Mercury from K071 wastes is typically recovered using a wet process, reflecting the BDAT for this waste.

\\11\ U.S. EPA, BDAT Document for Mercury Wastes, November 1989,
page 2-11.

K106 Wastes--Wastewater treatment sludge from the mercury cell process in chlorine production. Like K071 wastes, K106 wastes are generated from chlorine production using the mercury cell process. Effluent from the mercury cell includes spent brine, a portion of which is recycled and a portion of which is purged to wastewater treatment. Other plant area wastewaters (e.g., stormwater, washdown waters) are also typically sent to this treatment system. The wastewater treatment process generates a sludge through precipitation and filtering, which is K106 waste. Sulfides (as either sodium sulfide, Na₂S, and/or sodium bisulfide, NaHS) have been commonly used as a precipitation agent for at least the last 10 years (1988 to 1998), according to data from the Chlorine Institute. Sludges generated in this manner are comprised, in part, of mercuric sulfide. Other (minor) precipitation agents result in the formation of mercury hydroxide or in elemental mercury. However,

sulfide precipitation is preferable to hydroxide precipitation using hydrazine because mercury hydroxide is susceptible to matrix dissolution over a wide range of pH under oxidizing conditions.

Available analytical information for K106 wastes indicates they are primarily composed of water and diatomaceous earth filter aid. This is true for K106 wastes generated by both sulfide treatment and hydrazine treatment. K106 wastes from sulfide precipitation contain approximately 4.4 percent mercury, as mercuric sulfide, while K106 wastes from hydrazine treatment contain approximately 0.5 percent mercury, as mercurous hydroxide.¹²

\12\ U.S. EPA, BDAT Document for Mercury Wastes, November 1989, page 2-11.

The mercury concentration in K106 waste is consistently greater than 260 mg/kg and therefore retorting is a required technology for this waste. K106 waste also contains significant levels of sulfides/sulfates, sodium chloride, and organics, although the mercury is likely in an elemental or a sulfide form.

P065 Wastes--Mercury fulminate. P065 wastes consist of discarded mercury fulminate product, off-specification mercury fulminate product, and container or spill residues thereof. No waste characterization data were available for P065 listed wastes. The quantity of P065 waste is expected to have declined, as the military has phased out its use in explosives.¹³

\13\ Mercury Treatment and Storage Options Summary Report, A.T. Kearney report for USEPA Reg 5, May 1997, page 1.

P092 Wastes--Phenylmercury acetate. P092 wastes consist of discarded phenylmercury acetate product, off-specification phenylmercury acetate product, and container or spill residues thereof. There are very little data available on the composition of P092 listed wastes. The primary constituent of P092 listed wastes is phenylmercury acetate; organic constituents (in particular, benzene) are also expected to be present.¹⁴ The use of phenylmercury acetate as a preservative in latex paint was phased out in 1991. Thus, the quantity of P092 waste is expected to decline dramatically as the stock of mercury-bearing paint is depleted.¹⁵

\14\ U.S. EPA, BDAT Document for Mercury Wastes, November 1989, page 2-17.

\15\ Mercury Treatment and Storage Options Summary Report, A.T. Kearney report for USEPA Reg 5, May 1997, page 1.

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U151 Wastes--Mercury. U151 wastes consist of discarded elemental mercury product, off-specification metallic mercury product, and container or spill residues thereof. The majority of U151 wastes reported as a single waste code (i.e., not mixed with other listed or characteristic wastes) in the EPA 1986 Generator Survey are over 50 percent mercury. The principal constituent of U151 is metallic mercury.¹⁶/

\16\ U.S. EPA, BDAT Document for Mercury Wastes, November 1989, page 2-17.

B. Existing LDR Regulations for Mercury-Bearing Wastes

Table 4 summarizes the current LDR requirements for these wastes.

Table 4.--LDR Regulations for Mercury-Bearing

Nonwastewaters

Mercury Subcategory waste codes	Description Federal Register publication	LDR treatment requirements	Applicable
		Concentration in mg/l TCLP; or Technology code	
High Mercury-Organic 55 FR 22569, (i.e., the waste has a total mercury (June 1, 1990). content greater than or equal to 260 mg/kg), contains organics, and is not an incinerator residue.		Incineration (IMERC); OR Roasting or Retorting (RMERC).	D009 P092
Mercury fulminate waste regardless of 55 FR 22569, total mercury content and is not an (June 1, 1990). incinerator or RMERC residue.		IMERC.....	P065
Phenylmercury acetate waste 55 FR 22569, regardless of total mercury content (June 1, 1990). and is not an incinerator or RMERC		IMERC; OR RMERC.....	P092

residue.		
High Mercury-Inorganic Subcategory	RMERC.....	D009
55 FR 22569,		
(i.e., the waste has a total mercury		K106
(June 1, 1990).		
content greater than or equal to 260		U151
mg/kg), and is inorganic, including		
residues from incineration, roasting		
and retorting.		
Low Mercury Subcategory (i.e., the	0.20 mg/l TCLP.....	D009
^(a)	55 FR 22569,	
waste has a total mercury content		K071
(June 1, 1990).		
less than 260 mg/kg), and that are		K106
residues from RMERC only.		P065
		P092
		U151
Low Mercury Subcategory (i.e., the	0.025 mg/l TCLP.....	
D009^(a)	55 FR 22569,	
waste has a total mercury content		K071
(June 1, 1990).		
less than 260 mg/kg), and are not		K106
D009 treatment standard		
residues from RMERC.		P065
revised 63 FR 28568,		
		P092
(May 26, 1998).		
Elemental mercury contaminated with	AMLGM.....	D009
55 FR 22569,		
radioactive materials.		U151
(June 1, 1990).		
Hydraulic oil contaminated with	IMERC.....	D009
55 FR 22569,		
Mercury Radioactive Materials		
(June 1, 1990).		
Subcategory.		

^a D009 wastes with concentration-based standards, rather than specified technology standards, must also meet Sec. 268.48 standards (LDR Phase IV final rule, May 26, 1998).

V. Mercury Treatment Technologies-Roasting and Retorting of Mercury Wastes

A. Process and Regulation

Roasting or retorting of mercury (RMERC) and subsequently condensing the volatilized mercury for recovery is currently required for D009, K106, and U151 wastes in the high mercury-inorganic

subcategory (i.e., 260 mg/kg total mercury and above), and P065 and P092 nonwastewaters that are incinerator residues or residues from roasting or retorting that still contain greater than 260 mg/kg total mercury. RMERC is also a treatment option for D009 wastes in the high mercury-organic subcategory that are not incinerator residues, and P092 wastes that are not incinerator or RMERC residues.

Most retort processes use a batch vessel. The mercury-bearing waste is sealed in the vessel and volatile gases, such as mercury vapor, are released when the vessel is heated (sometimes under vacuum conditions). The mercury vapor is condensed, collected, and subsequently purified by successive distillation. The BDAT Background Document ¹⁷ also describes roasting, where air is introduced to the hot waste to oxidize mercury compounds and to help transport mercury vapor to the condenser.

\\17\ Final BDAT Background Document for Mercury-Containing Wastes D009, K106, P065, P092, and U151, USEPA, May 1990, page 3-2.

All wastewater and nonwastewater treatment residues derived from the RMERC process must meet various standards that ensure proper mercury removal via RMERC. If treatment residues are still in the high mercury subcategory (i.e., contain 260 mg/kg total mercury or more), they must be retreated. If the RMERC treatment residues are in the low mercury subcategory (i.e., contain less than 260 mg/kg total mercury), they must meet a standard of 0.20 mg/L TCLP mercury prior to being land disposed. (Note: low mercury subcategory wastes that are not residues of RMERC must meet a more stringent standard of 0.025 mg/L TCLP mercury.) Thus, current LDR regulations mandate recovery (and therefore recycling) of mercury waste that contains greater than or equal to 260 mg/kg total mercury; impose regulatory control over the emissions from roasting and retorting and the disposal of residues derived from the process; and differentiate between the residues from RMERC versus other treatment processes to encourage recycling and recovery. The Agency requests comment on whether RMERC should include types of recycling technologies other than roasting or retorting, which also would allow treatment residues from those technologies to be eligible for the 0.20 mg/L standard.

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B. Air Emissions from Roasting and Retorting

Air emissions from a mercury retorting or roasting unit (or facility) also are regulated. The unit or facility must be subject to one or more of the following (40 CFR 268.42):

(a) A National Emissions Standard for Hazardous Air Pollutants (NESHAP) for mercury;

(b) A Best Available Control Technology (BACT) or Lowest Achievable Emission Rate (LAER) standard for mercury imposed pursuant to a Prevention of Significant Deterioration (PSD) permit; or

(c) A state permit that establishes emission limitations (within meaning of section 302 of the Clean Air Act) for mercury.

Secondary mercury production is estimated to have accounted for approximately 0.4 Metric tons of mercury emissions in 1995.¹⁸ Air emissions from retorting or roasting units are generally scrubbed and passed through carbon filters that efficiently capture mercury vapor. When spent, these filters are retorted or roasted along with other wastes to recover the mercury that has been trapped. The units may also incorporate an afterburner prior to any additional air pollution control devices (APCDs) for odor control.

\18\ Mercury Study Report to Congress, USEPA, December 1997, Volume I: Executive Summary, page 3-6.

(a) Chlor-alkali facilities

Of the 14 chlor-alkali facilities using the mercury cell process, six conduct onsite retorting or roasting. The background document ``Waste Specific Evaluation of RMERC Treatment Standard'' presents air emissions data for these six facilities from the TRI, and for two other facilities that do not conduct onsite mercury recovery. These two facilities ship their wastes off-site to other facilities owned by the same parent company. The releases shown represent all releases, including retorting emissions, fugitive emissions and emissions from hydrogen stream purification.¹⁹ The airborne mercury releases from all facilities with a retort process unit range from 250 to 1,500 pounds for 1995. However, mercury releases from facilities without a retort process unit are comparable to the releases from facilities with retorters, indicating that retort emissions are relatively small compared to total facility emissions.

\19\ Telephone conversation, Iliam Rosario, U.S. EPA, and John Vierow, SAIC, July 1998.

(b) Commercial Facilities

The background document ``Waste Specific Evaluation of RMERC Treatment Standard'' contains data on mercury emissions to air, water, and offsite recycling sites for the three commercial roasting or retorting facilities that submitted TRI reports. No other emissions information is available for other facilities.

Air emissions data for the three facilities indicate that releases are low. Stack emissions data were not obtained, but verbal correspondence indicates that measured emissions are also low. For

example, one facility measures for mercury at the stack several times per day. A State official believed that these measurements are normally non-detects and, if any mercury is detected, the operation shuts down.

\20\ Telephone Conversation between John Vierow, SAIC, and Luis Pizarro, USEPA Region 3, June 1998.

Detailed air pollution control device information is also available for several facilities. Air pollution control at several of the commercial roasting/retorting facilities includes carbon adsorption with no scrubbers.\21\ BRS data indicate that at least one facility uses carbon absorption and a scrubber. Literature reviews and discussions with technology vendors indicate that the use of activated carbon beds can achieve 90% or more mercury removal, with some greater than 99%.\22\

\21\ Ibid.

\22\ Draft Technical Support Document for HWC MACT Standards, USEPA, February 1996, F-96-RCSP-S0047.

At one facility, all retorting and ancillary operations (e.g., material handling) are conducted indoors.\23\ This facility has emission controls for its furnace operation and for the building where the ancillary operations are conducted. The furnace off gas is cooled, then passed through activated carbon and a gas afterburner. Vent gas from the building passes through activated carbon and is emitted to the atmosphere. A second facility's furnace emissions are cooled, passed through a series of activated carbon absorption, and emitted to the atmosphere.\24\ A third company's retort process is contained in a multicompartment building and all of the operations are conducted under negative pressure to help control emissions. The facility also uses sealed rooms for the preheating and cooling of the mercury-bearing wastes, and the rooms are equipped with their own carbon adsorption filters to trap mercury vapor.\25\

\23\ Bethlehem Apparatus, Waste Analysis and Recycling Plan, 1996.

\24\ Telephone Conversation between John Vierow, SAIC, and Luis Pizarro, USEPA Region 3, June 1998.

\25\ Mercury Refining Company, Facility Information Packet.

The Agency requests additional data on air emissions from roasting and retorting units, including information detailing the effectiveness

of existing after burner, carbon bed, and scrubber controls.

C. Request for Comment

The Agency specifically requests comment on the following:

1. What Wastes Are Not Amenable to RMERC?

Mercury recovery facilities are exempt from the boiler and industrial furnace requirements of 40 CFR part 266, subpart H provided they meet certain requirements, such as the rejection of wastes with greater than 500 ppmw of certain organic constituents (i.e., organic compounds on 40 CFR part 261, appendix VIII). However, these units may process wastes containing various plastics, which may require the thermal destruction of odor causing emissions resulting from the pyrolysis (i.e., thermal decomposition) of these plastics. See appendix XIII of part 266. Other problem wastes for mercury recycling include:

- Wastes containing organic forms of mercury (e.g., mercury fulminate, phenylmercury acetate). Independent of regulatory restrictions, some facilities do not accept any organomercury compounds because the compound does not decompose into elemental mercury. Instead, the compound is carried through the retort and distillation system and results in an impurity in the final mercury product.\26\

\26\ Frederick J. Manley, USPCI Lab Pack Manager, letter to EPA, July, 2, 1992.

- Wastes with a high water content. Large quantities of generated steam interfere with the mercury condensation process. To solve this problem, one facility precipitates or concentrates liquid solutions prior to retorting.

- Wastes containing mercuric chloride, polyvinyl chloride, and halogens. Mercury chloride and other salts carry over during the retorting and condensation process, forming impurities.\27\ Additionally, in the presence of steam, halogens will form acids, which corrode equipment. One facility pre-treats corrosive solutions using ion-exchange to overcome this problem. Another company uses chemical conversion to mercuric oxide prior to retorting to remove halides before processing.

\27\ Ibid

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- Wastes containing volatile metals. Some retorting facilities restrict certain metals, including lithium, arsenic, and thallium. It is not known why these self-imposed restrictions exist.

<bullet> Radioactive wastes. For regulatory and safety reasons, most facilities reject radioactive wastes. Only one facility has been identified that accepts radioactive mercury-bearing wastes.

<bullet> Mercury nitrate/nitrite solutions. This material typically results in an ignitable solution, which appears to raise permit concerns for facilities\28\

\28\ Ibid

<bullet> Wastes containing mercuric sulfide. These wastes are difficult to retort. Additives are required to scavenge elemental sulfur produced before it can recombine with the mercury.

The Agency requests further information detailing the problems that occur when treating wastes in retorting units, including the forms of mercury wastes that are not technically amenable to retorting and/or are not accepted at retorting facilities.

2. Should Non-Thermal Recycling Technologies Be Allowed for High Mercury Wastes and, if so, Should They Continue To Be Subject to a More Stringent Residual Standard?

Since the RMERC regulations were promulgated, additional recycling technologies have been developed. One such technology is Universal Dynamic's REMERC process. While this process accomplishes mercury recycling in a closed system that limits air emissions, the residues are currently subject to the more stringent 0.025 mg/L TCLP mercury standard for non-RMERC residues. The Agency requests comment and data to determine whether non-RMERC recycling processes, if properly designed and operated, should continue to be under more stringent regulation because these processes may result in less mercury recovery than roasting and retorting processes, increased mercury content of residuals, higher air emissions, or a less stable final waste form. If these alternative recycling technologies are determined to be viable and are demonstrated to be properly designed and operated, the residuals could be subject to the current RMERC residual standard of 0.20 mg/L, or to a new treatment standard that the alternative technology has been demonstrated to achieve. Alternatively, the current regulations could be expanded to include recycling technologies other than RMERC as potential options for treating high mercury subcategory wastes.

3. Should the Mercury Concentration Requirement for RMERC (260 mg/kg or above) Be Adjusted?

The Agency requests data to support the potential adjustment of the 260 mg/kg total mercury distinction between the high and low mercury subcategories. The Agency requests data on difficult to treat wastes, particularly ones that have required one or more processings to achieve a total mercury concentration of less than 260 mg/kg, and on initial total mercury content and total mercury content after each treatment, together with the associated analytical quality assurance measurements and operation and design parameters of the unit. The Agency reminds

commenters submitting data in support of their views to include with the data evidence that appropriate quality assurance/quality control \29\ (QA/QC) procedures were followed in generating the data. Data that the Agency cannot verify through QA/QC documentation may be given less consideration or disregarded in developing regulatory options for proposed and final rules. Also, it is important that commenters demonstrate their processes were optimized and under stable operation during the test period. The Agency also requests information from retorting facilities concerning the minimum, maximum, and average concentration levels of mercury wastes accepted at these facilities.

\29\ For guidance, see Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance/Quality Control Procedures and Methodology; USEPA, October 23, 1991.

4. Should the Agency Allow Alternative (Non-Recycling) Treatment Options to RMERC for High Mercury Wastes?

The Agency requests comment on whether treatment options besides recovery should be permissible for high mercury subcategory wastes. Recycling mercury in industrial processes and using recycled mercury as a raw material for commercial products are potential sources of mercury releases into the environment. Because mercury releases to the environment have had adverse impacts on both human health and the environment, federal regulations have concentrated on controlling and, in some cases, phasing out mercury use in industry. At least in part, a result of these findings and actions has been a decline in the use of mercury in U.S. industry over the years.

Therefore, the Agency seeks information on technologies that will treat high mercury wastes into a safe environmental form so that all mercury release pathways into the environment are minimized. The Agency requests comment on whether alternative land disposal treatment technologies to recovery (e.g., sulfide conversion and stabilization with sulfur-polymer cement) for high mercury wastes should be made an option and requests data on mercury releases from wastes treated by these technologies. Data and information should also be included on the technology's ability to treat wastes containing organics, and the maximum organic level that the technology can handle.

One waste form that deserves particular mention is waste containing mercuric sulfide. These wastes are difficult to retort efficiently, and additives are required to react with or otherwise bind the elemental sulfur to prevent its recombination with the elemental mercury being recovered. As an alternative, precipitation of mercury using sulfide is a technology commonly applied in wastewater treatment. The Agency requests comment and data on whether such wastes should be either exempt from the RMERC requirement, subject to numerical standards, or subject to another technology standard.

5. Can Emissions From Secondary Mercury Production Be Further Reduced?

While the roasting/retorting processes effectively recycle mercury

and have air emission controls, an estimated 0.4 Metric tons/yr of air emissions from secondary mercury production still exists. The Agency requests comment on the feasibility of more efficient controls during secondary mercury production and on the use of enclosed treatment processes.

6. Should EPA Consider Revising the Debris Standards To Require That High Mercury Subcategory Wastes That Also Meet the Definition of Debris Be Retorted?

The debris standards for hazardous wastes are listed in Table 1 of 40 CFR 268.45. EPA requests comment on potential revision of these standards to require the roasting or retorting of hazardous debris if the mercury concentration is greater than or equal to 260 mg/kg total mercury. EPA dealt with a specific case of mercury debris in early 1997 involving Aid-to-Navigation (ATON) batteries, and the most appropriate treatment and disposal method. At that time, EPA stated that it is more appropriate to apply the debris standards than the non-debris standards for mercury wastes, the latter of which would require RMERC (if the wastes contain 260 mg/kg or more total

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mercury). However, in subsequent discussions with members of the recycling industry, the Agency was informed that retorting is indeed feasible on these types of wastes. We are seeking comments on whether the debris standard should be revised to require RMERC if the waste is in the high mercury subcategory. Commenters are encouraged to also include the possible ramifications of such a revision.

VI. Mercury Treatment Technologies--Incineration of Mercury Wastes

A. Current Regulations

Three categories of waste streams must or can be incinerated under the current LDR treatment standards. These three are: D009 high mercury-organic subcategory; P092 wastes regardless of total mercury content that are not incinerator residues or are not residues from RMERC; and P065 wastes regardless of the total mercury content that are not incinerator or RMERC residues. The current regulations specify that incineration (IMERC) must be performed in units operated in accordance with the technical requirements of 40 CFR part 264, subpart O and 40 CFR part 265, subpart O.\30\ All wastewater and nonwastewater residues derived from this treatment process must then comply with the corresponding treatment standards per waste code, with consideration of any applicable subcategories.

\30\ 40 CFR 264 subpart O and 265 subpart O are the regulations for hazardous waste incinerators.

B. Characteristics of Mercury in Incinerators and Current Emission Control Systems

Mercury is slightly volatile at ambient temperatures but is quite volatile at temperatures common to thermal treatment devices. It boils at approximately 356 degrees Celsius and typically escapes with other stack gases from incineration. With respect to mercury behavior in combustion systems and existing control techniques, mercury is volatilized and converted to elemental mercury in the high temperature regions of furnaces. As the flue gas is cooled, elemental mercury is oxidized to ionic forms. Elemental mercury, mercuric chloride, and mercuric oxide are all in the vapor phase at flue gas cleaning temperatures and special methods must be used for their capture. Each of these forms of mercury can be adsorbed onto porous solids such as fly ash, powdered activated carbon, and calcium based acid gas sorbents for subsequent collection in a particulate matter control device. Only one hazardous waste incinerator (WTI, Inc., East Liverpool, Ohio) currently has this type of APCD installed. Control of mercury in municipal waste combustors has been based on injection of powdered activated carbon upstream of an electrostatic precipitator or fabric filter, and many municipal units have this type of system installed.

Mercury compounds also can be captured effectively using activated carbon or other sorbents. Fixed bed, fluidized bed, and duct injection arrangements have all been demonstrated to perform at 90% or more mercury removal efficiency, with some as high as 99% or greater. Systems without carbon injection, i.e., wet scrubbing systems designed for acid gases like hydrochloric acid, have much poorer mercury capture efficiency ranging from 0 to 40%. The highest control levels for activated carbon systems are achieved by optimizing the carbon type and the critical operating parameters of the control system. For example, for activated carbon injection, these parameters would include carbon feedrate, injection location, and temperature.\31\

\31\ Draft Technical Support Document for HWC MACT Standards,
USEPA, February 1996, F-96-RCSP-S0047.

C. Amount of Mercury Emitted from Incinerators and Other Hazardous Waste Combustors

As part of our current MACT rulemaking to upgrade emission standards for hazardous waste incinerators and hazardous waste-burning cement kilns and lightweight aggregate kilns (collectively known as hazardous waste combustors), the Agency developed a database containing detailed information on hazardous waste emissions, including mercury. The database also includes information on the quantity of mercury in each feedstream fed to the combustion unit. These feedstreams include, if applicable, the hazardous waste, coal and other conventional fuels, and raw materials.

Table 2, which is presented earlier in this preamble, shows national emission estimates for hazardous waste combustors for 1990, 1994 and 1997. In 1990, mercury emissions from these sources totaled approximately 6.4 metric tons per year. Table 2 shows a further breakdown of the mercury emissions contribution from each hazardous waste combustor category. For 1994, national emissions from hazardous waste combustors were estimated to be approximately 6.4 metric tons per year. These sources are estimated to contribute approximately 4.4 percent of the total anthropogenic, or man-made, emissions of mercury in the U.S. For 1997, mercury emissions from hazardous waste combustors total approximately 6.0 metric tons per year. In general, mercury emissions from hazardous waste combustors have decreased slightly between 1990 and 1997.

\32\ When interpreting any apparent data trends in Table 2, you should note that differences in emissions estimates are due to a combination of factors including actual data from performance in the field, revisions to our estimation methodology, and changes in the number of facilities operating within each category. See documents noted as sources for Table 2.

D. General Waste Characterization Data on Mercury in Hazardous Waste Streams

Treatment capacity determinations for the LDR program are generally made based upon the broader Biennial Report System database, which covers all types of hazardous waste activities. If we were to amend our LDR treatment standards in any respect, we would also consult this database. The 1995 Biennial Report indicates that for mercury-bearing wastes, 86,400 tons were incinerated and 380,000 tons were reused as fuel (i.e., sent to cement kilns and light weight aggregate kilns). However, the BRS system itself does not distinguish between the high and low mercury subcategories, nor does it show what concentration of mercury is present in these waste streams.

D009 wastes are extremely variable in composition, and their characteristics depend on the industry and process that generate the waste. Mercury concentrations in D009 wastes can range from 0.2 ppm to greater than 75 percent of the total waste composition. Although characterization data for D009 wastes are limited, some conclusions can be made regarding potential treatability issues. According to the 1995 BRS, the three largest volumes of D009 waste by waste form were reported as ``halogenated/nonhalogenated solvent mixture'' (21,700 tons), ``other halogenated solids'' (8,400 tons), and ``concentrated solvent-water solution'' (4,700 tons). These waste form descriptions suggest that the mercury is not the primary contaminant in the wastes. Finally, because concentration data are not provided in the BRS, D009 wastes could be comprised of both high and low mercury subcategory wastes.

Certain D009 waste streams may be incinerated for reasons other than the LDR IMERC treatment requirement. For example, BRS waste streams containing

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hazardous materials, particularly dioxins and PCBs, as well as certain ignitables and reactives require incineration treatment. Incineration and other types of combustion are the only common treatment methods that completely destroy dioxins and PCBs. Therefore, many of the waste streams reported to the 1995 BRS may have to be processed using incineration regardless of the mercury content. Many waste streams contain D009 mercury organic-bearing wastes from lab packs, halogenated/nonhalogenated solvent mixtures, certain halogenated solids, oily sludges, and organic paints.

No waste characterization data were found for P065 listed wastes. Two facilities in the 1995 BRS reported incineration of P065.

Very little data are available on the composition of P092 listed wastes. The primary constituent of P092 listed wastes is phenylmercury acetate; organic constituents (in particular, benzene) are also expected to be present (USEPA 1989). Five facilities in the 1995 BRS reported incineration of P092.

E. EPA's Re-Evaluation of the IMERC Standard

As discussed earlier, the current LDR regulations require or allow incineration of three types of waste streams, most notably D009 wastes that contain mercury above 260 mg/kg and that also contain some organics (i.e., the high mercury organic subcategory). The two original premises behind IMERC were that: (1) incineration would destroy the organic component or organomercury complexes in the waste stream, and the residues, if greater than 260 mg/kg total mercury, would be retorted to recover the mercury; and (2) applicable regulatory controls would provide adequate control of mercury air emissions.

With respect to the premise that mercury would be recovered from incineration systems, either incinerator bottom ash residues or emission control residues (e.g., spent activated carbon, scrubber sludges) could be sent to mercury recovery units. Incinerator bottom ash is likely to contain little mercury, however, because mercury is easily volatilized to the combustion gas. In addition, incinerators generally are not equipped with emission control equipment that removes mercury from combustion gas. In fact, the latest BRS report shows no record of incinerator residuals going to mercury recovery units. As a practical matter, although incineration destroys the organics, it does not make the mercury particularly amenable to recovery. It is therefore difficult to regard incineration as contributing to the recovery of mercury, which was one of our original premises.

With respect to the second premise that applicable regulatory controls would provide adequate control of mercury emissions from incineration, neither the incinerator or BIF regulations nor the LDR

regulations specifically require the use of emission control devices that effectively capture mercury (e.g., activated carbon). As implemented in practice, the BIF regulations and some incinerator permits restrict mercury in the hazardous waste feed. Because feed restrictions are not so stringent as to eliminate mercury in the feedstream and because the current regulations do not require the use of emission control devices that efficiently capture and remove mercury, it is still emitted to the atmosphere.³³

\33\ Mercury emissions can also be controlled under special conditions imposed through RCRA omnibus authority. See Sec. 270.32(b).

While the recently proposed (61 FR 17358, April 19, 1996) Hazardous Waste Combustor Maximum Achievable Control Technologies (MACT) regulations will impose some emission limitations on mercury emissions from hazardous waste incinerators, cement kilns, and lightweight aggregate kilns, these regulations are unlikely to require the capture and recovery of mercury from the combustion emissions or other combustion residuals. Thus, the implementation focus at individual combustion facilities is expected to continue to be controlling feedrate levels of mercury-bearing hazardous waste into the combustion device. The Agency is likely to determine under the final MACT rule that requiring specific APCDs on hazardous waste combustors to capture mercury is not cost-effective.

Although feed restrictions can and do reduce mercury emissions and to some extent the associated risks, we are still concerned with the environmental loading of mercury. The MACT rule does not take into account the long-range transport of mercury emissions, and uncertainties in the HWC MACT risk assessment allow the Agency to conclude only that risks from mercury emissions within 20 kilometers are likely to be small.³⁴ The Agency wishes to consider whether we can further reduce the environmental loading by amending the LDR regulations to reduce the volume of mercury wastes that require IMERC and to promote the use of alternative treatment methods.

\34\ ``Risk Assessment Support to the Development of Technical Standards for Emissions from Combustion Units Burning Hazardous Wastes: Background Information Document,' February 20, 1996.

Thus, the IMERC standard bears further investigation to see whether, given the heightened concern over all sources of mercury emissions, even ones at relatively low levels, alternative LDR approaches may be appropriate to ensure better protection of human health and the environment. We note that EPA must address any

significant remaining residual risks posed by sources subject to the MACT technology-based standards within eight years after promulgation of the Hazardous Waste Combustor MACT standards. See section 112(f)(2). The Agency is required to impose additional controls if such controls are needed to protect public health with an ample margin of safety, or to prevent adverse environmental effects. Our mercury reevaluation in this proceeding is also expected to assist EPA in any residual risk evaluation.

F. Additional Considerations Related to Alternatives to Incineration

A possible alternative to incineration for some mercury-bearing wastes is the physical separation of the mercury containing and organic components of the waste streams. Mercury retorters report that mercury-bearing organic wastes may be separated prior to treatment, when the mercury is associated with particulates in the waste. After retorting of the particulates, the retort condenser sludge is separated and returned to the retorting process for additional mercury recovery. The residual organic phase with reduced mercury content is then incinerated. While such waste separations may be feasible for organic wastes containing inorganic mercury, such separations would likely not work for organomercury wastes. Thermal or other destruction of the organomercury compounds present appears to be needed to convert the organomercury compounds to a recoverable form, as was originally envisioned in the IMERC standard.

G. Request for Comment

The Agency has several potential concerns with the IMERC standard. Specifically, from the available combustion database and the BRS data, it appears that non-trivial volumes of mercury-bearing waste are going to combustion units. As discussed above, because mercury is a volatile metal and unless the combustion unit has an APCD capable of capturing mercury emissions (normally not the case), potentially all of the mercury fed into

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the unit will be vaporized and released into the atmosphere.

The Agency specifically requests comment on the following:

1. What Mercury Waste Streams Will Continue to Warrant IMERC?

There may be wastes for which incineration is the best available treatment option, for example, wastes with low mercury concentrations and high levels of organics, mercury wastes containing PCBs, and mercury wastes containing or combined with reactive and ignitable hazardous waste. In an attempt to identify such wastes, the Agency examined BRS data for wastes that are D009 and also contain dioxins or PCBs. A search of the 1995 BRS data showed only one hazardous waste incinerator that processed waste streams containing both D009 wastes and dioxin wastes. (EPA hazardous waste codes F020-F023 and F026-F028).

According to the 1995 BRS, the facility processed approximately 80 tons of wastes containing dioxins from 27 separate waste streams. Many of these wastes are from soil and debris from facility decommissioning. However, no concentration data were available. Three facilities process waste streams containing both D009 wastes and PCB wastes. These facilities processed approximately 446 tons of wastes from 22 separate waste streams in 1995. Most of the PCB wastes were organic solids and sludges and again, no concentration data were available. Waste streams containing reactive and ignitable hazardous wastes covered a wide variety of waste stream codes. Many of the ignitable and reactive wastes were flammable liquids, solvents, and petroleum. In addition, it appears there are other waste streams, such as oily wastes, that require incineration.

However, inorganic mercury is generally associated with solids in highly organic wastes. These mercury-bearing solids can be separated by centrifuge prior to retorting. The Agency requests information on mercury-bearing wastes that may continue to require incineration, and on wastes that would be amenable to the separation of mercury solids for recovery prior to incineration of the remainder of the waste. Specifically, the Agency requests comment on the feasibility of requiring the separation of mercury-bearing solids from organic wastes and identification of any wastes for which such pretreatment would not be feasible.

2. What Alternative Technologies Are Available To Treat Mercury Wastes Containing Organics While Also Minimizing Mercury Emissions?

Because mercury emissions from incinerators may be costly to control, alternative technologies are sought that can either recycle the mercury in the wastes, separate the mercury from the organics prior to incineration of the organics, or produce a stable residue for disposal that reduces the risks attributed to the organic and mercury constituents. The Agency seeks waste characterization and technology performance data on alternative technologies for the treatment of wastes that are currently incinerated.

We also request information on the impediments to using alternative technologies, such as RMERC, to treat mercury wastes containing organics (RMERC is currently listed as an alternative in the regulations), and whether the organics can be destroyed or captured. Would an alternative technology such as an oxidation-leaching-precipitation train be more desirable? What are the concentration limits of organics that could be treated by these alternative technologies? If these alternative technologies are shown to effectively treat mercury wastes containing organics, should the incineration standard then be retained only if the unit has appropriate APCDs to capture the mercury and/or only if the organics in the wastes are ``hard to treat?'' The Agency specifically requests comment and data supporting commenter's views on these issues. The Agency also requests information regarding the current capacity of alternative oxidation technologies.

VII. Regulatory Options Involving Source Reduction

As discussed above, EPA's current LDR regulations set both technology and numerical based treatment standards that require waste management facilities to either retort, roast, or incinerate hazardous wastes that contain greater than 260 mg/kg of total mercury (depending on the presence of organics; see Table 4); or treat hazardous wastes that contain less than 260 mg/kg of total mercury to 0.025 mg/L TCLP prior to land disposal.

Some companies have found ways to reduce or eliminate the amount of mercury in their waste by making changes in their production processes and plant management, including changing raw materials, equipment, process design, and maintenance activities. In some cases, these changes have taken several years to design, test and install, while simultaneously relying on costly treatment technology to remain in compliance. For example, chlor-alkali producers, which are the largest manufacturing users of mercury in the U.S., have historically relied on a mercury cell process to manufacture chlorine and caustic soda. Caustic soda produced from this process may contain mercury, which in turn may contaminate other products and generate mercury-bearing hazardous wastes. By 1994, approximately one-half of the chlor-alkali plants had changed to a membrane cell production process, which does not use mercury. The membrane cell process has resulted in better environmental results and lower energy and waste management costs for the facilities that use this technology.

EPA wishes to consider regulatory options that produce superior environmental results and cost-savings for the regulated community beyond the requirements of end-of-pipe technology standards. EPA recognizes that once a company invests in end-of-pipe recovery or treatment technologies that meet compliance requirements, there may be little or no incentive to invest more money in process changes that would reduce or eliminate a particular hazardous waste, particularly since there would be no relief from waste management costs while process changes are being designed and tested.

In today's document, EPA is seeking comment on potential regulatory incentives that would encourage companies to invest in manufacturing process redesign, raw materials substitution or other technologies that would reduce the amount of mercury found in hazardous waste. To make this approach incentive-based, EPA is seeking views and information on the possibility of extending LDR compliance dates for companies willing to develop and/or install technologies that could be used instead of, or in combination with, end-of-pipe technologies to reduce the generation of mercury-bearing hazardous wastes.

One approach EPA is considering is a two-part LDR standard. The first part of this standard would be a traditional standard, developed from data on the best available treatment technologies. The second and novel part of the standard would be an alternative standard that facilities could elect in lieu of the first, more traditionally-based standard. This alternative standard would involve the installation of source reduction-oriented process changes that would either reduce the volume of mercury waste produced or the concentration of mercury in the

wastes. As an incentive for encouraging

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companies to comply with the alternative standard (particularly if the mercury concentration level is lower than the level for the first part of the standard), EPA would extend the generator exclusion from permitting beyond the current 90 days, or provide some other kind of incentive.

EPA is seeking comment on the development of a two-part standard, like the one discussed above, or another standard that provides economic or regulatory incentives to promote source reduction of mercury in hazardous wastes. EPA would also like comment on whether extending the compliance dates would foster reductions in wastes beyond the limits achievable using end-of-the pipe treatment technologies.

VIII. Mixed Wastes

Ongoing inventory of mercury-contaminated wastes currently awaiting disposal at Department of Energy (DOE) facilities has identified 7,284 cubic meters of such wastes. These wastes are the legacy of past nuclear weapons production for national defense. Table 5 presents an inventory of this waste.

Table 5.--Mercury Containing Wastes at DOE Facilities

Category	Inventory (cubic meters)
Elemental.....	17
<260 mg/kg.....	6,000
>260 mg/kg.....	325
Unknown.....	942
Total.....	7,284

Source: DOE Mercury Working Group, 1999.

Under current regulations, no separate treatment category exists for high mercury wastes that also contain radioactive materials. Therefore, the regulations direct that high mercury-organic subcategory mixed wastes be subjected to RMERC or IMERC and that high mercury-inorganic subcategory mixed wastes be subjected to RMERC. At the time of promulgation, these regulations intended that the mercury be separated from the wastes and recycled. However, with the cessation of nuclear weapon production, there are no longer any uses for mercury that is still contaminated with radioactive materials. Thus, current regulations may result in the contamination (by radiation) of additional equipment to recover mercury that has no subsequent use and

for which the treatment standard for disposal is again RMERC. Department of Energy's (DOE) Mixed Waste Focus Area-Mercury Working Group, in conjunction with EPA, has initiated studies of the direct treatability of high mercury-inorganic subcategory wastes for direct disposal. Should these tests demonstrate the successful treatment of such wastes, EPA could, as part of this or a separate LDR rulemaking, create a separate subcategory for these mercury-bearing mixed wastes and potentially develop a numerical treatment standard for the subcategory. These treatability studies include the evaluation of technologies such as alternative oxidation technologies, stabilization using specialized amendments, amalgamation technologies, sulfur polymer cement stabilization, and mercury solubilization and removal. Further information on these technologies is located in the docket to today's ANPRM. The Agency expects that several of these studies will be further along by the time of a proposed rule (scheduled to follow this ANPRM by approximately one year). Any available data from these tests will be discussed in the proposed rule and placed in the docket to that rule.

The Agency specifically requests comments on eliminating the RMERC standard for mixed mercury wastes, and on allowing the use of alternative technologies that are currently being investigated by EPA and DOE, with the residuals having to comply with a numerical limit.

IX. Discussion of Alternative Treatment Technologies

A. Possible Alternative Technologies to Retorting

As discussed in the May 1990 Best Demonstrated Available Technology (BDAT) Background Document for Mercury Containing Wastes, retorting is not the only technology that has been used in treating high mercury wastes. Alternative treatment technologies are categorized as either removal/recovery technologies or immobilization technologies. These alternatives are presently used, or could potentially be used for treating such wastes.

Alternative treatment technologies presently exist, or have existed in the past, for two reasons. First, the alternative technology may be simply another competing process to remove mercury from, or fix mercury within, a matrix. Second, the technology may overcome restrictive waste characteristics that cause difficulty during retorting or roasting. For example, several processes are actually ``pretreatment'' processes to prepare the waste for retorting. These processes remove waste characteristics that restrict treatment, such as water content, and convert mercury compounds into easier to treat forms.

Several technologies which may hold some promise for the treatment of high mercury wastes include the following:

Removal/Recovery Technologies

(1) Acid/chemical leaching (solids, slurries, or aqueous wastes). The mercury is converted to a more soluble form and thus is removed from the waste matrix.

(2) Carbon adsorption (aqueous wastes or vapors). Mercury retort facilities commonly use carbon adsorption as a way of removing and

concentrating mercury removed from stack gas or effluents.

(3) Ion exchange. Ions in the exchange resin are substituted for mercury ions of similar charge.

These technologies are described in more detail in the background document ``Waste Specific Evaluation of RMERC Treatment Standard.'' Immobilization Technologies

(1) Solidification/stabilization (solids or slurries). Solidification/stabilization(S/S) processes are nondestructive methods to immobilize the hazardous constituents in a matrix while decreasing the waste surface area and permeability. ³⁵ Common S/S agents include Type 1 Portland cement, lime, and fly ash. The final product can be a monolith of any practical size or a granular material resembling soil. ³⁶ Sulfur polymer cement (SPC) is one stabilization technology that can be used to convert mercury compounds to mercuric sulfide and encapsulate simultaneously (U.S. DOE, 1998). However, the encapsulation process temperatures can volatilize mercury, so the mercury vapor and oxide that forms must be captured and recycled in the process.

\35\ U.S. EPA, Technical Resource Document: Solidification/ Stabilization and its Application to Waste Materials, EPA/530/R-93/012, June 1993.

\36\ U.S. EPA, Engineering Bulletin: Solidification/ Stabilization of Organics and Inorganics, EPA/540/S-92/015, February 1993.

(2) Amalgamation. Amalgamation typically involves the mixing of elemental mercury with a powdered granular metal (typically zinc), forming a non-liquid, semi-solid matrix of elemental mercury and the metal. Two generic processes that are used for amalgamating mercury in wastes are an aqueous replacement (solution) process, and a non aqueous process.³⁷

\37\ U.S. EPA, Treatment Technology Background Document, January 1991, pages 74-80.

The Agency requests more information, including any data from treatability studies and their

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applications to various waste matrices, on these technologies.

B. Possible Alternative Technologies to Incineration

This section discusses the treatment technologies that are being

studied to treat high mercury wastes currently requiring incineration. The goal of these technologies is to achieve the same degree of destruction of the organic compounds as is achieved with incineration, while maintaining control over the residual mercury. Many variables need to be considered, including the degree of organic destruction required prior to further mercury treatment, the degree of mercury speciation control required by the waste form, and other operating procedures to ensure mercury extraction from nonwastewaters and wastewaters. Because the mercury cannot be destroyed, various treatment process steps are necessary to treat or recover the mercury, depending on the mercury species present in the waste, its concentration, and the overall waste form.

Currently, the only common process capable of destroying organics is oxidation, which can be done thermally or chemically. It is usually combined with other technologies to form a treatment train. One such train is the oxidation, leaching, and precipitation train, which has been shown to be effective in treating high mercury wastes currently requiring incineration. Once the organics are destroyed, leaching and precipitation treat the inorganic mercury forms, such as oxides and hydroxides. The resulting waste is then suitable for retorting or immobilization prior to disposal. Note that this type of treatment train cannot destroy dioxins, furans, or PCBs.

The Agency also has limited information on a number of developing technologies including nonthermal (i.e., Delphi DETOX (Delphi Research), Direct Chemical Oxidation (LLNL), Acid Digestion (Savannah River)) and thermal processes (such as steam reforming) (ThermoChem Inc.), and Catalytic Chemical Oxidation (LBNL)) under development in support of the waste treatment needs of the Department of Energy facilities. One or more of these technologies may soon be available and used for mercury-bearing wastes, followed by stabilization. EPA requests further information on the aforementioned technologies, as well as any others that may be used in place of IMERC.

C. Current Mercury Treatment Companies

Several sources were researched to identify facilities and companies that provide alternative treatment for mercury-bearing organic wastes. These sources include BDAT capacity background documents, the 1995 Biennial Reporting System (BRS), Alternative Technology Treatment Information Center (ATTIC) database, Vendor Information System for Innovative Treatment Technologies (VISITT) database, technical background documents, online web searches for company and treatment technology profiles, and the Risk Reduction Engineering Laboratory (RREL) database. Limited information is available on vendors and facilities that treat mercury-bearing organic wastes using methods other than incineration or retorting. BRS data indicate that there are numerous facilities that treat mercury-bearing organic wastes. The BRS waste management code, the code used to report the final treatment of the waste, in a few cases indicated there is acid leaching or oxidation used to treat the mercury-bearing organic

waste stream. This may be because the final treatment step is the only management code reported, and does not indicate if a multiple step process is used. The predominant treatments reported in BRS are stabilization/chemical fixation using cementitious and/or pozzolanic materials and phase separation. There are several data gaps that require further investigation on a process and waste stream specific level. In addition, the BRS data do not adequately describe the organic content of the actual waste stream being treated, especially where multiple waste form codes are reported together with the D009 code. A table listing the mercury treatment facilities is provided in the background document ``Analysis of Alternatives to Incineration for Mercury Wastes Containing Organics,`` which can be found in the docket to today's ANPRM.

D. Request for Comment

The Agency seeks comments on the viability and parameters of these alternative technologies and any other technologies not specifically mentioned in this ANPRM. Specifically, the Agency seeks the following information: description of the process; types of wastes capable of being treated; total, leachable, and volatile mercury content of the wastes and of the residues following treatment; amount of mercury air emissions from treatment; operating conditions and parameters; data showing the efficiency of the technology; commercial availability of the technologies and their available capacity; limitations of the technologies; cost information for these alternative technologies; and other potential benefits of using these alternative technologies over the existing treatment technologies. All data submitted should have appropriate QA/QC documentation to ensure their consideration by the Agency. Data without QA/QC may be disregarded.

X. Possible Revisions to the Mercury LDRs

A. Purpose of ANPRM

The Agency plans to examine potential revisions to the LDR mercury treatment standards, including the potential to encourage manufacturing process changes (i.e., source reduction changes) that further reduce the amount of mercury entering hazardous waste streams, as the next step in this rulemaking process. The Agency decided that this ANPRM is necessary before proposal development because the Agency would benefit from additional mercury treatment data, including information on source reduction opportunities, as well as industry information to consider in amending the standards. The nature and extent of these amendments have not yet been determined. This ANPRM is expected to be beneficial to the regulating entities (including States), the regulated community, and the public as a means of public outreach and opportunity for public comment early in the rulemaking process. EPA encourages all interested persons to submit comments, and to identify any relevant issues not addressed by this ANPRM. The Agency also welcomes comments regarding

whether the LDR mercury treatment standards should be revised. The Agency encourages commenters to submit examples or documentation to support their positions. The input from public comment will assist the Agency in developing a proposed rule that successfully addresses all appropriate revisions to these standards. An Agency decision to issue a proposed rule to revise LDR mercury treatment standards and the nature of those revisions will be ultimately based on the comments received on this ANPRM, as well as data obtained from other sources (e.g., ongoing treatability studies).

B. Schedule

The Agency has general plans to release a notice of proposed rulemaking by early 2000. The final rule date will depend on the amount of information submitted and the issues raised.

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C. Impact on Small Businesses

The Agency believes, at this point, that the impact on small businesses will not be significant. EPA requests comment on the potential costs and benefits to small businesses, should revisions be made to the LDR mercury treatment standards as described in this ANPRM. Suggestions on ways the Agency might mitigate any adverse effects would also be welcome.

D. Impact on State Programs

The Agency will be cognizant of the impact of any proposed revisions to the LDR mercury treatment standards on State programs, and encourages comments on this subject.

XI. Administrative Requirements

A. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) generally requires an agency to conduct a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small not-for-profit enterprises, and small governmental jurisdictions. This ANPRM will not have a significant impact on a substantial number of small entities because it does not create any new requirements. Therefore, EPA provides the following certification under the Regulatory Flexibility Act, as amended by the Small Business Regulatory Enforcement Fairness Act: Pursuant to the provision at 5 U.S.C. 605(b), I certify that this action will not have a significant economic impact on a substantial number of small entities. However,

there is the potential for future actions related to this ANPRM to have a significant economic impact on a substantial number of small entities. Therefore, the Agency will examine whether the Regulatory Flexibility Act applies in the preparation of any future rulemakings related to this ANPRM.

B. Executive Order 13045

Protection of Children from Environmental Health Risks and Safety Risks (62 FR 19885, April 23, 1997), applies to any rule that: (1) is determined to be ``economically significant'' as defined under E.O. 12866, and (2) concerns an environmental health or safety risk that EPA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, the Agency must evaluate the environmental health or safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

This ANPRM is not subject to E.O. 13045 because it does not, at this point, involve decisions intended to mitigate environmental health or safety risks. Of course, as the information in response to this ANPRM is evaluated, we will continue to examine whether E.O. 13045 applies.

List of Subjects in 40 CFR Part 268

Environmental protection, Hazardous waste, Reporting and recordkeeping requirements

Dated: May 21, 1999.

Carol M. Browner,
Administrator.

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Partial thread listing:

Potential Revisions to the Land Disposal Restrictions [envsubset](#) (05/28/99)

Possible follow-ups

- [envsubset](#) (07/27/99)

Underground Storage Tank Program: Approved State Petroleum, [envsubset](#) (05/28/99)

Land Disposal Restrictions: Site-Specific Treatment, [envsubset](#) (05/26/99)

Announcement of Public Meeting on the Development, [envsubset](#) (05/25/99)