

US EPA ARCHIVE DOCUMENT

DCN FLEP-00028

COMMENTS Institute of Real Estate Mgmt.

SUBJECT DATA3

COMMENTS B. Air Exposure Mercury exposure to the ambient air is very minimal - only 3 percent of the 100Mg of mercury burned comes from lamps. IREM supports the requirement that all municipal waste combustors install post-combustion mercury controls. Post-combustion mercury control at the municipal waste combustors would reduce mercury levels 80 percent to 90 percent, meaning only 0.3 percent to 0.6 percent of the remainder would come from lamps. Regarding lamps that are broken before they reach the landfill or incinerator, the EPA admits that they don't know the impact on ambient air. Therefore, they should research if it is a problem before they mandate transportation procedures.

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 FR 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, Mercury Emissions From the Disposal of Fluorescent Lamps,⁶ discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices).

Based on the results of this report and additional information, the Agency believes the universal waste approach is appropriate for hazardous waste lamps. The EPA emphasizes its belief that management controls under RCRA are needed to minimize the release of mercury from lamps into the environment. Although most mercury emissions are associated with combustion, all releases contribute to the mercury reservoirs in land, water and air. In addition, mercury has been shown to be transported in the atmosphere many miles from the source of its release.

The Agency is convinced that the requirements of the universal waste program can be highly effective in mitigating risks posed by breakage of hazardous waste lamps during storage and transport. The universal waste requirements for proper packaging and handling of the lamps to avoid breakage during accumulation and transport should prevent releases of mercury or lead to the environment before recycling or other management, which will make the risks posed during accumulation and transport extremely low.

DCN FLEP-00091

COMMENTS Sterling Environmental Services, Inc.

SUBJECT DATA3

COMMENT Comment was also requested on the prohibition of intentional breakage of bulbs. The generators that crush bulbs seem to be doing it as a cost savings for disposal. The issue of mercury exposure from crushing the bulbs has typically been addressed by OSHA standards. Many generators have installed mercury capturing devices for fugitive mercury emissions.

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 FR 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, Mercury Emissions From the Disposal of Fluorescent Lamps,³ discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices).

The current universal waste rule prohibits universal waste handlers from treating universal wastes (40 CFR ' 273.11 and 273.31). The final rule for hazardous waste lamps retains the treatment prohibition for universal waste handlers and applies the prohibition to handlers of hazardous waste lamps. The definition of treatment under RCRA includes Any method, technique, or process...designed to change the physical, chemical, or biological character or composition of any hazardous waste, so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render such waste non-hazardous, or less hazardous; safer to transport, store or dispose of; or amenable for recovery, amenable for storage, or reduced in volume.⁴ The crushing of hazardous waste lamps clearly falls within the definition of treatment under RCRA (40 CFR 260.10).

Some commenters to the proposed spent hazardous waste lamps rule requested that the Agency allow generators of such lamps to crush them on-site before sending them off-site for treatment or disposal. However, as explained in the preamble to the final universal waste rule (60 FR 25519), the Agency believes that it is not appropriate to allow universal waste handlers to treat universal wastes because the handlers are not required to comply with the Subtitle C hazardous waste management standards for generators (40 CFR Part 262). These hazardous waste generators must obtain EPA identification numbers, are subject to the 90-day (or 180-day) accumulation

limit, and must comply with the technical standards of 40 CFR Part 265 for storage and accumulation units. Because these standards are relatively stringent, EPA's policy is that generators may treat hazardous wastes on-site, provided that they comply with all applicable requirements of 40 CFR Part 262 for storage and accumulation of hazardous wastes.

Universal waste handlers, on the other hand, are allowed a much longer accumulation time limit of one year and need not comply with specific technical standards for accumulation and storage units. Instead, they are subject only to the general performance standard of managing universal wastes in a manner that prevents releases to the environment. In addition, information available to the Agency on drum top crushing systems for lamps indicates that these units may allow significant air emissions of mercury, particularly when the units are not in operation, and emissions often may exceed the OSHA limit of 0.05 mg/m³.

For these reasons, the Agency is not allowing crushing of hazardous waste lamps under federal regulations. However, generators located in a state with an authorized universal waste program may be allowed to crush, universal waste lamps, if within the state authorization process the Agency determines that a state's program allowing generators to treat lamps under controlled or restricted conditions is equivalent (per RCRA ' 3006) to the federal prohibition. EPA believes that this approach both ensures protection of human health and the environment while allowing for the development of state regulatory programs that include specific standards for the safe crushing of hazardous waste lamps.

DCN FLEP-00145

COMMENTS ASTSWMO

SUBJECT DATA3

COMMENT Additionally, atmospheric concentrations of mercury have been increasing. A 1994 report conducted in Minnesota titled Strategies for Reducing Mercury in Minnesota found that the annual atmospheric deposition of mercury has increased more than threefold since 1850. This increase translates to an average increase of about 1.7% per year over the one hundred forty (140) years since 1850. Similarly, a report conducted by F. Slemr and E. Lahger and reported in Nature in 1992 (Vol. 335, page 434-437) indicated an average annual increase of 1.5% has been found in the mercury concentration in air over the Atlantic ocean for the period between 1977 and 1990.

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 FR 37183) the Agency made available to the public additional data on mercury

emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, Mercury Emissions From the Disposal of Fluorescent Lamps,⁶ discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices).

DCN SCSP-00146

COMMENTS Advanced Environmental Recycling Corp.

SUBJECT DATA3

COMMENTS During the course of the various research and development activities conducted by AERC, many quantitative and qualitative analyses were conducted to determine both industrial hygiene and overall environmental issues associated with the handling of fluorescent lamps. Utilizing a J-W mercury vapor sniffer (Model MV2) with an ultraviolet photometer and the sensitivity of 0.01 milligrams per cubic meter, AERC simulated various situations to determine the associated mercury vapor readings. These tests centered around breaking fluorescent lamps in a controlled environment. The results of one broken lamp at 20 feet were "off scale" on the meter, which equated to levels well in excess of 1.0 milligrams per cubic meter in all cases. Although these tests are qualitative in nature, they did reflect a significant industrial hygiene problem associated with broken lamps. These tests provided critical information for the design of air handling and personal protective equipment at our facilities. The USEPA must consider this type of information in evaluating the most environmentally sound and proper methods of handling fluorescent lamps.

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 FR 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, Mercury Emissions From the Disposal of Fluorescent Lamps,⁶ discusses the methodology, data and assumptions used in developing the Mercury Emissions

Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices).

The universal waste rule ensures that mercury emissions are minimized during all stages of lamp management. The universal waste rule includes storage and packaging standards for handlers of mercury lamps to ensure the proper management of spent lamps and to prevent uncontrolled and unintentional breakage during storage and transport to the recycling or treatment facility. Crushing is prohibited under the universal waste program. Under the universal waste rule, destination facilities (i.e., facilities that treat, dispose, or recycle universal wastes) are subject to all hazardous waste management requirements applicable to permitted or interim status hazardous waste treatment, storage, and disposal facilities.

DCN FLEP-00156

COMMENTER National Electrical Manufacturers Assn.

SUBJECT DATA3

COMMENT With respect to mercury emissions from lamps broken prior to landfilling or recycling, NEMA directs EPA's attention to a study conducted by Lawrence Berkeley Laboratory [25] [Footnote 25: Clear and Berman, Op Cit.] and confirmed by NEMA research [26] [Footnote 26: 26 See NEMA document entitled "The Management of Spent Electric Lamps Containing Mercury", September 1994 (Enclosure 2) for discussion. See also Enclosure 9 for discussion of NEMA research.]. The Lawrence Berkeley Laboratory study showed that if all of the mercury in a fluorescent lamp were exposed to air at room temperature, it would experience an evaporation rate of approximately 1 percent over the first 24 hours. Most of the evaporation in the experiment occurred during the first two hours. Evaporation decreased substantially after this point.[27] [Footnote 27: 27 NEMA believes that it is extremely unlikely that a 1 percent mercury evaporation rate would be reached, even over several days. This is because a large part of the mercury in a used lamp is imbedded in the lamp phosphor and glass and is not exposed to air when a lamp is broken. (See Enclosure 4, "Mercury Content of Residues From Four Foot Fluorescent Lamp Reclamation/Recycling"). Additionally, most broken lamps are thrown in with other trash, stored in sealed drums, or otherwise covered before 24 hours.] NEMA believes that the 1 percent release rate is a more likely level than the 6.6 percent release rate cited in the RTI Report. The 6.6 percent figure was derived

from a model developed for the prediction of volatile organic chemical air releases, not for the unique volatilization and diffusion properties of a metal such as mercury. The 6.6 percent also does not take into account the mercury balance within the lamp, which the NEMA study (Enclosure 4) showed can significantly affect the ultimate environmental release pattern. Unless EPA develops a model more appropriate to mercury which contradicts the 1 percent rate, NEMA recommends that the Agency use 1 percent as the expected release rate.

RESPONSE

The Agency appreciates the commenter's submission of additional data pertaining to the mercury release rate from hazardous waste lamps. The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 FR 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, "Mercury Emissions From the Disposal of Fluorescent Lamps," discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices). EPA used a range of 1.1 - 6.8 % release rate for divalent mercury, which is apparently what the commenter is referring to, in order to estimate high, low, and average releases of mercury. The Agency used a 2.8 % release rate as the central, or best estimate.

The Agency does not have data characterizing the behavior of mercury in different types of landfills over long time periods, although available data from shorter-term studies suggest that mercury can and has been released to groundwater and air. (For a more complete discussion of mercury releases from landfills and fate and transport in groundwater, see the Toxicity Section of this Response to Comments document.) Data available to the Agency show that mercury can be found in municipal landfill leachate, and EPA remains concerned that landfill releases may pose threats over the long term. The Agency has concluded that some management controls are essential for these wastes.

DCN FLEP-00164

COMMENTS E.I. Du Pont De Nemours and Co., Inc.

SUBJECT DATA3

COMMENT With regard to the EPA's concerns over air emissions, information available from the National Electrical

Manufacturers Association (NEMA) indicates that a considerable

percentage of a lamp's mercury content becomes 'tied up" or consumed in other lamp components over the life of the lamp. Additional studies done by Lawrence Berkeley Labs indicate that a relatively insignificant amount (less than 1 %) would be released if all the mercury in a fluorescent lamp were exposed to air at room temperature. Hence, these concerns are easily addressed through proper packaging and handling practices, and perhaps even more so through on-site crushing in units equipped with appropriate emission controls.

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 FR 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, Mercury Emissions From the Disposal of Fluorescent Lamps,[@] discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices).

EPA agrees that proper packaging and handling can help minimize potential emissions and therefore setting specific management standards in today's rule. However, the universal waste rule prohibits universal waste handlers from treating universal wastes (40 CFR ' 273.11 and 273.31). The final rule for hazardous waste lamps retains the treatment prohibition for universal waste handlers and applies the prohibition to handlers of hazardous waste lamps. The definition of treatment under RCRA includes Any method, technique, or process...designed to change the physical, chemical, or biological character or composition of any hazardous waste, so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render such waste non-hazardous, or less hazardous; safer to transport, store or dispose of; or amenable for recovery, amenable for storage, or reduced in volume.[@] The crushing of hazardous waste lamps clearly falls within the definition of treatment under RCRA (40 CFR 260.10).

Some commenters to the proposed spent hazardous waste lamps rule requested that the Agency allow generators of such lamps to crush them on-site before sending them off-site for treatment or disposal. However, as explained in the preamble to the final universal waste rule (60 FR 25519), the Agency believes that it is not appropriate to allow universal waste handlers to treat universal wastes because the handlers are not required to comply with the Subtitle C hazardous waste management standards for generators (40 CFR Part 262). These hazardous waste generators

must obtain EPA identification numbers, are subject to the 90-day (or 180-day) accumulation limit, and must comply with the technical standards of 40 CFR Part 265 for storage and accumulation units. Because these standards are relatively stringent, EPA's policy is that generators may treat hazardous wastes on-site, provided that they comply with all applicable requirements of 40 CFR Part 262 for storage and accumulation of hazardous wastes.

Universal waste handlers, on the other hand, are allowed a much longer accumulation time limit of one year and need not comply with specific technical standards for accumulation and storage units. Instead, they are subject only to the general performance standard of managing universal wastes in a manner that prevents releases to the environment. In addition, information available to the Agency on drum top crushing systems for lamps indicates that these units may allow significant air emissions of mercury, particularly when the units are not in operation, and emissions often may exceed the OSHA limit of 0.05 mg/m³.

For these reasons, the Agency is not allowing crushing of hazardous waste lamps under federal regulations. However, generators located in a state with an authorized universal waste program may be allowed to crush, universal waste lamps, if within the state authorization process the Agency determines that a state's program allowing generators to treat lamps under controlled or restricted conditions is equivalent (per RCRA ' 3006) to the federal prohibition. EPA believes that this approach both ensures protection of human health and the environment while allowing for the development of state regulatory programs that include specific standards for the safe crushing of hazardous waste lamps.

DCN FLEP-00187

COMMENTER PacifiCorp

SUBJECT DATA3

COMMENT 3. Air Emission Impacts Do Not Warrant Regulating Mercury-Containing Lamps as Hazardous Waste In addition to groundwater mercury contamination, the Agency seeks comment on the potential for contamination of soil and surface water due to the volatilization of mercury during the transportation and crushing of mercury-containing bulbs and the release of mercury in landfill gas. 59 Fed. Reg. at 38292-93. Here again, however, the record evidence demonstrates that mercury disposed of in MSW landfills volatilizes at such a low rate that there would be little or no impact on nearby air quality. Mercury landfill gas emissions attributable to the disposal of mercury-containing bulbs are exceedingly minor and, in effect, barely measurable when compared to other sources. *Id.* at 38292. Based on the results of a Swiss study of landfill gas from municipal waste landfills, which EPA found were comparable to U.S. MSWLFs, the

record demonstrates that "the amount of mercury annually released in landfill gas can be estimated as 0.8 kg, about 0.0001 percent of the total mercury load entering MSW landfills (643 Mg)." Id. Taking this amount and adjusting it to the proportion of total mercury contributed by mercury-containing lamps to the MSW streams (3.8 percent), provides an estimate of annual landfill gas emissions from lamps of about 0.03 kg. less than 0.00001 percent of the total municipal solid waste mercury input." Id. (emphasis added). The RTI report also cites a Finnish study which found, based on an assessment of landfill gas that accepted municipal refuse, including mercury from batteries, fluorescent lamps, and broken thermometers, that "mercury concentrations in the air around landfills is slightly higher than rural areas, but at the same level as other city areas and that the refuse dump does not seem to increase the metal concentrations in air to levels above normal urban values." RTI Report at 112. Based on the above findings, the RTI Report concludes that "mercury concentrations in landfill gases appear to have little or no measurable impact on air quality around a landfill." Id. at 113 (emphasis added). In short, the record evidence compels the conclusion that mercury emissions attributable to the management of mercury-containing lamps do not pose a threat to human health and the environment. [3]

[Footnote 3: PacifiCorp again directs EPA's attention to the Tetra Tech report cited in note 2, supra. The report found that only a very small percent of the mercury in spent bulbs escapes upon bulb breakage, and that the mercury content of landfill gas is many times lower than what would be acceptable at a workplace under OSHA regulations.]

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 *FR* 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, *Mercury Emissions From the Disposal of Fluorescent Lamps*,[@] discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and

lamp mercury emissions rates from specific waste management practices).

The Agency disagrees with the commenter's assertion that mercury emissions from landfill disposal of hazardous waste lamps have little or no impact on air quality. The Agency does not have data characterizing the behavior of mercury in different types of landfills over long time periods, although available data from shorter-term studies suggest that mercury can and has been released to groundwater and air. (For a more complete discussion of mercury releases from landfills and fate and transport in groundwater, see the Toxicity Section of this Response to Comments document.) Data available to the Agency show that mercury can be found in municipal landfill leachate, and EPA remains concerned that landfill releases may pose threats over the long term. The Agency has concluded that some management controls are essential for these wastes.

DCN FLEP-00187

COMMENTS PacifiCorp

SUBJECT DATA3

COMMENT Nor is there any danger from mercury releases during the breakage of lamps during transportation or the release of mercury during disposal in a landfill. See 59 Fed. Reg. at 38293. Mercury emissions from the breakage of bulbs with no cover results in the release of approximately 3 percent of the mercury, with far lesser amounts in cases where cover is involved. The Report also confirms the findings in the literature that mercury emissions in the form of landfill gas attributable to the disposal of mercury-containing lamps is de minimis and is orders of magnitude below the applicable OSHA PELs for mercury.

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 FR 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, Mercury Emissions From the Disposal of Fluorescent Lamps,[@] discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices).

The Agency does not have data characterizing the behavior of mercury in different types of

landfills over long time periods, although available data from shorter-term studies suggest that mercury can and has been released to groundwater and air. (For a more complete discussion of mercury releases from landfills and fate and transport in groundwater, see the Toxicity Section of this Response to Comments document.) Data available to the Agency show that mercury can be found in municipal landfill leachate, and EPA remains concerned that landfill releases may pose threats over the long term. The Agency has concluded that some management controls are essential for these wastes.

The Agency disagrees with the commenter's assertion that there is not any danger from mercury releases during the breakage of lamps during transportation or the release of mercury during disposal in a landfill. The EPA emphasizes its belief that management controls are needed under RCRA to minimize the release of mercury from lamps into the environment. Although most mercury emissions are associated with combustion, all releases contribute to the mercury reservoirs in land, water and air. In addition, mercury has been shown to be transported in the atmosphere many miles from the source of its release. The deposition of atmospheric mercury into surface waters, its presence in runoff from soil, or the recycling of mercury from sediment into the water column can result in the accumulation of the metal in many animal species, particularly aquatic organisms. The EPA published a Mercury Study Report to Congress (December 1997) that examines many of the health effects resulting from mercury exposure. Examples of mercury-related risks include neurotoxicological problems and developmental effects in fetus and adults (e.g., Mad Hatter's disease), and accumulation of the metal in many animal species, particularly aquatic organisms. For example, fish with high levels of mercury in their tissues have exhibited increased mortality, reduced reproductive success, impaired growth, and behavioral abnormalities.

DCN FLEP-00191

COMMENTS Utility Solid Waste Activities Group

SUBJECT DATA3

COMMENT b. The Tetra Tech Report Confirms That Air Emissions From The Management of Mercury-Containing Lamps Do Not Pose a Threat to Human Health and The Environment The Tetra Tech Report buttresses the record evidence that mercury emissions attributable to the management of mercury-containing lamps do not pose a threat to human health and the environment. i. Emissions from the Breakage of Fluorescent Bulbs The Tetra Tech study involved experiments designed to measure mercury emissions from broken mercury-containing lamps under different cover scenarios. Report at 5. Step one of the experiment involved the breaking of a 4 foot long fluorescent bulb into three separate PVC tubes. The tubes were immediately covered and an airflow was started. The first tube had no soil cover, the second tube had a

6 inch soil cover and the third tube had a one foot soil cover. Mercury emissions were continuously sampled at the top of the tube through iodide impregnated carbon traps. The experiment was run for a 20-day period. See Report at 5 for details of the experimental set-up. One of the major findings of the experiment was that "[t]he mass of mercury volatilized from the bulbs represents a small percent of the total mass of mercury present in the bulb." Report at 13. In particular, in the "worst case" scenario involving no soil cover the total mercury released to the air during the 20-day period was 1.28 mg, which is estimated to be approximately only 3 percent of the total mercury in a typical fluorescent tube given an average total quantity of 42 mg (although this concentration is decreasing in new bulbs). *id.* at 13. The total release of mercury from the crushed bulbs for the scenarios involving soil cover were considerably less, ranging from only 0.2 percent (in the case of 1 foot of soil cover) to 0.8 percent (in the case of 6 inches of soil cover). *Id.* USWAG emphasizes that the Tetra Tech Report's finding of only a three percent release of mercury under a worst case scenario (with only a 0.2 - 0.8 percent release with soil cover) is less than one-half of the 6.6 percent release assumption used by EPA in its modeling of mercury emissions from broken bulbs. 59 Fed. Reg. at 38292-93. The Report concludes that "[i]f the remaining mercury volatilized at the same rate as at the end of the 20-day period, about 43 years would be needed for the remaining mercury to be released." Report at 13. Thus, at a minimum, EPA's modeling assumptions overestimate the potential emissions from broken lamps because they are based on a 6.6 percent release assumption that is more than double the actual mercury emission releases observed in the Tetra Tech Report. Other findings from step one of the Tetra Tech experiment revealed that (1) the most significant release of mercury occurs during the first 15 minutes of breakage, (2) the remaining mercury in a bulb volatilizes much more slowly after the initial breakage, and (3) mercury fluxes reach a low steady-state after approximately three days. The experiments also indicated that soil cover plays a significant role in determining the potential for mercury flux, with far less mercury flux in circumstances where soil cover is present. See *id.* at 7 and 9 (Figure 2-3).

ii. Mercury Emissions Attributable to Landfill Gas The second step of the Tetra Tech project involved using the

emission rates calculated above to estimate the ambient air concentrations of mercury in landfill gas. *Id.* at 14. The calculations were made for two separate scenarios: (1) a straight calculation based on the mercury flux data discussed above, and (2) calculations that incorporated into the equation the effect of landfill gas production. *Id.* The results for the scenario without the effect of landfill gas production revealed minimal ambient mercury concentrations. In particular, in the case with no soil cover, the maximum concentration was 4.7 ug/m³ after the initial disposal, with the concentration failing to below 1 ug/m³ by the second day. In the cases with 6 inches and 1 foot of soil cover, the maximum ambient concentrations were 0.6 ug/M³ and 0.1 ug/m³, respectively. See *id.* at 14 and 16 (Figure 3-2) [See hard copy of Comment FLEP-00191 for Figure 3-2]. All of these concentrations are orders of magnitude below the OSHA permissible" exposure limit ("PEL") for airborne mercury of 50 ug/m³. The second phase of the Tetra Tech project involved incorporating the effect of landfill gas production into the calculation of ambient mercury concentrations. The Report observed that the mercury flux due to landfill gas migration is larger than the diffusion of flux through the soil cover, with the gas generation increasing mercury fluxes by a factor of approximately 3.5. *Id.* at 17. Notwithstanding this increase in flux, the maximum ambient concentration for the scenario with no soil cover was slightly greater than 16 ug/m³, with the maximum concentrations for soil cover scenarios remaining below 2.0 ug/m³. All of these concentrations are far below the OSHA PEL of 50 ug/m³. Moreover, even these calculations overestimate the exposure because only a maximum of 1 foot of soil cover over the waste was included in calculating emission rates, and after closure of a landfill at least a 2 foot layer of clay and topsoil is added, further decreasing the mercury flux through the top of the landfill. *Id.* at 17. Finally, the Report's conclusions are consistent with the literature data on the subject. In addition to the European studies cited above, Tetra Tech observed that 1993 measurements of mercury in landfill gases at three landfills in the Twin Cities Metropolitan area revealed concentrations ranging from 0.36 ug/m³ to 4.47 ug/m³. Moreover, even these low numbers are not totally attributable to bulbs. Rather, the measurements represent the total contribution from the various sources of

mercury present in the landfill, not just the contribution from bulbs, which are considered to represent only 3.8 percent of the total mercury loadings to the landfill. *Id.* Therefore, the actual amount of mercury emissions attributable to bulbs is de minimis.

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 *FR* 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, *Mercury Emissions From the Disposal of Fluorescent Lamps*,⁶ discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices). EPA used a range of 1.1 - 6.8 % release rate for divalent mercury, which is apparently what the commenter is referring to, in order to estimate high, low, and average releases of mercury. The Agency used a 2.8 % release rate as the central, or best estimate.

The Agency does not have data characterizing the behavior of mercury in different types of landfills over long time periods, although available data from shorter-term studies suggest that mercury can and has been released to groundwater and air. (For a more complete discussion of mercury releases from landfills and fate and transport in groundwater, see the Toxicity Section of this Response to Comments document.) Data available to the Agency show that mercury can be found in municipal landfill leachate, and EPA remains concerned that landfill releases may pose threats over the long term. The Agency has concluded that some management controls are essential for these wastes.

The Agency disagrees with the commenter's assertion that mercury emissions from hazardous waste lamps do not pose a threat to human health or the environment. The EPA emphasizes its belief that management controls under RCRA are needed to minimize the release of mercury from lamps into the environment. Although most mercury emissions are associated with combustion, all releases contribute to the mercury reservoirs in land, water and air. In addition, mercury has been shown to be transported in the atmosphere many miles from the source of its release. The deposition of atmospheric mercury into surface waters, its presence in runoff from soil, or the recycling of mercury from sediment into the water column can result in the accumulation of the metal in many animal species, particularly aquatic organisms. The EPA published a Mercury Study Report to Congress (December 1997) that examines many of the health effects resulting

from mercury exposure. Examples of mercury-related risks include neurotoxicological problems and developmental effects in fetus and adults (e.g., Mad Hatter's disease), and accumulation of the metal in many animal species, particularly aquatic organisms. For example, fish with high levels of mercury in their tissues have exhibited increased mortality, reduced reproductive success, impaired growth, and behavioral abnormalities.

DCN FLEP-00229

COMMENTS Global Recycling Technologies, Inc.

SUBJECT DATA3

COMMENT ANALYZING VAPOR RELEASES Using the more conservative data on vapor release during lamp breakage [10], [Footnote 10: "EVALUATION OF MERCURY EMISSIONS FROM FLUORESCENT LAMP CRUSHING", Batty, McGeough, Overcash, EPA-453/D-94-018, February, 1994.] the following analysis shows mercury vapor that would be, or is currently released to the atmosphere. VAPOR RELEASED RESULTANT FROM LAMP BREAKAGE: LAMP BREAKAGE VAPOR: .08/mg per lamp MAXIMUM EVAPORATION: 1% x 41.6 mg = .416 mg per lamp TOTAL: .49 mg/lamp TOTAL MERCURY RELEASED TO ATMOSPHERE- U.S. (600 MILLION LAMPS/YR.): 294,000,000 mg Using the EPA mercury release value [11] [Footnote 11: EPA 40 CFR Part 261.4; Federal Register, July 27 1994; Hazardous Waste Management System; Modification of the Hazardous Waste Program; Mercury-Containing Lamps.] of 6.6%. VAPOR RELEASED RESULTANT FROM LAMP BREAKAGE: LAMP MERCURY CONTENT: 41.6/mg per lamp MERCURY RELEASE: 6.6% x 41.6mg 2.75 mg per lamp TOTAL MERCURY RELEASED TO ATMOSPHERE: U.S. (600 MILLION LAMPS/YR.): 1,650,000,000 mg

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 FR 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, "Mercury Emissions From the Disposal of Fluorescent Lamps," discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices).

DCN FLEP-00301

COMMENTS Minnesota Pollution Control Agency/MOEA

SUBJECT DATA3

COMMENT E. Mercury Emissions from Lamp Breakage prior to Disposal.

The CE alternative provides no requirements for lamp handling prior to disposal. The reality of the CE alternative is that lamps will be discarded with mixed municipal solid waste and will be completely broken by the time daily cover is applied at the landfill. In fact NEMA, a major supporter of the CE alternative, promotes on-site crushing as long as it is conducted in compliance with OSHA standards. We must point out that OSHA standards are solely for worker protection and do not govern releases of mercury to the environment. In the absence of supporting experimental data, the proposal estimates that about 6% of the mercury in a lamp is released when it is broken. However, NEMA has estimated that 20 percent of the mercury contained in a lamp has the potential to be released when broken. [Footnote 23: Letter from Timothy Feldman, NEMA Vice President for Government Affairs, to U.S. EPA Office of Solid Waste and Emergency Response. June 18, 1993. Page 6.] Assuming there is up to 42 mg of mercury per spent lamp and up to 600 million fluorescent lamps generated per year in the United States, up to 10,500 lbs. of mercury may be released annually into the environment from broken lamps destined for solid waste landfills. NEMA is now claiming that mercury release from broken lamps is one percent or less. [Footnote 24: Letter from Timothy Feldman, NEMA Vice President for Government Affairs, to U.S. EPA Office of Solid Waste and Emergency Response. June 18, 1993. Page 6.] Even then, 525 lbs. of mercury may be released annually from broken lamps destined for disposal. because of the tendency of mercury to be transported long distances and bioaccumulate, these are significant amounts of mercury emissions. Again, this is an area where independent credible research is necessary. We believe that there is significant mercury release from lamp breakage for the following reasons: 1) Mercury is volatile at room temperature; 2) There are turbulent conditions and phosphor dispersal associated with breakage of a tube containing a vacuum; 3) The spotty evidence on worker exposure indicates significant releases of mercury from lamp crushing operations.

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues

pertaining to hazardous waste lamp management. Today's final rule adds hazardous waste lamps to the universal waste regulations under 40 CFR Part 273. The Agency has determined that hazardous waste lamps meet the criteria established for designating a material as universal waste. The universal waste rule provides a reduced, or streamlined set of requirements (i.e., universal waste rule standards are less stringent than full Subtitle C management standards). In today's rule, the Agency is not finalizing the conditional exclusion (CE) option for the management of hazardous waste lamps.

The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 *FR* 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, *Mercury Emissions From the Disposal of Fluorescent Lamps*, discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices). Based on the results of this report and additional information, the Agency believes the universal waste approach is appropriate for hazardous waste lamps.

The Agency does not have data characterizing the behavior of mercury in different types of landfills over long time periods, although available data from shorter-term studies suggest that mercury can and has been released to groundwater and air. (For a more complete discussion of mercury releases from landfills and fate and transport in groundwater, see the Toxicity Section of this Response to Comments document.) Data available to the Agency show that mercury can be found in municipal landfill leachate, and EPA remains concerned that landfill releases may pose threats over the long term. The Agency has concluded that some management controls are essential for these wastes.

DCN FLEP-00305

COMMENTER Sierra Club National Solid Waste Comm.

SUBJECT DATA3

COMMENT Release of mercury from discarded lamps during collection and transportation is a major concern. The assumption of only 6.6% of mercury released from collection in garbage trucks is extremely questionable. The majority of lamps collected in this way could be broken with the potential for much of the mercury-containing phosphor powder to be released into the environment. This process may be a significant release mechanism under the conditional exclusion option. Since lamps are so

susceptible to breakage with the release of mercury to the environment, a reduction in the CESQG limit for this waste should be considered.

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. Today's final rule adds hazardous waste lamps to the universal waste regulations under 40 CFR Part 273. The Agency has determined that hazardous waste lamps meet the criteria established for designating a material as universal waste. The universal waste rule provides a reduced, or streamlined set of requirements (i.e., universal waste rule standards are less stringent than full Subtitle C management standards). In today's rule, the Agency is not finalizing the conditional exclusion option for the management of hazardous waste lamps.

The universal waste rule ensures that mercury emissions are minimized during all stages of lamp management. The universal waste rule includes storage and packaging standards for handlers of mercury lamps to ensure the proper management of spent lamps and to prevent uncontrolled and unintentional breakage during storage and transport to the recycling or treatment facility. Under the universal waste rule, destination facilities (i.e., facilities that treat, dispose, or recycle universal wastes) are subject to all hazardous waste management requirements applicable to permitted or interim status hazardous waste treatment, storage, and disposal facilities.

The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 FR 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, Mercury Emissions From the Disposal of Fluorescent Lamps, discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices).

EPA is not changing the CESQG regulations at this time. It should be noted that CESQGs can manage their hazardous waste lamps under the CESQG regulations found in 40 CFR 261.5 or the universal waste regulations found in 40 CFR Part 273.

DCN FLEP-00309

COMMENTS Bethlehem Apparatus Company

SUBJECT DATA3

COMMENT A. Advantages Of Option 2. 1. RCRA Compliance As stated above,

application of the Universal Waste Proposal to Lamps will result in the direct discharge of less mercury into the environment. While Bethlehem is not in the business of landfilling, it is aware of the general proposition that with time, all municipal solid waste ("MSW") landfills may leach materials into the environment. Second, even if MSW landfills do not leak, the leachate generated by landfills has to be treated to remove the contaminants contained therein prior to discharge to a receiving stream. The greater the amount of mercury disposed of in a landfill, the greater will be its presence in the leachate. As treatment involves removal, or transfer to another media, i.e., treatment sludge which is disposed of, the mercury is still released back into the environment. Third, without regulation, mercury will be released to the air and soil by the breakage of the Lamps during transportation and disposal of the Lamps at a landfill. Using a composite average of EPA's estimate of the mercury content in fluorescent Lamps, (Proposed Rule at 38,290), for Lamps installed between 1990-1995 of 34.3 mg, and the figure of 550 million Lamps per year (Proposed Rule at 38,296) yields a total 18.865 metric tons of mercury available to the environment. Based on EPA's assumption of 6.6% of mercury in Lamps vaporizes upon breakage, 1.245 metric tons would be released to the air by virtue of breakage of fluorescent Lamps alone in transit or disposal. The remainder could spill during transit and/or leach out into the landfill leachate. Fourth, the MSW portion of the mercury Lamps which will continue to be incinerated will continue to release 2.9 metric tons per year. All of these releases could be eliminated however with an intelligently crafted regulatory system as proposed in Option 2.

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. Today's final rule adds hazardous waste lamps to the universal waste regulations under 40 CFR Part 273. The Agency has determined that hazardous waste lamps meet the criteria established for designating a material as universal waste. The universal waste rule provides a reduced, or streamlined set of requirements (i.e., universal waste rule standards are less stringent than full Subtitle C management standards). In today's rule, the Agency is not finalizing the conditional exclusion option for the management of hazardous waste lamps.

The universal waste rule ensures that mercury emissions are minimized during all stages of lamp management. The universal waste rule includes storage and packaging standards for handlers of

mercury lamps to ensure the proper management of spent lamps and to prevent uncontrolled and unintentional breakage during storage and transport to the recycling or treatment facility. Under the universal waste rule, destination facilities (i.e., facilities that treat, dispose, or recycle universal wastes) are subject to all hazardous waste management requirements applicable to permitted or interim status hazardous waste treatment, storage, and disposal facilities.

The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 *FR* 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of hazardous waste lamps under different regulatory approaches. The final report, *Mercury Emissions From the Disposal of Fluorescent Lamps*,²⁵ discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices).

DCN FLEP-L0001

COMMENTS Environmental Technology Council

SUBJECT DATA3

COMMENT It is also important to note that methyl mercury, which is the form of mercury that enters the food chain, is produced when bacteria are present with inorganic mercury. The latter is supplied by fluorescent lamps. Landfills are biological systems, which will therefore produce methyl mercury when inorganic mercury, as supplied by fluorescent lamps, is placed in them. Thus, for example, one landfill analyzed by the state of Minnesota showed a high concentration of methyl mercury in the condensate from the landfill gas collection system. [25]
[Footnote 25: *Ibid.*, p.2.]

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. Today's final rule adds hazardous waste lamps to the universal waste regulations under 40 CFR Part 273. The Agency has determined that hazardous waste lamps meet the criteria established for designating a material as universal waste. The universal waste rule provides a reduced, or streamlined set of requirements (i.e., universal waste rule standards are less stringent than full Subtitle C management standards). In today's rule, the Agency is not finalizing the conditional exclusion option for the management of hazardous waste lamps.

The Agency does not have data characterizing the behavior of mercury in different types of landfills over long time periods, although available data from shorter-term studies suggest that mercury can and has been released to groundwater and air. (For a more complete discussion of mercury releases from landfills and fate and transport in groundwater, see the Toxicity Section of this Response to Comments document.) Data available to the Agency show that mercury can be found in municipal landfill leachate, and EPA remains concerned that landfill releases may pose threats over the long term. The Agency has concluded that some management controls are essential for these wastes. The Agency published a Notice of Data Availability on July 11, 1997 (62 FR 37183). This notice presented data collected by the Agency and an assessment of potential mercury emissions from the management of hazardous waste-containing lamps under several regulatory approaches.

The Agency believes that management controls under RCRA are needed to minimize the release of mercury from lamps into the environment. Although most mercury emissions are associated with combustion, all releases contribute to the mercury reservoirs in land, water and air. In addition, mercury has been shown to be transported in the atmosphere many miles from the source of its release. The deposition of atmospheric mercury into surface waters, its presence in runoff from soil, or the recycling of mercury from sediment into the water column can result in the accumulation of the metal in many animal species, particularly aquatic organisms. In December 1997, the EPA published a Mercury Study Report to Congress that examines many of the health effects resulting from mercury exposure. Examples of mercury-related risks include neurotoxicological problems and developmental effects in fetus and adults (e.g., Mad Hatter's disease), and accumulation of the metal in many animal species, particularly aquatic organisms. For example, fish with high levels of mercury in their tissues have exhibited increased mortality, reduced reproductive success, impaired growth, and behavioral abnormalities.

DCN FLEP-00229

COMMENTS Global Recycling Technologies, Inc.

SUBJECT DATA3

COMMENT The vapor released from a typical 4' lamp is from .2% - 20%, or even higher of content of lamp mercury [8]. [Footnote 8:

"EVALUATION OF MERCURY EMISSIONS FROM FLUORESCENT LAMP CRUSHING", Battye, McGeough, Overcash, EPA-453/D-94-018, February, 1994.] Furthermore, data has shown that mercury evaporation is about 1 % over the first 24 hours when exposed to air at room temperature. [9] [Footnote 9: "Environmental and Health Aspects of Lighting: Mercury", Clear and Barman, Journal of the Illuminating Engineering Society, Summer 1994.] This percentage is expected to be higher when broken lamps are exposed to elevated temperature as would be experienced in landfills. NEMA has provided data that shows that up to 20% of

the mercury dosed into the lamp during manufacture escapes to the atmosphere during breakage. EPA references in the Federal Register that 6.6% of the mercury escapes when a lamp breaks. This may help explain why landfill leachate analysis are low since some mercury never makes it to the landfill, and what does may be further evaporated into the atmosphere.

RESPONSE

The Agency appreciates the commenter's submission of additional data addressing issues pertaining to hazardous waste lamp management. The Agency considered the additional data submitted by commenters in the development of its model on mercury emissions. On July 11, 1997 (62 FR 37183) the Agency made available to the public additional data on mercury emissions from the management of spent lamps. The information provided as part of the Notice of Data Availability consisted of an electronic model and a report that provide an assessment of mercury emissions from the management of mercury-containing lamps under different regulatory approaches. The final report, *Mercury Emissions From the Disposal of Fluorescent Lamps*,⁶ discusses the methodology, data and assumptions used in developing the Mercury Emissions Model. The report describes inputs used in the model for estimating potential mercury emissions during waste management and disposal activities (e.g., lamp properties, lamp disposal rates, and lamp mercury emissions rates from specific waste management practices).

The Agency does not have data characterizing the behavior of mercury in different types of landfills over long time periods, although available data from shorter-term studies suggest that mercury can and has been released to groundwater and air. (For a more complete discussion of mercury releases from landfills and fate and transport in groundwater, see the Toxicity Section of this Response to Comments document.) Data available to the Agency show that mercury can be found in municipal landfill leachate, and EPA remains concerned that landfill releases may pose threats over the long term. The Agency has concluded that some management controls are essential for these wastes.

The Agency believes that management controls under RCRA are needed to minimize the release of mercury from lamps into the environment. Although most mercury emissions are associated with combustion, all releases contribute to the mercury reservoirs in land, water and air. In addition, mercury has been shown to be transported in the atmosphere many miles from the source of its release. The deposition of atmospheric mercury into surface waters, its presence in runoff from soil, or the recycling of mercury from sediment into the water column can result in the accumulation of the metal in many animal species, particularly aquatic organisms. In December 1997, the EPA published a Mercury Study Report to Congress that examines many of the health effects resulting from mercury exposure. Examples of mercury-related risks include neurotoxicological problems and developmental effects in fetus and adults (e.g., *Mad Hatter's*⁷ disease), and accumulation of the metal in many animal species, particularly aquatic organisms. For example, fish with high levels of mercury in their tissues have exhibited increased mortality,

reduced reproductive success, impaired growth, and behavioral abnormalities.