

US EPA ARCHIVE DOCUMENT

**NOTICE OF DATA AVAILABILITY FOR THE STUDY ON MERCURY  
EMISSIONS FROM THE DISPOSAL OF FLUORESCENT LAMPS**

**COMMENT RESPONSE DOCUMENT**

Office of Solid Waste  
U.S. Environmental Protection Agency

*May 1998*

## INTRODUCTION

### Background

On July 27, 1994, the U.S. Environmental Protection Agency (EPA) published a proposed rule addressing the management of spent mercury-containing lamps (59 FR 39288). In the proposal, the Agency presented two options for changing the regulations governing spent mercury-containing lamps:

- Add mercury-containing lamps to the universal waste regulations (UW option).
  - Under this option, spent mercury-containing lamps that failed the TC would be subject to universal waste regulations. (See 40 CFR Part 273 for existing universal waste regulations applicable to specified types of spent batteries, pesticides, and thermostats.) The proposed standards for generators and consolidation points of spent lamps include procedures for maintaining the condition of lamps (e.g., proper packaging), and storing the lamps (e.g., storage time limits, labeling), notifying EPA as specified, and responding to releases. The proposed standards for transporters of spent lamps include procedures for proper packaging of broken/unbroken lamps, storing and treating lamps (e.g., dilution prohibition), and responding to releases. Destination sites (e.g., landfills and recyclers) receiving spent lamps would be subject to the RCRA hazardous waste regulations at 40 CFR Part 264-270 and 124, as applicable.
- Conditionally exclude mercury-containing lamps from regulation as hazardous waste (CE option). Under this option, generators would qualify for the exclusion if they satisfy the following conditions:
  - Generators would be required to either dispose of these lamps in a municipal landfill that is permitted by a State/tribe with an EPA-approved municipal solid waste permitting program, or
  - If generators do not send these lamps to a municipal solid waste landfill, they would be required to send them to a mercury reclamation facility permitted, licensed, or registered by the State; and
  - Generators must keep records of the lamps shipped to management facilities.

Under this option, generators would be able to ship their lamps as part of their municipal waste stream, avoiding the RCRA hazardous waste generator standards (e.g., manifesting, record keeping), and ship the lamps to either a Subtitle C or D landfill, or a reclamation facility.

In June 1997, the Agency finalized development of a study on mercury emissions from the management and disposal of mercury-containing lamps. The study consisted of a Mercury Emissions Model (Model), a user guide entitled A User's Guide to the Mercury Emissions Model (User Guide), and a report entitled Mercury Emissions from the Disposal of Fluorescent Lamps (Report). The study was designed to assist interested parties in examining the amounts and sources of mercury emissions that might be produced in managing and disposing of spent lamps under the options. The Model provides emissions estimates for a modeling period extending from 1998 to 2007. Emissions estimates include both disposal emissions and net emissions. Installation of energy-efficient T8 lamps will reduce demand for electricity, which in turn reduces mercury emissions from utility boilers (in particular, coal-fired boilers). Net mercury emissions are defined as the difference between disposal emissions and the emissions avoided from energy savings.

In July 1997, EPA made the study available to the public and accepted public comments during the 45-day comment period, plus an extension. In total, thirty-five comment letters were received by EPA's RCRA docket. After the close of the comment period, EPA reviewed all letters received, revised the study as appropriate, and prepared this Response-to-Comment Document.

### **Purpose of Document**

The purpose of this document is to identify substantive comments received and provide Agency responses. In the document, the Agency identifies each comment by the commenter's name and the RCRA docket number of the comment letter. In developing this document, the Agency reviewed all comments received and corrected, clarified or otherwise revised the mercury study in response to many suggestions. Each comment was reviewed for content and relevance to the study and addressed accordingly. Of the thirty-five comment letters received by the Agency, a total of twenty comments are addressed in this document. Most of these comments contain more than one issue, each of which is addressed separately. The remaining fifteen comments either requested an extension to the public comment period or were deemed to be outside the scope of the study (e.g., comments on the proposed options themselves).

For the most part, the Agency did not include comments that were outside the scope of the study, such as comments on the regulatory options themselves. In addition, the Agency did not include comment letters requesting extension of the comment period or comments in support of the study. However, EPA has reviewed and acknowledges receipt of these comments.

## Major Issues and Responses

In the following paragraphs, the Agency summarizes the primary comments received and identifies where revisions to the study have been made.

- Many commenters raised concerns about the Model's Subtitle D landfill emissions rates. Several commenters believed that EPA should not have rounded the high emissions rate of 0.8 percent to one percent. EPA believes this is a valid concern and has revised the Model to include the original 0.8 percent emissions factor. EPA has retained the original central and low emissions rates for Subtitle D landfills.
- Several commenters also raised concerns that EPA had misinterpreted data from the State of Florida on its recycling emissions estimates. EPA has carefully reviewed available recycling emissions data and revised the Model's central and low emissions factors for divalent mercury emissions. EPA revised the central estimate from three percent to 1.09 percent and the low estimate from one percent to 0.07 percent.
- Many commenters believed that the Model should clearly distinguish between conditionally exempt small quantity generator (CESQG) and non-CESQG lamp mercury emissions. They pointed out that CESQG lamp emissions are outside the scope of the rulemaking effort and are thus interfere with the Model's results. EPA agrees with this concern and has revised the Model to segregate non-CESQG from CESQG lamp emissions.
- A number of commenters believe that the higher compliance costs under the UW option would be a disincentive for certain building owners from conducting lighting upgrades. These commenters believe that the CE option would expedite upgrades and are concerned that the Model assumes that upgrades are independent of the policy option. In response to the comments, EPA revisited its assumptions and performed a number of additional calculations on the impact of disposal costs on a lighting upgrade's internal rate of return (IRR). The Agency has found that, holding all other lamp operating costs constant, the cost of lamp disposal had minimal impacts on an upgrading project's IRR. At a \$0.50/lamp transportation and recycling cost, the IRR for a typical project over ten years was 51 percent. At a \$1.00/lamp transportation and recycling cost, the IRR was 50 percent — only a slight decrease in IRR despite a 100 percent increase in waste management costs. Because of these reasons, EPA continues to believe that use of T8 lamps is independent of the policy options.

- A number of commenters indicated that the Model underestimated lamp recycling rates under the baseline and overestimated the rate of Subtitle C landfilling. Commenters suggested that the national lamp recycling rate is approximately ten percent and that Subtitle C landfilling of lamps is near three percent. EPA agrees with these comments, and has revised the baseline's recycling rate to ten percent and reduced the Subtitle C disposal rate to about two percent.
- Based on its review of the Model, EPA has also made its own revisions. First, the Agency has revised the rule effectiveness for municipal waste combustor (MWC) emissions from 80 to 95 percent. This revision has the effect of decreasing the MWC high emission factor for divalent mercury from 30 percent to 16 percent. Second, EPA revised the disposal rates under the baseline and options to account for the fact that some CESQGs voluntarily recycle their spent lamps.

## COMMENTS AND RESPONSES

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### 0002 Utilities Solid Waste Activities Group

**Comment No. 0002-1:** The assertion that the rate of relamping will not be affected by the policy option selected is supported by two incorrect statements. First, EPA suggests that “disposal costs are a small fraction of the upgrade to energy efficient lighting, generally accounting for less than one percent of the cost.” Mercury Emissions Study, at 2-5. The Report, however, does not cite any study to support this analysis and fails to indicate how the Agency arrived at this conclusion. Indeed, the UW option would include regulations governing the collection, storage and transportation of spent lamps, and notification and record keeping requirements. Further, under the UW option, lighting wastes would have to be disposed of at a Subtitle C landfill or sent to a qualified recycler. Since EPA's own data confirm that managing lighting wastes under the CE option would result in lower costs than managing such wastes under the UW option, the suggestion that the rate of energy efficient relamping is independent of the policy option selected appears at odds with EPA's own data.

EPA's second rationale supporting its position is that “in a series of interviews with firms declining to participate in the Green Lights Program, lamp disposal costs and issues were never mentioned as a reason for not participating.” Mercury Study, at 2-5. But the Agency recognizes that most generators do not even realize that mercury containing lighting wastes are currently subject to the hazardous waste rules and thus do not manage them in compliance with Subtitle C. Id. at ES-1. It is therefore not surprising that these companies do not mention the hazardous waste rules as an obstacle to the Green Lights program when they are not even aware of the applicable rules. In contrast, companies that have sophisticated hazardous waste compliance programs - such as electric utility companies - have repeatedly indicated to EPA that managing such wastes as hazardous discourages their participation, and the participation of their customers, in the Green Lights program.

In sum, the Agency's own economic analysis and the evidence from the regulated community indicate that adoption of the CE option will prompt more companies to upgrade to energy efficient lighting than the UW option.

As discussed above, the CE option would be less costly than the existing RCRA Subtitle C regulations or the proposed UW option and, as a result, would accelerate the rate in which companies would upgrade to energy efficient T8 lamps. By reducing energy demand, power plants would need to generate less electricity and burn less fossil fuel. In the 1994 proposal, EPA cites this potential energy savings as one of the primary objectives of the Green Lights program. *Id.* at 38289.

In the mercury emissions study, however, the Agency fails to incorporate such energy savings into its analysis of the CE option. As a result, the study underestimates the energy savings and the corresponding reductions in mercury emissions that would result. The 1994 proposal, for example, observed that electric utilities (when burning fossil fuels) emit mercury at a rate of 0.0428 mg/kwh sold, on a national average. 59 Fed. Reg. at 38289. The failure to incorporate accelerated relamping and the corresponding reductions in mercury emissions from power production into the Agency's analysis of the CE option undermines the objectivity of the study. (pg. 6-10)

**Response:** EPA agrees with the commenter that the Agency had previously suggested that the CE option could prompt more companies to upgrade to energy-efficient lighting than the UW option. EPA also agrees that the UW option would impose slightly higher costs on waste handlers than the CE option. However, based on additional analyses, the Agency has concluded that, although certain owners may see the higher disposal costs under UW as a disincentive to upgrade, the majority of owners will recognize that lamp disposal costs are minimal when viewed in terms of the lamp's life-cycle costs. For example, the Agency has estimated that the cost of operating a typical four-foot lamp (including the ballast losses) for its 20,000-hour life is \$64 at the national average electric rate of seven cents per kilowatt-hour. Assuming a \$0.50/lamp disposal fee, disposal costs would be less than one percent of its operating costs. See the February 1997 edition of "Lighting Waste Disposal" (EPA 430-B-95-004) for additional information on upgrading costs. EPA has also conducted a number of independent analyses of the internal rate of return (IRR) of various lighting upgrades. The Agency has found that, holding all other lamp operating costs constant, the cost of lamp disposal had minimal impacts on an upgrading project's IRR. At a \$0.50/lamp transportation and recycling cost, the IRR for a typical project over ten years was 51 percent. At a \$1.00/lamp transportation and recycling cost, the IRR was 50 percent — only a slight decrease in IRR despite a 100 percent increase in waste management costs.

Finally, EPA consulted with Green Lights staff who work with building owners on lighting upgrades. These staff indicate that the UW option would not be a disincentive to upgrades for owners considering replacement programs. Because of these reasons, EPA continues to believe that use of T8 lamps is independent of the policy options and that neither lighting upgrades nor utility emissions savings will be affected by the regulatory approach EPA adopts.

**Comment No. 0002-2:** Of the minimal mercury emissions identified by EPA from the management and disposal of spent mercury-containing lamps, the study highlights transportation emissions as the largest relative source of emissions, particularly under the CE option. Indeed, EPA found an emissions rate for elemental mercury of 100 percent under the CE option, as opposed to a one percent elemental mercury emissions rate for transport under the UW option. Mercury Study, at 2-16 - 2-17. For divalent mercury, EPA estimates that the CE option would result in emissions ranging from 1.1 percent to 6.8 percent, whereas emissions under the UW option would range from 0.01 percent to 0.14 percent. *Id.* This finding implies that the UW option would result in fewer overall mercury emissions.

This would be an important conclusion if it were not based on unfounded assumptions. The Report assumes a 100 percent breakage rate for lamps discarded as part of the non-hazardous waste stream. In contrast, EPA suggests that breakage of lamps during transport to recycling facilities typically falls within the range of 0.2 percent to 5 percent, with one percent being the central estimate. Interestingly, the study does not address the breakage rate for transport to Subtitle C facilities, but conveniently lumps Subtitle C transport in with recycling facilities. The result therefore is pre-ordained: the CE option has relatively high transport emissions, whereas the UW option has comparatively lower transport emissions. (pg.10-11)

**Response:** EPA does not agree with the commenter that the Model's results are pre-ordained. Although the Model assumes that all lamps break during CE transport (without best practices), it also assumes that all lamps are crushed during stabilization at the Subtitle C landfill and that 100 percent of elemental mercury is emitted. In this respect, the Agency believes the Model provides a balanced and reasonable assessment of lamp breakage rates and mercury emissions.

In addition, EPA believes that lamp breakage rates under Subtitle C transport would be comparable to breakage rates under recycling. Under Subtitle C, lamp generators sending their lamps to disposal must comply with EPA and Department of Transportation (DOT) requirements for packaging, manifesting and transporting hazardous waste. Such requirements would help to minimize breakage during transport.

**Comment No. 0002-3:** Reviewing the mercury emissions Report is reminiscent of peeling an onion in that they both lack a core. While the study seems to analyze a wide variety of issues, a review of the Report reveals that its broad conclusions are based on a handful of data points and simplifying assumptions. (The notable exception to this pattern is the section addressing emissions from Subtitle D landfills, which have been analyzed in three separate studies.) EPA therefore should be reluctant to give much weight to the Report as the study is little more than the product of its assumptions.

The authors of the study themselves acknowledge the significance of the data limitations. The Report states that “[a] major obstacle in developing the Model was the scarcity of reliable data on certain aspects of lamp management and disposal, lamp mercury emissions, and mercury emissions from utility boilers. Much of the data and assumptions are based on the Agency's best professional judgment (e.g., partitioning coefficients) and conversations with industry and States (e.g., emissions factors).” Mercury Study, at 1-3 (emphasis added).

These data limitations cripple the Agency's ability to answer some of the most fundamental issues posed by this rulemaking. For example, EPA found no studies specific to mercury emissions from Subtitle C landfills, but based on various assumptions, the Agency nevertheless concludes that emissions from such landfills are 100 percent for elemental mercury and zero for divalent mercury. *Id.* at 2-22. Similarly, the Report found no data on mercury emissions during transportation to Subtitle C landfills but assumed that the breakage rate would be one percent because personnel at a recycling facility in Maryland “seemed to believe that breakage rates on the order of one percent were typical of their operation.” *Id.* at 2-17. Perhaps most significantly, the Agency admits that the waste management flow partitioning coefficients, which overwhelm all other factors in driving the model's conclusions, are entirely based on EPA's best professional judgment. *Id.* at 1-3. These severe data limitations significantly erode the Report's credibility as anything more than a collection of unsupported assumptions.

Consequently, USWAG believes that it would be highly inappropriate for the Agency to place great weight on a model that is entirely based on questionable assumptions and admittedly scarce data. A better approach would be for EPA to consider the evidence in the record independently and determine whether the disposal of mercury-containing lamps in municipal solid waste landfills poses a threat to human health or the environment and, if so, to determine the appropriate management controls. (pg. 12-14)

**Response:** Many commenters have expressed doubt about the usefulness of the Model because of its questionable data or data gaps. EPA acknowledges the many data limitations of the Model. This was openly recognized in the July 11, 1997 notice of data availability (NODA), where the Agency stated: “The study is considered by EPA to be a qualitative study based partly on quantitative analyses. It is considered qualitative by EPA due to limitations of the data. The study should be used in combination with available scientific knowledge to help evaluate primary and secondary mercury emissions potentially associated with the management of spent lamps.” However, the Agency believes the Model still serves several useful purposes. Most important, the Model incorporates the most reliable data compiled by the Agency to date on mercury emissions, and therefore, the Model represents the Agency's best current understanding of the issue. The Model also allows EPA and other interested parties to manipulate the data as needed where better data are obtained and to rerun the scenarios. Finally, the Model provides a basis for further dialogue between the Agency and stakeholders regarding mercury emissions under the options.

**Comment No. 0002-4:** Based on the RTI report, the Tetra Tech study and the data from the Fresh Kills landfill, EPA estimates that mercury emissions from Subtitle D landfills range from one percent as the high estimate to 0.00001 percent as the low estimate, with a central estimate of 0.2 percent. Mercury Study, at 2-22. These estimates confirm that, from an environmental perspective, mercury emissions from Subtitle D landfills are minimal. Nevertheless, because of mistakes in analyzing the Tetra Tech and Fresh Kills data, EPA significantly overestimates the amount of emissions from Subtitle D landfills.

The Tetra Tech study indicated that mercury emissions from releases of broken lamps under a 0.5 foot of soil cover averaged 0.8 percent over a 20-day period, whereas releases from under a one foot cover averaged 0.2 percent over a 20-day period. Id. at 2-21. EPA's reliance on these data is based on the unsupported assumption that, at a municipal solid waste landfill, broken lamps would remain six inches from the surface for a 20-day period. It is just as reasonable to assume that lighting wastes would be covered under other solid wastes and landfill cover within hours. This unsupported assumption is compounded by EPA's decision to "round" the unrealistic estimate of 0.8 percent up to one percent, which was then used as the high range estimate. Id. at 2-22. The use of these assumptions, coupled with the arbitrary "rounding up" by 25 percent, creates serious distortions.

EPA makes similar errors in interpreting the data from the Fresh Kills landfill. The report provides an estimate of mercury emissions (about 2.4 pounds annually), but does not indicate the amount of mercury entering the landfill. Id. at 2-21. EPA therefore guesses that, at two bulbs for each of the approximately seven million people using the landfill, the mercury input would be about 420 kg, resulting in an emissions rate of about 0.2 percent. Id. at 2-21 - 2-22.

Rather than relying on such uncertain assumptions, EPA should have referred to the 1993 RTI Report, which indicates that lamps historically contribute only 3.8 percent of the mercury in the municipal solid waster system. Research Triangle Institute Report, "Management of Used Fluorescent Lamps: Preliminary Risk Assessment," at 78 (table 4-1). Based on these data, the estimated mercury emissions rate from the Fresh Kills landfill would plummet to 0.0076 percent (which is still two orders of magnitude higher than the RTI study).

General Electric notes that even this estimate would be unrealistically high as mercury-containing lamps have been disposed in the Fresh Kills landfill for decades and the older lamps contained a much higher amount of mercury. See Comments of General Electric, dated August 25, 1997, at 13. General Electric suggests that a more realistic estimate would be that the average lamp disposed of at Fresh Kills contained approximately 50 mg of mercury per bulb, rather than 30 mg as assumed in EPA's Report.

Thus, EPA should have used the 0.8 percent estimate from the Tetra Tech study as a high (and unrealistic) estimate, the RTI report's estimate of 0.00001 percent as the low end estimate, and a central (although conservative) estimate of 0.0076 percent based on the Fresh Kill data. More important than the actual estimate adopted by EPA is the obvious conclusion that mercury emissions from the management of mercury containing lighting waste in municipal solid waste landfills are environmentally negligible. This conclusion further supports EPA's final adoption of the CE option. (pg. 14-16)

**Response:** EPA agrees with the commenter that the Model should include the original 0.8 percent estimate from the Tetra Tech study and has revised the Model to include the 0.8 percent estimate. EPA does not agree with the commenter that the estimate from Fresh Kills data is unreasonable. As noted by the commenter, GE proposed a central emissions factor of 0.005 percent. NEMA proposed an emissions factor of 0.008 percent. On the other hand, commenters such as the State of Minnesota expressed concern that the Model's central estimate may not be high enough. In light of these differing opinions, EPA has decided to retain the central estimate at 0.2 percent.

**Comment No. 0002-5:** EPA recognizes that monthly generation of about 350 four foot lamps would be necessary to exceed the 100 kg/month threshold for CESQGs, which is roughly 4,200 lamps discarded per year. Mercury Study, at 2-23. After analyzing commercial floor space and lamp density, the Agency concludes that less than 22 percent of the buildings are large enough to exceed the CESQG status. Id. Yet the study seems to ignore its finding in its waste management flow scenarios. Rather, the study adopts unrealistic waste flow assumptions (dubbed “partitioning coefficients”) that fundamentally warp the Model's conclusions.

The basic issue that EPA is attempting to address in this rulemaking is “whether an exclusion from regulation as hazardous waste is appropriate for mercury lamps....” 59 Fed. Reg. at 38288. But, according to the report, the vast majority of the universe of lighting wastes are not currently regulated as hazardous since roughly 80 percent of buildings would qualify as CESQGs. As a result, this rulemaking would only affect those 20 percent of generators who would not otherwise qualify as CESQGs.

EPA's baseline waste management flow scenario (set forth in Figure 2-1) is therefore flawed. Mercury Study, at 2-12. Having determined that 80 percent of lighting wastes are CESQG, the Agency assumes that 20 percent of mercury-containing lighting wastes currently are managed in compliance with Subtitle C. Yet these assumptions do not provide for those generators that, as EPA states, “do not realize that their spent mercury-containing lamps are

hazardous waste and thus do not manage them in compliance with the RCRA hazardous waste regulations.” Mercury Study, at ES-1. In other words, EPA underestimates the volume of lighting wastes that should be included in the “Subtitle D/CESQG” category and overestimates the baseline flow into Subtitle C management units. (pg. 16-17)

**Response:** EPA agrees that the draft Model does not correctly distinguish between RCRA-regulated and conditionally exempt lamps. Without this distinction, the Model overestimates the number of lamps subject to the baseline and options. EPA has revised the Model by creating completely separate disposal trees for (i) RCRA-regulated lamps and (ii) conditionally exempt lamps under the baseline and options. In addition, under the “RCRA-regulated” disposal flow, EPA has included lamps that are managed in compliance and non-compliance with RCRA.

**Comment No. 0002-6:** The UW waste flow scenario (Figure 2-3) is similarly flawed. EPA suggests that the “Subtitle D/CESQG” category will drop from 80 percent to 20 percent under the UW option. Id. at 2-14, 2-25. This rosy assumption for which EPA presents no support or rationale is incorrect for two reasons. First, EPA acknowledges, as it must, that the UW option would cost generators more than the “Subtitle D/CESQG category.” See discussion above in Part 1, section II.A. As a result, it is unreasonable to assume that companies in this latter category will automatically “upgrade” to the more expensive UW option, simply because it is available.

The second reason why it cannot be assumed with certainty that the UW option will bring 80 percent of lighting wastes into the “Subtitle C Management” category is that companies can easily phase-in their relamping projects so as to remain CESQGs. Rather than install energy efficient lighting in an entire office complex at once, companies may design a relamping schedule such that the lamp upgrades occur floor by floor, building by building over time. This type of strategy would, based on EPA's estimates in the 1994 proposal, save the average generator between \$2,000 to \$2,250. 59 Fed. Reg. at 38299. The incentive to adopt such a strategy would be even greater for those companies that might otherwise generate a large quantity of mercury containing lighting wastes. For these reasons, it appears dubious at best that the UW option would prompt such a dramatic increase of spent lamps into the hazardous waste system. Because of these flaws in the baseline management flow scenario and the UW flow scenario, the Model's conclusions in Tables 3-1, 3-2, 3-3 and 3-4 are inaccurate. (pg. 17-18)

**Response:** EPA disagrees with the commenter that the Model's estimate of compliance under the UW option is flawed, and it has left the Model's estimates of UW compliance unchanged. EPA expects that building owners will have an increased incentive to comply with the UW option relative to the Base Case. As EPA noted in the 1995 Universal Waste Final Rule, a primary goal of the rule was to separate universal waste from the municipal waste stream (60 FR 25494). The Agency expects that many of the mechanisms for increasing management of

universal wastes outside of RCRA Subtitle D will also apply to lamps under the UW option (e.g., lower compliance costs and greater convenience in land waste management). The Agency also believes that the UW option would increase recycling rates in particular (e.g., because of increased ability to consolidate lamps). Further, the Agency acknowledges that it cannot predict the number of building owners that may attempt to phase in lighting upgrades to avoid UW regulation. Because the UW option would place minimal requirements on lamps, EPA believes that such activities would be the exception rather than the rule.

**Comment No. 0002-7:** EPA examines emissions from mercury recycling without any discussion of the range of mercury recycling operations that currently exist. See Mercury Study, section 2.3.1.3. While some mercury recyclers are quite sophisticated and have limited emissions rates, the Agency is undoubtedly aware that others employ rudimentary techniques and may have significantly greater emissions.

Unfortunately, EPA's analysis seems to have ignored the full range of mercury recyclers and focused exclusively on the high-end of the business. For example, the mercury study cites the RTI report as estimating that "emissions from a well managed facility could range from 0.2 percent to 0.4 percent of total mercury, and a well managed facility using advanced technology will have overall mercury recovery rates of 99 percent of total mercury." Mercury Study, at 2-19. There is no indication that the data presented by Florida or by NEMA captured the less sophisticated, low-end of the industry.

In addition, NEMA notes that its estimate of a three percent mercury emissions rate (which was adopted by EPA as the central estimate) is no longer accurate. See Comments of NEMA, dated August 22, 1997. NEMA explains that as mercury dose levels in lamps have decreased, the percentage of mercury in the residuals have increased and the percentage of mercury recovery from recycling operations have decreased. As a result, NEMA now estimates that actual recycling levels are likely to be closer to the central and high range estimate (three to six percent) rather than the low range estimate (one percent).

In sum, EPA's failure to recognize the full range of mercury recyclers and the change in mercury dose levels means that the study would underestimate emissions from mercury recyclers. (pg. 18-19)

**Response:** EPA disagrees with the commenter that the Model underestimates recycling emissions. EPA acknowledges the difficulty in estimating recycling emissions rates across all types of recycling facilities. EPA therefore established a low, central and high recycling emissions factor in the Model to capture all types of recycling operations. EPA notes that the

high recycling emissions factor represents a six-fold increase over the low emissions factor. In addition, no commenter requested that the high factor be increased above six percent. Therefore, EPA has retained the high recycling emissions factor. Please refer to the response to Comment No. 0031-1 for EPA's discussion of the low and central emissions factors for recycling.

**Comment No. 0002-8:** The study suggests that the “effective” mercury recycling rate would be three percent under the baseline management scenario, four percent under the CE option and 57 percent under the UW option. Mercury Study, at 2-12, 2-13 and 2-14 (Figures 2-1, 2-2, 2-3). But the Agency fails to explain why recycling would become so attractive under the UW option. As discussed in section 11 above, it is unclear at best whether the majority of lighting waste generators -- who are presently in the Subtitle D/CESQG category -- would voluntarily subscribe to the more expensive UW management option. For example, if lighting wastes were included in the existing UW rules, mercury recyclers would be considered “destination facilities.” 40 C.F.R. 273.60. Such facilities would still be required to undergo the lengthy and expensive process of obtaining a Treatment, Storage or Disposal (“TSD”) permit, unless they are somehow able to avoid storing the waste before recycling. Id. at §273.60(b). Even facilities that do not need to get a TSD permit would still be subject to notification requirements, manifest obligations and the Subpart AA and BB air permit rules. Id. Under EPA's 1994 analysis the UW option would save generators only about \$0.05 per bulb. 59 Fed. Reg. at 38299. As previously noted, these management and disposal costs will discourage participation in the Green Lights program or, at the very least, encourage generators to schedule their installation of energy efficient lighting so as to not exceed CESQG status.

USWAG recognizes that the UW option would encourage on-site consolidation of lighting wastes and therefore would result in some increased recycling. Nevertheless, it is unclear why the UW option would increase the effective recycling rate by 1,800 percent. (pg. 19-20)

**Response:** EPA agrees that the Model's recycling rates under the baseline need revision. Commenters generally agree that the national lamp recycling rate is approximately 10 to 12 percent annually. Based on commenters' input, and additional data that EPA has compiled, EPA has revised the annual recycling rate in the Model to ten percent under the baseline. Given this revision, the Model assumes a roughly 800 percent increase in the number of lamps recycled under the UW option over the ten-year modeling period. EPA reasons that this assumption is valid for several reasons. The UW option would reduce compliance requirements and costs under RCRA (e.g., streamlined waste tracking, extended accumulation periods); therefore, the Agency expects compliance rates and the number of lamps managed under the UW option to

increase substantially. In addition, as the commenter notes, increased accumulation and consolidation would also encourage more efficient lamp recycling and potentially lower recycling costs. Finally, a few States have already established UW programs that specifically encourage lamps recycling. EPA expects this trend to continue in the future.

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**0004 National Electrical Manufacturing Association**

**Comment No. 0004-1:** The Report contains a detailed, complex analysis to estimate the number of lamps disposed in the US. While NEMA appreciates the effort that went into developing this analysis, a much simpler and more accurate way to determine lamp disposal is available from NEMA and Bureau of Census data using the actual number of lamps sold in the US. It is reasonable to assume that the number of lamps disposed in a year cannot exceed the number of lamps sold four years previously. We have attached the actual sales data for all lengths of T8s and T12s (not just four foot lamps) from 1992 to 1996 and projected future sales of these lamps through the year 2007. The actual sales data shows that EPA has overestimated the number of annual discarded lamps by over 60 percent.

For example, manufacturers sold 488 million T8 and T12 lamps in 1996. Projecting four years for average lamp life, EPA should expect that there will be 488 million spent T8 and T12 lamps in the year 2000. The estimate in the Report is over 800 million lamps. NEMA does not expect lamp manufacturers to come close to selling 800 million T8 and T12 lamps in any year considered in the EPA study.

NEMA strongly encourages EPA to discard the analysis in the Report and use the actual lamp sales data and forecasted sales of T8s and T12s with the average four-year lamp life to arrive at the number of annual spent lamps. (pg. 1-2)

**Response:** The EPA appreciates these comments, but maintains that there are valid reasons for retaining the Model's approach. For example, NEMA suggests that the Model should calculate lamp populations based on Bureau of Census data, which indicate the number of lamps sold in the U.S. Because the Model assumes an average lamp life of four years, NEMA believes that the Model should assume that the number of lamps sold in a given year should be the upper limit of lamps disposed of four years hence. Although EPA acknowledges benefits of applying NEMA's approach, there are several drawbacks. Most important, without incorporating data on building size/floor space, lighting densities, delamping and disposal rates, it is unclear whether the NEMA

approach would enable calculations to derive the number of lamps generated at conditionally exempt small quantity generator sites. In addition, although the NEMA approach assumes a four-year average lamp life, it does not appear to account for the fact that some lamps may fail in other years of operation. Because the approach taken in the Model accounts for these and other considerations, EPA has retained the Model's approach for determining populations of disposed lamps.

**Comment No. 0004-2:** Tables 2-2 and 2-3 on page 2-4 contain assumptions on the mercury content of lamps by year and lamp type. Although most of the assumptions are fairly reasonable, the assumption regarding future mercury levels for T12 lamps is not. NEMA projects that average mercury levels for all four foot lamps in 2000 will be less than 12 mg. NEMA believes that 12 mg is a much more appropriate figure, for mercury levels in 1997-2007 T12 lamps, than the 21 mg figure contained in the Report. (pg. 2)

**Response:** The EPA disagrees that the Model's estimates of future lamp mercury content are not reasonable. In developing its estimates of lamp mercury content, EPA obtained information from lamp manufacturers including GE, NEMA, Phillips, and Sylvania. EPA also referred to Agency laboratory analyses conducted to determine lamp mercury content. In the final analysis, EPA believes that the Model's assumptions fairly reflect the data obtained.

**Comment No. 0004-3:** The Report uses the difference in energy between T8s and T12s to arrive at an estimate of mercury reductions from utilities as a result of using energy-efficient fluorescent lamps. This method underestimates mercury reductions because it does not include energy efficiency improvements (3-4 times more efficient) resulting from shifts from incandescent to fluorescent lamps. The efficiencies gained from these shifts are much greater than efficiencies gained moving from T12s to T8s. (pg. 2)

**Response:** The estimation of mercury emission reductions resulting from the use of fluorescent in place of incandescent lamps, including the utility emissions potentially saved by this shift, is outside the scope of the Model. EPA, however, is aware of studies conducted on the trade-offs of using incandescent versus fluorescent lamps.

**Comment No. 0004-4:** The Report uses the RTI estimate for primary and secondary recycling emissions to arrive at a one percent "low" estimate for recycling. This estimate is extremely unlikely to be accurate because it underestimates actual mercury levels resulting in lamp residuals. It also ignores the reduction in mercury dose levels in lamps. NEMA based its three

percent secondary emissions estimate on the average four foot lamp manufactured in 1990 with 41.6 mg of mercury. As mercury dose levels decrease, the percentage of mercury in the residuals increases and the percentage of mercury recovery from recycling operations decreases. This means that the actual recycling emission levels are much more likely to be at the central to high range, not the low range.

**Response:** EPA agrees and has revised the Model's low and central emissions factors based on the comments received. See response to Comment No. 0031-1 for a discussion.

**Comment No. 0004-5:** NEMA also believes that the flow diagrams contain errors regarding actual and projected recycling levels. Current recycling levels for lamps are roughly 10-12 percent. The baseline flow diagram on page 2-12, however, shows recycling at closer to three percent (0.2 Subtitle C Management \* 0.8 Subtitle C Transportation \* 0.2 recycling baseline). NEMA believes that EPA should reverse the recycling and Subtitle C baselines of 20 percent and 80 percent respectively to arrive at a more reasonable estimate. (pg. 3)

**Response:** EPA has revised the recycling rate under the baseline to ten percent. See response to Comment No. 0002-8.

**Comment No. 0004-6:** NEMA also believes that the flow diagram on page 2-14 showing an effective recycling rate of 57 percent is not realistic. First, it is our professional judgment that much less than 80 percent of lamps, and at most 50-60 percent, will be subject to universal waste rules because lamps either are not hazardous or fall under the CESQG exemption. Using a 60 percent figure, the effective recycling rate would be 43 percent. Even achieving this rate will take many years as States adopt universal waste rules and recyclers build the necessary recycling infrastructure. Assuming that universal waste would result in a 57 percent recycling rate at any time in the near future (UW Rapid) if EPA were to adopt the universal waste rule is unrealistic. (pg. 3)

**Response:** EPA has revised the recycling rates in all of the policy options. The following adjustments were made:

- Baseline - ten percent of all lamps;
- CE - ten percent of all lamps; and
- UW - 18 percent of all lamps by the end of the modeling period.

There is uncertainty about the final recycling rate under the UW option and the time necessary to achieve this rate. It was this uncertainty that drove the Agency to examine the relationship among time, recycling rates, and emissions, through the development of three UW scenarios. Many commenters mistook the presentation as a discussion of plausible outcomes, as opposed to an examination of the sensitivity of the results to time dependence. The three scenarios allow the Agency and others to bound the complications of compliance and recycling rates and determine if significant differences exist in the outcomes.

**Comment No. 0004-7:** The Report estimates that mercury controls at municipal waste combustors (MWCs) range in effectiveness from 70 to 92 percent. NEMA's experience with MWCs with mercury controls is that mercury reduction is in the range of 95-98 percent. NEMA suggests that EPA talk directly with officials knowledgeable about measuring mercury emissions at such facilities including Dr. Ramana Rao at the Montgomery County Maryland Department of Public Works and Transportation and Mr. Mike Winka of the New Jersey Department of Environmental Protection rather than use the estimates in the Report.

**Response:** The EPA agrees that the MWC emissions rates need to be further refined. Based on input from EPA's Office of Air Quality Planning and Standards, EPA has revised the high municipal waste combustor emissions factor to reflect a rule effectiveness value of 95 percent. The resulting high emissions factor has been revised from 30 percent to 16 percent for divalent mercury. Therefore, the mercury emission control values are 92 percent, 85 percent, and 84 percent, for the low, central and high emissions factors, respectively.

**Comment No. 0004-8:** The Report also relies on data from the Fresh Kills Landfill to estimate emissions from landfills. The Report concludes that mercury emissions at the Landfill are roughly 0.2 percent of mercury inputs and uses the 0.2 percent as the central estimate of mercury landfill emissions from lamps. Lamps, however, have historically accounted for only 3.8 percent of all the mercury deposited in municipal landfills (Truesdale, Beaulieu, and Pierson, Research Triangle Institute, "Management of Used Fluorescent Lamps: Preliminary Risk Assessment," May 1993). Using 0.2 percent as the central estimate would lead to overestimating mercury emissions from lamps in landfills by over 25 times. Using 3.8 percent, the estimate of mercury releases from landfills should be 0.008 percent. NEMA recommends that EPA revise this estimate to account for the relatively low level of mercury in landfills from lamps.

**Response:** EPA does not agree that the Model's central emissions factor for Subtitle D landfills of 0.2 percent needs to be revised. See response to Comment No. 0002-4.

**Comment No. 0004-9:** NEMA has identified numerous problems in the Report that result in a significant overestimation of mercury releases from management of spent lamps. In addition, the CE option fails to consider best management practices. Ignoring these problems, the Report shows that mercury emissions from lamps are a very small percentage of anthropogenic mercury emissions. Even including all faulty assumptions, the unrealistic CE High option still only would account for less than one percent of anthropogenic mercury emissions. The actual emissions for all options under more realistic assumptions will be significantly lower. (pg. 4)

**Response:** EPA is appreciative of the feedback provided by this and all other commenters on the Model. The Agency has found such feedback helpful in identifying and resolving problems with the Model's data and assumptions. EPA is confident that refinements to the final Model will enhance its ability to estimate mercury emissions.

EPA disagrees with the commenter that the Agency has failed to consider best practices under the CE option. Chapter 3 of the Report analyzes the impacts of best practices, estimating mercury emissions under the CE option based on a 10 percent, 25 percent, 50 percent, and 75 percent lamp breakage rate. Based on the analysis, the Agency concludes that, assuming a 10 percent breakage rate, total mercury emissions under the CE option would be lower than the baseline and UW option in 1998.

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**0008            General Electric Company**

**Comment No. 0008-1:** The amount of mercury released under the various lamp management scenarios in the Report is overstated by a factor of at least 60 percent. This is because the Report's estimate in Table 2-5 on page 2-7 of the annual number of lamps disposed is overestimated by approximately 60 percent. The actual number of lamps disposed is shown in Table I of these comments, which is based on NEMA data on lamps shipped by all U.S. lighting manufacturers. Assuming a four-year lamp life, which is actually an underestimate since lamps generally last five years, lamps sold in 1996 would be disposed in the year 2000. According to NEMA sales figures, the number of lamps disposed in 2000 would be 488.48 million, not the 800 million estimated by EPA. There was no need for EPA to conduct the rather extensive analysis of commercial building space lighting needs in Section 2.1 of the Report. Use of the correct figures will substantially reduce the estimates of mercury emitted under all of the various management scenarios.

This means that for the highest and lowest annual emissions scenarios, mercury emissions from spent lamp management actually range from 0.6 percent to 0.03 percent of the total anthropogenic mercury emissions of 220,000 kg estimated in EPA's Mercury Report to Congress, as shown below. This is an environmentally insignificant amount of mercury. The fact that this is environmentally insignificant should be highlighted in the Report.

**Response:** The Agency disagrees that the Model overestimates lamp populations. See response to Comment No. 0004-1.

**Comment No. 0008-2:** In addition, while the mercury content of lamps shown in Tables 2-2 and 2-3 on page 2-4 is generally correct, the 21 mg figure used for T12 lamps for the years 1997 to 2007 is overstated by a factor of greater than 50 percent. NEMA estimates an average mercury content of 12 mg or less for all four-foot lamps and all T12 lamps for the year 2000. This correction to the mercury content assumption used in running the emissions Model will further reduce the estimates of overall mercury emissions from spent lamp management.

**Response:** The EPA disagrees and has decided against revising the lamp mercury content. See response to Comment No. 0004-2.

**Comment No. 0008-3:** The Report correctly points out that most of the extremely limited amount of mercury that is emitted from lamps in the waste stream is emitted during the transportation step of the process. This is the reason that GE Lighting has consistently supported the option of a regulatory exclusion for lamps that is based on compliance with Best Management Practices that would greatly reduce the lamp breakage rate during transport. In fact, the Report shows that a Conditional Exclusion with a 100 percent or 25 percent breakage rate produces emissions that are lower over a ten-year period than some of the Universal Waste and the Base Case options. GE Lighting believes that this is a significant finding and that it should receive fuller consideration in the Report and in the Agency's ultimate regulatory decision-making process. By neglecting to discuss this finding in the Report and by neglecting to mention it in the Conclusions, EPA creates the impression that the Conditional Exclusion is not a serious option worth considering. Given that this option can greatly reduce mercury emissions from lamp disposal, GE Lighting believes this is a serious oversight on EPA's part.

**Response:** The Agency disagrees that the Report does not provide enough consideration to Best Management Practices (BMPs) under the CE option, or that BMPs are not considered in the Report's conclusions. Section 3.2 of the Report is devoted to analyzing mercury emissions under the CE option if BMPs are employed during transportation. The Report also notes the issue of BMPs in the executive summary and conclusion.

**Comment No. 0008-4:** The Rapid Universal Waste scenario is so optimistic as to be impossible to achieve and therefore should either be adjusted or removed from the analysis. First, the effective recycling rate of 57 percent is not realistic. It is based on an assumption that 80 percent of all facilities would be regulated generators, as shown in Figure 2-3 on page 2-14. Given that most lamp generators are Conditionally Exempt Small Quantity Generators and that the low mercury lamps currently entering the market pass the Toxicity Characteristic and thus are not hazardous waste, GE believes that a more realistic figure would be 50 percent or less. Using a 50 percent number would lead to a more likely recycling rate of 36 percent.

Second, because it takes time for recycling facilities and regulations to be put in place, this 36 percent recycling rate would occur over time, not immediately. Achievement of this rate by 1998 is essentially impossible, therefore the Rapid Universal Waste scenario is essentially impossible to achieve.

**Response:** The EPA agrees. As discussed in response to Comment No. 0004-6, the Agency has revised the Model's recycling assumptions.

**Comment No. 0008-5:** The Gradual Universal Waste scenario is also flawed. The recycling rate for lamps managed as a Subtitle C hazardous waste today is 80 percent. This is due to the fact that recycling typically costs 30 to 40 cents per lamp, while hazardous waste landfilling can be as high as \$1.00 or more per lamp. The actual disposal method occurring under the current baseline regulations is approximately 80 percent recycling and 20 percent hazardous waste landfilling, producing a current recycling rate of 12 percent, as opposed to the three percent shown in Figure 2-1 on page 2-12. The gradual increase to 80 percent, called for in the Gradual Universal Waste scenario therefore has zero probability of occurring because it has already been achieved. The Baseline case should also be corrected to reflect the 12 percent recycling rate.

**Response:** The EPA agrees. See response to Comment No. 0004-6.

**Comment No. 0008-6:** Figure 2-2 on page 2-13 greatly understates the recycling rate for the Conditional Exclusion by assuming that it would be four percent, based on an assumption that five percent of lamps would go to recycling. This scenario assumes that all States will adopt the Conditional Exclusion and retract all current State legislation and regulations governing lamp management. GE Lighting believes this to be a faulty assumption. At a minimum, the 20 percent estimated to be managed as Subtitle C waste today will continue to be managed in this fashion, maintaining the current national 12 percent recycling rate. If we assume that the 38 States which currently have Universal Waste or similar programs in place or planned remain

committed to recycling, and that these 38 States (75 percent including the District of Columbia), would achieve a recycling rate of 36 percent, as discussed above, this would result in a national recycling rate of 27 percent. Additionally considering more stringent State programs, a national recycling rate under the Conditional Exclusion would more likely be over 30 percent. EPA's analysis should be adjusted to reflect this more realistic figure.

**Response:** The EPA agrees with the commenter that a percentage of States with lamp programs may not adopt a CE option if it were selected by EPA. EPA estimates that a number of States have established special procedures to manage lamps (e.g., under universal waste rules), and many encourage lamp recycling. Given this information, the Agency acknowledges the difficulty in predicting whether States would adopt the CE option. Therefore, the Agency has revised the Model to include those State programs with special procedures under the baseline and options. If they choose, users can manipulate the data to assume these programs would remain unchanged under either option chosen by EPA. Please note, however, that the emissions totals in the final Report do not account for these States' special lamps programs.

**Comment No. 0008-7:** GE Lighting believes that there are in actuality only three scenarios worthy of serious consideration in this Report: Universal Waste Moderate Central, Baseline Central, and Conditional Exclusion Central with a 10 percent breakage rate. (The 10 percent breakage rate would be achieved through use of BMPs that require proper packaging and transport.) These scenarios result in recycling rates of 36 percent, 12 percent, and 30 percent respectively. Using EPA's own numbers without the corrections we have discussed above and which we have already demonstrated are too high, we show in the table below that the Conditional Exclusion with BMPs produces the lowest level of mercury releases over a ten-year period, even assuming a 25 percent breakage rate. The GE estimate based on correct lamp disposal numbers and mercury content shows even lower emissions. As stated earlier, GE Lighting believes that this conclusion should be brought out more forcefully in the Report. Clearly, a policy objective of limiting mercury emissions, as opposed to promoting recycling, would dictate choosing the Conditional Exclusion with BMPs over Universal Waste or the Baseline.

**Response:** EPA agrees that the CE option with BMPs may be a viable option that needs further consideration. This is partly the reason why the Report devotes an entire section (i.e., Section 3.2) to an analysis of BMPs under the CE option. EPA does not agree, however, that the issue of BMPs needs to be brought out more forcefully in the Report. See response to Comment No. 0008-3 for EPA's reason for this.

**Comment No. 0008-8:** In the absence of documentation to the contrary, EPA has assumed that mercury emission reductions from energy savings are zero. This assumption is based on the theory that excess lighting demand is met by burning oil and gas, as opposed to coal. GE Lighting believes that this assumption is not only overly conservative, but also critically important to the outcome of the analysis. Because mercury emission rates from disposal of lamps are so small, even a small reduction in mercury emissions from coal-fired power plants would off-set any increases in mercury emissions resulting from the choice of management scenario. Any chance that disposal cost could impact the choice of lighting options or delay upgrades should be recognized in the analysis by using a number for mercury emission savings greater than zero. We also think that mercury emission reductions from power generation are in fact likely to occur because of replacement of incandescents with fluorescents, especially compact fluorescents. This scenario was not mentioned in the Report. We also think it possible that utility de-regulation could increase the amount of coal burned for reasons of cost-effectiveness.

**Response:** The Agency disagrees that the Report assumes that mercury emissions reductions from energy savings are zero. As stated in the Mercury Report, the Model assumes that installation of high efficiency lamps would reduce the mercury emissions from coal-fired power plants. (However, the Report states that a major limitation of this assumption is that the Model assumes that, as the demand for energy decreases, there would be a corresponding decrease in coal-fired electricity for all utilities and regions of the country. Yet, lamp manufacturers and utilities have indicated that, for many parts of the country, the marginal demand for electricity during business hours would be satisfied by gas and oil units, not coal-fired units. For such regions, a decrease in energy demand would not necessarily result in a decrease in coal-fired electricity.) The Report also explains EPA's belief that use of T8s is independent of the options. Having reviewed the comments on the Model, EPA continues in this belief. See response to Comment No. 0002-1 for an additional discussion.

Finally, analysis of incandescent lamps (including impacts on utility emissions) and de-regulation of utilities is outside the scope of the Model.

**Comment No. 0008-9:** The Report does not discuss the impact of lamps that pass the Toxicity Characteristic (TC) on the outcome of the Model. Non-hazardous lamps reduce the benefits of any control program. While the release of mercury will be lower from these lamps, it is logical to assume that generators will not manage them under Universal Waste. This is another reason EPA should develop a cost-effective and sensible Subtitle D program that limits breakage.

**Response:** The EPA agrees that the Model does not fully consider the possibility that certain lamps may pass the TC and be non-hazardous. EPA believes, however, that the majority of currently installed fluorescent lamps would fail a properly conducted TCLP test for mercury, and would thus be subject to regulation as a hazardous waste.

**Comment No. 0008-10:** Although high-intensity discharge lamps represent a small percentage of all mercury-containing lamps, they deserve mention in the Report.

**Response:** The EPA disagrees. EPA acknowledges that high-intensity discharge lamps represent a portion of the waste stream; however, analysis of such lamps is outside the scope of the Model.

**Comment No. 0008-11:** The Report states that many generators do not realize their lamps are hazardous waste. Two other reasons that generators do not manage their lamps as hazardous is that States do not enforce the hazardous waste requirements and recycling is overly expensive for small quantity lamp generators and small companies.

**Response:** EPA recognizes and agrees that there are a number of reasons why certain generators violate the RCRA regulations, as suggested by the commenter. EPA, however, does not believe the Report needs to identify and incorporate all possible reasons, and therefore has decided against revising it.

In addition, EPA believes that, even though the UW option would retain the lamps' designation as a hazardous waste, the option would provide a simpler waste management system, potentially making it easier for States to identify violators and encourage compliance. The Agency also believes the streamlined procedures would encourage compliance by waste handlers themselves. Finally, the Agency expects the UW option to spur lamps recycling. Increased competition within the recycling industry would potentially lower recycling costs, making it more attractive to large and small lamp generators to recycle.

**Comment No. 0008-12:** The Model does not appear to consider multiple transportation and storage cycles at consolidation facilities under the Universal Waste option.

**Response:** EPA acknowledges that many handling scenarios are likely under the UW option, such as multiple transportation. However, the Agency has made a number of simplifying assumptions in the Model, which capture the primary waste management activities that could potentially contribute to lamp mercury emissions.

**Comment No. 0008-13:** The conclusions section on page ES-4 is misleading because it presents the high emissions for the Conditional Exclusion and the low emissions for Universal Waste. In fact, there are scenarios where the Conditional Exclusion produces lower emissions than Universal Waste, as discussed earlier in these comments. If lamps are crushed on-site prior to being managed as an excluded waste or a Universal Waste, the emissions would be the same.

**Response:** EPA agrees that the Model indicates that certain CE scenarios may produce lower total mercury emissions than certain UW scenarios. EPA does not agree, however, that the Report's statements in the conclusion are misleading. The purposes of the statements is simply to indicate the range of annual mercury emissions estimated by the Model across the policy options. The Agency believes that the statements fairly present this range of emissions and that no revisions to the statements are needed.

**Comment No. 0008-14:** Pg. 2-13 and 2-14 - Some crushed lamps go to recycling. That option should be included in the Conditional Exclusion and Universal Waste flow charts.

**Response:** EPA disagrees. EPA holds that, in general, lamp recyclers would prefer to receive intact lamps and that recyclers convey this to their customers. In addition, some States have procedures in place to encourage management of lamps to ensure non-breakage. Therefore, the Agency believes that crushing lamps prior to recycling need not be represented in the Model.

**Comment No. 0008-15:** Pg. 2-15 and 2-16 - The Tetra Tech and RTI estimates for emissions from broken lamps are both inflated. The Tetra Tech report covers a 20 day period. It is not realistic to assume that 100 percent of all lamps are broken and would remain uncovered for 20 days prior to disposal. They would generally be covered immediately with other collected trash and would be permanently covered within the landfill within 24-48 hours or less. The three percent Tetra Tech release rate is therefore unrealistically high. The RTI release rate of 6.8 percent is unrealistically high because it is based on an engineering estimate using the results of a VOC model, rather than on the true behavior of mercury or actual studies. The most realistic emission rate for broken lamps is the low estimate.

**Response:** EPA notes the commenter's concerns with the data. In developing its estimates, EPA was limited to the existing information on mercury emissions, of which the Tetra Tech and RTI Reports were two reliable sources, and acknowledges such data limitations in the Report.

**Comment No. 0008-16:** On page 2-16, the Report fails to assess whether the lamps break while they are uncovered or while they are covered. In any co-disposal situation, they are more likely to break while they are covered and therefore, the emissions would be near or below the low estimate.

**Response:** EPA disagrees. The Model's high, medium and low transportation emissions factors adequately cover the range of likely emissions. The Agency does agree that emissions from covered lamps would be near the low estimate of 1.1 percent divalent mercury.

**Comment No. 0008-17:** Pg. 2-19 - The low estimate of recycling emissions is unrealistic. The RTI report only considers emissions from one type of highly controlled recycling process. The estimate appears to be based only on engineering assumptions, rather than actual data, and failed to consider emissions from all activities associated with the recycling process. GE Lighting recommends that EPA only consider the central and high estimates for recycling activity emissions.

**Response:** EPA agrees that the low recycling emissions factors need to be reevaluated. EPA has recalculated the low and central recycling emissions rates based on the comments received. EPA believes that a low emissions estimate of 0.07 percent for divalent mercury is justifiable based on the comments. See response to Comment No. 0031-1 for a fuller discussion.

**Comment No. 0008-18:** Pg. 2-21 - The Tetra Tech study results are inappropriately used in the Report. First, they are arbitrarily rounded from 0.8 percent to 1 percent, a 25 percent increase! Second, to use the 0.8 percent number, one would have to assume that all lamps are covered with 6 inches of soil or trash and that no additional soil or trash is added for 20 days. This is unrealistic. The 0.2 percent number with 1 foot of soil cover shows how quickly emissions are reduced with additional cover. As landfills add trash and cover daily, a 20-day static study is extremely conservative. At most, the 0.8 percent number should be used as the upper bound and even then be viewed as unrealistic.

**Response:** EPA agrees that the 0.8 percent estimate should not be rounded to one percent. See response to Comment No. 0002-4.

**Comment No. 0008-19:** The analysis performed on the Fresh Kills landfill data is incorrect. The analysis assumes that the lamps in the landfill contain 30 mg of mercury, when in fact lamps have been disposed in the landfill for decades that contain higher levels of mercury. A better assumption would be that the lamps contain 50 mg of mercury. Thus, the mercury input to the landfill from lamps is likely to have been 700 kg per year, not 420 kg per year. In addition, lamps historically make up only an estimated 3.8 percent of mercury in the municipal solid waste stream. Thus, total mercury disposed in the landfill per year is more likely to have been 18,421 kg. Mercury emissions of approximately 1 kg per year results in a mercury emissions rate of 0.005 percent. Thus the Tetra Tech estimate of 0.8 percent could be used for the high, but unrealistic estimate; 0.005 percent used for the central estimate; and the RTI value of 0.0001 [sic] percent used as the low estimate.

**Response:** EPA agrees with the 0.8 percent estimate as the high emissions factor; however, the Agency has retained the central and low factors of 0.2 percent and 0.001 percent, respectively. (Please note that the June 30, 1997 Report indicated erroneously that the low emissions factor is 0.00001 percent. However, the correct emissions factor, as included in the RTI report (and incorporated into the June 1997 electronic Model), is 0.001 percent. This has been corrected in the final Report.) See response to Comment No. 0002-4 for additional discussion of landfill emissions factors.

**Comment No. 0008-20:** The second paragraph on page 2-22 states that EPA assumes that vapor phase mercury would remain to be released during breakage at a landfill. Previously, the Report stated that EPA assumes that 100 percent of mercury would be released during the transportation phase. This needs to be clarified. According to the Report, there is no vapor phase left after transportation.

**Response:** EPA agrees with the commenter and has clarified the Report.

**Comment No. 0008-21:** On page 2-23, EPA should develop an estimate of the amount of non-lamp hazardous waste generated by buildings and the impact of that on the number of lamps that would remain excluded from Subtitle C.

**Response:** EPA disagrees. EPA acknowledges that its estimate of the number of CESQGs may be overstated because some facilities generate other hazardous wastes besides just lamps. However, EPA does not have reliable data on generation rates for CESQGs. The Agency has made the simplifying assumption that lamp generation rates determine regulatory status for lamp generators. The Agency believes that lamp generators are generally establishments that generate

low quantities of hazardous waste (e.g., office buildings); therefore, the Agency does not believe its approach to quantifying CESQGs is a major limitation to the analysis. Nonetheless, the Agency will note this limitation in the final Report.

**Comment No. 0008-22:** EPA mentions that California makes efforts to keep lamps out of the Subtitle D system. However, this effort is limited to large quantities of lamps. California allows 25 lamps to be disposed in the municipal solid waste system at a time.

**Response:** EPA notes the limitation of the Model's assumption regarding California's lamp rules, but holds that the Model adequately approximates lamp volumes entering the hazardous waste stream in that State.

**Comment No. 0008-23:** Pg. 2-24 - EPA states that crushing would decline under a Conditional Exclusion scenario. In fact, landfills often prefer to receive crushed lamps for reasons of landfill stability. It is probably reasonable to assume that the 20 percent of lamps that result from relamping projects would be crushed before landfilling under a Conditional Exclusion.

**Response:** EPA acknowledges the difficulty in predicting the percentage of lamps crushed under the CE option. However, the Agency continues to believe that a vast majority of generators would simply dispose of their lamps as part of their routine trash. Because of the lack of data on this issue, the Agency has decided to retain its estimate of ten percent.

**Comment No. 0008-24:** It is unlikely that CESQGs will utilize Universal Waste, as is stated on page 2-25. Recycling is too expensive for small businesses and small generators.

**Response:** EPA has compiled extensive data on lamp recycling practices and costs and believes that recycling costs are competitive with Subtitle C landfilling. This would be particularly true under the UW option, where generators and recyclers would be able to accumulate lamps for extended periods. Recyclers would thus be able to increase their economies of scale and potentially return a savings to their customers.

**Comment No. 0008-25:** Pg. 3-3 - GE Lighting notes that the Conditional Exclusion scenarios are not that different from the Baseline scenarios with respect to total mercury emissions. Because the Baseline is not being enforced, it makes sense for the Agency to move to a Conditional Exclusion. As a reduction in regulation will bring positive economic benefits with no reduction in environmental protection, GE Lighting urges EPA to move quickly toward finalization of a Conditional Exclusion.

**Response:** Comment noted. No response is required.

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**0010 Philips Electronics North America Corporation**

**Comment No. 0010-1:** Philips agrees with the tenets of EPA's analyses in its Report on which the Agency bases the five critical conclusions of its study. In particular, we endorse the following conclusions:

1. The highest mercury emissions would occur under the Conditional Exclusion (CE) disposal option (pg. ES-4). This conclusion is fully consistent with the data and analyses within the Report that shows most lamps to be broken during transport to a landfill under the CE option (pg. ES-4) and that transport emissions are the most important contributor to total mercury emissions.
2. Procedures should be established to minimize emissions during transport (pg. ES-4, 3-9). As the Report concluded, virtually all lamps would be broken during CE transport unless conditions are added to address releases (pg. ES-4, 2-16, 2-17). Philips agrees that such breakage should be avoided. Conditions to prevent such breakage -- appropriate handling and precautions -- would exist if EPA were to adopt the universal waste disposal option.
3. The mix of T8 vs. T12 lamp populations will be independent of the disposal policy option chosen by EPA (pg. ES-4 and 3-9). Philips agrees that EPA's disposal choice for fluorescent lamps is not an impediment to relamping with more environmentally friendly energy efficient T8 lamps. Philips agrees that EPA need not conditionally exclude lamps from the Resource Conservation and Recovery Act (RCRA) to effectuate relamping. In particular, Philips believes that EPA should not provide such an exclusion because its own data show that the CE disposal options would increase mercury emissions.
4. Under present Subtitle C disposal, lamp disposal costs are less than 1 percent of the relamping costs (pg. 2-5). Philips agrees that disposal costs are minimal contributors to relamping costs and therefore relamping choices are made without regard to EPA's policy choices that dictate such disposal costs. Philips' own customer surveys affirm EPA's conclusion. The relative minimal costs of lamp disposal support EPA choosing a policy option such as universal waste, which will result, as the Report concludes, in low emissions (pg. ES-4) and increased environmentally beneficial lamp recycling (pg. 2-25).

5. Interviews with Green Lights potential participants who have declined to participate in program show that none identify lamp disposal costs as a reason for not participating in the program (pg. 2-5). This conclusion is consistent with Philips' surveys and further demonstrates that an EPA policy choice, such as CE, that the Report concludes would result in increased emissions, would neither increase relamping nor further the Green Lights program.

Philips agrees with the study's five conclusions and believes that they support EPA choosing the policy option that will result in the most recycling and the least emissions. Philips urges EPA to choose its policy options based on recycling rates and emissions, and not, as others might suggest, on the theory that other policy options would increase relamping. The data contained in this Report demonstrate that no policy option will change relamping rates.

**Response:** Comment noted. No response is required.

**Comment No. 0010-2:** Philips submits additional information that would clarify the industry's mercury reduction capabilities. The efforts of the industry to reduce mercury in lamps are noted somewhat in the EPA Report (see pg. 2-4, 3-1), however, the Report states that most lamps still fail the Toxicity Characteristic Leaching Procedure (TCLP) for mercury (pg. ES-1, 2-22). These statements in the Report should be corrected because they ignore the low-mercury technology of the Philips ALTO TM lamp, which passes the TCLP. The reductions in mercury in the ALTO TM lamp will result in further mercury emissions reductions when such lamps are disposed of at the end of their useful lives. The ability of Philips and all manufacturers to make such mercury reductions in their product should be acknowledged in the Report.

**Response:** EPA disagrees and has elected not to revise the Model's assumptions of lamp mercury content. EPA acknowledges the continuing advancement of lighting technologies and, in particular, the declining mercury content of lamps. EPA developed its estimates of lamp mercury content based on information provided by a number of lamp manufacturers and other sources. Based on a review of the data, the Agency finds that the Model fairly reflects the information obtained.

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**0012**                    **State of Wisconsin, Department of Natural Resources**

**Comment No. 0012-1:** Prevention of mercury releases and waste minimization for mercury are high priority objectives for WDNR and for EPA's Great Lakes Initiative. We support the observations contained in the July 11th *Federal Register* notice concerning mercury emissions from waste lamps. We believe that the data from the study support these observations and conclusions. When waste lamps are managed through a protective system, we believe that mercury emissions are significantly lowered when compared to simply disposing the waste mercury-containing lamps in sanitary landfills. The waste lamps are typically crushed by the generator or hauler prior to landfilling, leading to a release of a significant portion of the mercury that we're all trying to control and keep out of the environment.

**Response:** Comment noted. No response is required.

**0014**                    **Mercury Waste Solutions, Inc.**

**Comment No. 0014-1:** Statement: The Model estimates annual lamp disposal emissions to range from a high of about 2,191 kg mercury (CE High) to a low of 95 kg mercury (UW Low). Comment: Even with a large margin of error, mercury emissions under the UW option could be up to 4,000 pounds less than the CE option.

**Response:** Comment noted. No response is required.

**Comment No. 0014-2:** Statement: The results suggests that Subtitle C and D landfilling would account for minimal lamp mercury emissions under either option (based upon Model assumptions that most lamps would be broken under either option). Comment: It needs to be pointed out that there should be minimal landfilling under the UW option. Not enough data exist to state that emissions would be minimal, even if the lamps are broken before getting into the landfill. As noted above, emission testing on landfills needs to be undertaken in order to obtain actual data. Without actual data, suggestions that there would be minimal emissions from landfills are purely speculative.

**Response:** EPA notes the commenter's concerns about the emissions data on landfills and agrees that landfilling under the UW option would be minimal. In the revised Model, EPA assumes a three percent Subtitle C disposal rate, which is comparable to the baseline. EPA also acknowledges the lack of data on landfill emissions. See response to Comment No. 0002-4 for further information on these emission rates.

**Comment No. 0014-3:** Statement: Transportation emissions are an important contributor to total mercury emissions, particularly under the CE option. Comment: Mercury emissions are an important contributor to total mercury emissions only under the CE option. As a lamp recycler with over five years of operational and transportation experience, our experience has shown that very little breakage occurs during transportation (less than two percent of total lamps). The use of proper packaging boxes/containers and the implementation of safe transportation procedures allow lamps to be transported safely and efficiently from generator sites to the lamp recycling facility.

It also needs to be noted that mercury emissions into the environment from our lamp recycling facility have consistently been well below detection levels.

**Response:** EPA agrees that significant differences exist in breakage and emissions rates among alternative transport scenarios. It is also true that, without best management practices, transportation emissions under the CE option, in particular, are a major contributor to total mercury emissions. The Agency has refined this presentation in the revised Report to separately address alternative transportation scenarios.

**Comment No. 0014-4:** Statement: Taken collectively, the observations suggest that, to reduce lamp mercury emissions under either option, procedures should be established that minimize emissions during transport and/or processing (e.g., crushing) of spent lamps. Comment: The EPA needs to get out and visit some lamp recycling facilities in those States that have banned lamps from landfills and have actively promoted lamp recycling. In Minnesota, the Minnesota Pollution Control Agency and the metropolitan counties have taken an active role in developing facility operating and transportation standards to ensure minimal mercury emissions.

**Response:** Comment noted. No response is required.

**0015 State of New Jersey, Department of Environmental Protection**

**Comment No. 0015-1:** Attached please find comments submitted to NESCAUM Northeast States/Eastern Canadian Provinces Hg Study in regard to Hg emissions from MSW landfills. The data calculates the annual Hg emissions from New Jersey- sanitary landfills based on the amount of waste-generated and the recently published data from the USEPA Fresh Kills Landfill Hg testing. It is clear from the data that SLF should be included as an anthropogenic source of Hg emissions to the environment and should be included in the Model calculations for impacts on the Universal Waste Rule for Lamps.

**Response:** EPA agrees that Subtitle D landfills should be included as a source of lamp mercury emissions in the Model. The final Model assumes that both CESQG lamps being landfilled, as well as most lamps from non-compliant generators under UW rules, would end up in Subtitle D landfills. Further, the Agency has revised its high emissions factor for Subtitle D landfills in response to the comments received, but has decided to retain the central and low estimates. See response to Comment No. 0002-4.

**0016 E.I Du Pont De Nemours & Company, Inc.**

**Comment No. 0016-1:** The purpose of the “Mercury Emissions From the Disposal of Fluorescent Lamps; Final Report” is to discuss the methodology, data and assumptions used in developing the “Mercury Emissions Model,” with the objective of allowing users to understand its function and results. The purpose of the Report is set forth in section ES-2.

DuPont strongly believes that one of the basic tenets of smarter regulation involves the need to continuously improve risk, assessment and risk-management methodologies. As importantly, we must establish a clear distinction between assessing risks and deciding how to manage them. The Agency's Report is intended to address the all important aspect of “assessing risk and is not intended to provide decisions on how to “manage risk.” However, the conclusions provided in the Report (see section ES-4 and 3-9) imply that a particular set of management techniques should be established under either waste management option.

The conclusions state that “... to reduce mercury emissions under either option, procedures should be established that minimize emissions during transport and/or processing (e.g., crushing) of spent Lamps.” This part of the conclusion goes beyond the Report's stated purpose of assessing risk and enters into recommendations of how to manage such risks. Thus,

at least part of the Report's conclusion is inappropriate in that through suggesting procedures that “should” be implemented, the readers and users of such information (e.g., State Agencies) will conclude that the Agency has sanctioned such suggested procedures as mandatory and the preferred way to reduce mercury emissions.

The management of risk is an entirely separate arena from the assessment of risk. DuPont believes that the Agency should themselves, and through management of their contractors, strive to avoid confusing the two areas in reports that will receive wide distribution and have the potential to shape the outcome of regulatory programs in many States. The Agency's recommendations on how to manage risks should be well thought out, developed with the involvement of all stakeholders and issued separately rather than represented only partially through a conclusion in a contractor prepared report.

**Response:** The EPA disagrees that the purpose of the Model is to address risk, e.g., assessing the probability of mercury intake by humans. Such a risk assessment is far beyond the scope or purpose of the present study. As stated in the Report, the purpose of the Model is to assist users in estimating the amount and sources of mercury emissions that might be produced in managing and disposing of spent lamps under the options. In this regard, the Agency believes that estimating the amount of mercury emissions under the CE option based on best practices falls within the scope of the Model.

**Comment No. 0016-2:** The Agency's approach to drum top crushing in its Report appears unfairly skewed against allowing generators to crush fluorescent lamps on-site. Limited monitoring for particulate dust and mercury vapor which DuPont has performed (in the units active and passive States) suggests that on-site Lamp crushing can be performed safely and well within established TLV's for an 8-hour TWA.

**Response:** EPA disagrees. Even though steps can be taken to detect and minimize mercury emissions from drum-top crushing, the Agency believes that drum-top crushing across the country often occurs without adequate emissions controls.

**Comment No. 0016-3:** DuPont believes that many readers of the Agency's Report will be misled into believing that greater than 97 percent of the total mercury contained in a used fluorescent lamp is recovered in existing recycling processes. DuPont's understanding, based upon information provided by fluorescent lamp recyclers, is that typically greater than 97 percent of the total mercury contained in the phosphor powder is recovered, not 97 percent of the

mercury contained in the entire lamp. Our experience is also that significant amounts of mercury remain in the glass, metal endcaps and other Lamp components from recyclers that only retort the phosphor powder (as opposed to some recyclers that retort the entire lamp or subject the entire lamp to other mercury extraction processes).

**Response:** The Agency agrees with the commenter that the emissions rate and the recovery rate should not be confused, and did not wish to imply that all mercury not emitted is recovered. As noted by the commenter, there are many possible fates for mercury within the recycling system, of which being emitted into the air is just one.

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**0019**            **Integrated Waste Services Association**

**Comment No. 0019-1:** Mercury lamp usage is estimated in the study by calculating commercial building floor space. Such commercial building floor space is highly concentrated in large cities such as Boston, New York, Philadelphia, Atlanta, Los Angeles, Chicago, Dallas, Houston, Denver, Seattle, San Francisco and other major metropolitan areas. None of the cities listed above use the services of a municipal waste combustor. (Detroit, Miami, and Baltimore do use a municipal waste combustor for disposal of trash.) Therefore, the study incorrectly apportions mercury lamps based on the national average of trash combusted. Municipal waste combustors process approximately 15 percent of America's trash, or about 34 million tons annually. Of that 34 million tons, only 25 percent -- or less than 10 million tons -- comes from large cities. EPA should adjust its assumptions accordingly by lowering the percentage for-trash containing mercury lamps processed by municipal waste combustors to 10 percent.

**Response:** EPA disagrees. The commenter should note that the "effective" rate of lamps entering municipal waste combustors under the baseline is approximately ten percent (i.e.,  $0.80 \times 0.13$ ). However, EPA does acknowledge the limitations of its approach to calculating the amount of lamps entering municipal waste combustors under the baseline.

**Comment No. 0019-2:** On page 2-20, Section 2.3.1.4, the first paragraph of this page contains a gross error. Municipal waste combustors with a spray dryer/fabric filter pollution control system without carbon injection achieve control efficiencies for mercury of 65 percent - 95 percent. The study's assumption is without basis in any fact that 90 percent of the mercury emissions from combustion of trash will exit the stack. Well over half of all municipal waste combustors have

scrubbers today, and all large units will have scrubbers within three years. Please contact Mr. Walt Stevenson at EPA's Air & Radiation office at RTP to verify and correct your assumptions. We have provided Mr. Stevenson with extensive information regarding control efficiencies.

**Response:** EPA disagrees. Overall, the Agency regards the municipal waste combustor emissions rates, as revised for the purposes of the Model, are appropriate. The EPA Office of Air Quality, Planning, and Standards (OAQPS) provided the information regarding MWC emissions for the Report.

**Comment No. 0019-3:** Please end the sentence on page 2-20, Section 2.3.1.4, first paragraph, last sentence. With the words: "i.e., no acid gas control systems."

**Response:** EPA disagrees. EPA has considered the commenter's suggestion, but finds the statement is sufficiently accurate. Therefore, the Agency will retain the statement as written.

**Comment No. 0019-4:** The fifth paragraph on page 2-20, Section 2.3.1.4 offers a ludicrous assumption. Municipal waste combustors will be required to continuously monitor carbon feed rate and carbon consumption and will annually test for mercury and verify that the selected carbon feed rate is achieving 100 percent compliance. The correct mercury emission control values should be 85 percent, 90 percent, and 95 percent for the low end, central and high end cases, respectively. In addition, please change the divalent values in Table 2-11 to 10 percent, 15 percent and five percent to more accurately reflect reality. Tables 3-2 and 3-4 should be revised to account for the above comments.

**Response:** EPA agrees that several factors warrant revision. See response to Comment No. 0004-7.

**00020          Superior Special Service, Inc.**

**Comment No. 0020-1:** Superior Special Service Inc. (Superior) has reviewed the Mercury Emissions From The Disposal Of Fluorescent Lamps Final Report dated June 30, 1997 and would like to take this opportunity to comment on the Report. The Report found that the two greatest mercury emission sources were lamp crushing and transportation under the CE option.

Superior Special Services, Inc. researched several lamp crushing machines since 1993 and agrees that most drum mounted lamp crushers simply do not have the proper emission control devices. Even the negative pressure drum mounted lamp crushers are typically not run continuously and therefore can have significant emissions while sitting idle. Superior has viewed portable drum crushers that literally shot the mercury contaminated powder back at the person feeding the machine. It is Superior's opinion that the best alternative is to utilize a commercial lamp recycling facility compete with the proper emission controls and one that is regulated by an appropriate air permit.

Superior Special Services, Inc.'s parent company, Superior Services, Inc. currently operates solid waste collection operations in nine States. Superior Special Services Inc. agrees that, in practice, most lamps collected for landfilling (CE option) would ultimately get crushed in the collection and transportation process. Garbage collection units are fitted with hydraulic compactors so that an operator can pick up more garbage before having to empty the truck. It is this compacting operation that would certainly break any fluorescent lamps that were not broken during the loading process.

**Response:** Comment noted. No response is required.

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**0021**            **Osram Sylvania**

**Comment No. 0021-1:** We fully endorse the comments from the National Electrical Manufacturers Association (NEMA) which point out some of the major overestimates of disposed lamps, which when corrected, will significantly lower the already low disposal risk of this waste stream. The agency, given its scarce resources, should focus its attention on more serious environmental risks.

**Response:** Comment noted. No response is required.

**Comment No. 0021-2:** GE also points out that the Report is flawed in its assumption that there are no emission reductions due to energy savings from fluorescent lamps. In addition, the increased utilization of coal fired power generation that is the inevitable outcome of Utility Deregulation must be factored into the Report's conclusions.

**Response:** EPA believes the commenter has misinterpreted the Report. The Report indicates the Agency's belief that there would be a reduction in mercury emissions from coal-fired boilers from use of energy efficient lighting. See page 2-8 of the draft Report. On the other hand, the Agency holds that the use of T8 and T12 lamps is independent of the policy options. See response to Comment No. 0002-1 for additional discussions of the Agency's views on this issue.

**Comment No. 0021-3:** Several commentators support regulations that will allow generators to crush lamps. A rulemaking that allows this, under properly controlled conditions, will be crucial in addressing the Report's conclusions on mercury emissions during transportation. The air emissions from lamps that are already crushed is zero. Crushing will increase the disposal options available, and minimize transportation cost. Crushed lamps can be accepted by reclamation facilities, and contribute also to the stability of landfills.

**Response:** The Agency feels that, under the UW option, lamp crushing may be allowed only under state authorized regulatory programs that permit crushing under conditions that are protective of human health and the environment. Crushing is prohibited if a state does not establish protective standards under an authorized regulatory program.

**Comment No. 0021-4:** The Report does not properly address the residuals of reclamation (recycling) and the inappropriateness of their reuse in processes involving heating or melting. Several commentators, including the International Sign Association and DuPont, have emphasized this point, with which we agree.

**Response:** EPA agrees that the Model does not track residual mercury produced from lamp waste management activities. However, the purpose of the Model is to estimate mercury emissions directly from lamps, not from down-line management activities involving residuals.

**Comment No. 0021-5:** We endorse the comments of DuPont concerning the Report having inappropriately crossed the threshold between risk assessment and risk management. There are many significant corrections needed in the Report before any conclusions can be drawn. Because so many States are looking to EPA for guidance, the Report borders on rulemaking by inference.

**Response:** EPA disagrees with the commenter's concerns about risk. See response to Comment No. 0016-1 for the Agency's clarification on this issue. The Agency also disagrees that the Report "borders on rulemaking by inference." The Agency expects States and others to interpret the Report for what it is — a study of lamp mercury emissions based on available data and assumptions.

**Comment No. 0021-6:** Clarification is necessary for the Report's assertion that, in interviews with nonparticipants in the Green Lights program, disposal costs were not mentioned as a reason for non-participation. Historically, only about one-third of relamping programs are completed under the auspices of Green Lights, so the interviewers should have cast their net much wider. The estimate of less than one percent added cost is also inaccurate since it fails to account for the costs of transportation as a hazardous waste that is still required in many States. For a more thorough appraisal of the impediments to relamping expressed by a wider cross-section of users, EPA need look no further than its 1994 proposed rulemaking docket. A summary of those comments was included in Statement 10 of the NEMA letter to Hon. Elliott Luros on May 2, 1995, which is enclosed as Attachment "B."

**Response:** EPA agrees that clarification is needed. EPA has re-visited its analyses regarding the effect of disposal costs on the use of T8 lamps and, based on the results, continues to believe that use of T8s is independent of the policy options. This will be clarified in the final Report. See response to Comment No. 0002-1.

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**0023**            **Mercury Technologies International, Inc.**  
(comments/responses also reflective of comment letter 0007)

**Comment No. 0023-1:** We have stated the Model falls short in estimating mercury emissions from mercury-containing lamps (MCLs) because it only estimates 4-foot linear lamps entering the disposal system. There are large volumes of other sizes and shapes also being disposed, and many of them contain more mercury than 4-foot lamps.

**Response:** The Agency agrees that there exist other types of mercury containing lamps, including eight-foot linear, U's, HIDs, as well as specialty lamps found in certain signs. However, the Agency believes that because most of the data on lamps (e.g., mercury content, usage patterns, etc.) is available for four-foot linear lamps, the Agency elected to focus on four-foot linear lamps. The Agency believes that as a general rule, the major conclusions of the study can be extended to other lamp types (e.g., breakage during transport is likely to be a major source of emissions, etc.). The Agency, therefore, sees no fundamental deficiency in examining only the population of four-foot lamps for the purposes of the Report.

**Comment No. 0023-2:** We believe these volumes if known, would significantly increase the universe of MCLs requiring management. NEMA, GE, and the Report focus just on the amount of mercury in lamps. The volume of the mercury constituent is estimated and used in comparison to other sources of mercury in the environment. RCRA is not based on the volume of the hazardous constituent in a waste but the entire hazardous waste stream. The volume of hazardous waste regulated by RCRA is the total tonnage of listed or characteristic waste regardless of the amount of the constituent(s). Thus, mercury lamp disposal is estimated at about 180,000 tons per year.

**Response:** The Agency agrees that the total mass of lamp waste (glass, end caps, phosphor powder) is much larger than the mass of mercury, but does not see this as a limitation of the Report. The purpose of the Report was to estimate mercury emissions from lamp disposal, not the total quantity of lamp waste generated.

**Comment No. 0023-3:** MTI has participated in a survey conducted by the lamp recycling industry in the U.S. The industry reports that approximately 80 million lamps are being recycled (11-13 percent, depending on what the actual total is).

**Response:** EPA agrees. See response to Comment No. 0002-8.

**Comment No. 0023-4:** The Report already discusses breakage and other risks associated with this type of handling, but it does not mention the human health risk associated with the releases each time lamps break. We feel this is a serious omission, given the significance of exposure to humans when lamps are not properly managed. The State of California is currently examining human exposure scenarios as part of the Cal-EPA's Regulatory Structure Update. This study is not yet completed, but it has already identified exposure pathways such as inhalation of dust and toxic vapors (including mercury and lead) by landfill workers.

**Response:** EPA disagrees with the commenter's concern about the absence of risk analysis. The purpose of the study is to estimate the amount of mercury emitted during lamp management and disposal. Assessing risk is not its purpose, e.g., assessing the risk of mercury inhalation by humans. See response to Comment No. 0016-1.

**Comment No. 0023-5:** There is no way to ensure the integrity of landfill-bound lamps during the transportation phase.

**Response:** EPA disagrees. Transporters of lamps under Subtitle C must abide by EPA and DOT regulations for packaging and marking. EPA believes these procedures would assist in minimizing breakage during transport to Subtitle C landfills. EPA recognizes, however, that transportation under Subtitle D would not be subject to these procedures.

**Comment No. 0023-6:** It is not uncommon in the solid waste industry to witness landfill fires. These fires often burn for days or weeks, burning on the surface and deep within the mass of buried garbage. They are very difficult to put out. When these fires occur there is no way to contain the products of combustion and any toxic chemicals there may be in the landfill. To our knowledge there are no studies that measured mercury emissions from landfill fires. Nevertheless, it is intuitively correct to assume that when there is mercury in the landfill it will heat up and be released during a fire.

**Response:** The Agency agrees that landfill fires may occur, but believes it would be inappropriate to adjust the Model's landfill emissions factor based on unusual events.

**Comment No. 0023-7:** MTI has included in its earlier comments a recent study by the California EPA, which revealed that landfill leachate is more aggressive at solubilizing and mobilizing mercury than either the RCRA TCLP test or the California WET test. This study presents evidence that there are a complex set of chemical reactions in a landfill which could result in the movement of mercury that would not happen if it were not there.

**Response:** The Agency agrees that circumstances exist in landfills that can mobilize mercury. However, the Agency did not base any emissions rates used in the Model on the TCLP or WET tests.

**Comment No. 0023-8:** In early 1997, the Sonoma County Landfill in Northern California operated by the Sonoma County Public Works Department, discovered that mercury in the leachate was being discharged to the municipal POTW in concentrations that were not allowable under the Clean Water Act. This landfill suspects fluorescent lamp disposal as the source of the mercury and is now instituting a local policy of diverting lamps.

**Response:** EPA thanks the commenter for information about mercury in POTW wastewater. The Model, however, does not consider mercury releases from leachate accumulating in landfill collection systems. The Model is not designed to consider all possible waste handling scenarios or waste streams where mercury could be present. Such a task would be far too broad in scope for purposes of the study. Further, information on leachate concentrations of mercury in general

appears to confirm that typical leachate mercury levels are low, and mercury associated with lamps is unlikely to result in leachate problems. The Agency agrees, however, that in certain cases mercury contamination resulting from landfills has resulted in environmental damage.

**Comment No. 0023-9:** MTI has commented on this docket that there are major flaws in the Report and Model with regard to the estimation of mercury emissions from lamp recycling facilities.

**Response:** EPA agrees that improvements are needed to the study's recycling emissions estimates. Please note that the Agency has revisited some of its recycling emissions estimates in finalizing the Model. Several public commenters raised concerns that EPA had misinterpreted data from the State of Florida on its recycling emissions estimates. EPA carefully reviewed available recycling emissions data and revised the Model's central and low emissions factors for divalent mercury emissions. EPA revised the central estimate from three percent to 1.09 percent and the low estimate from one percent to 0.07 percent.

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**0026            Philips Electronics North America Corporation**

**Comment No 0026-1:** Philips wants to emphasize that EPA should not choose conditional exclusion to promote Green Lights. The cost of disposal under RCRA Subtitle C for non-TCLP-compliant lamps is a disincentive to implementation of the Green Lights Program. EPA's final Report of June 30, 1997, "Mercury Emissions from the Disposal of Fluorescent Lamps," concludes that the population of T8 to T12 lamps is not dependent on which disposal policy option is chosen. (See EPA, Notice of Data Availability, Hazardous Waste Management System; Modification of the Hazardous Waste Program; Mercury-Containing Lamps, 62 Fed. Reg. 37183 (July 11, 1997)). As presented in color chart format during our meeting, it is Philips' experience that return on investment vs. electric rate appears to be the driving factor in Green Lights Program participation. Thus, EPA's mercury-containing lamp regulatory decisions should not be predicated on a perception that a particular policy decision can advance the Green Lights Program.

**Response:** EPA agrees. No response is required.

**0027 Mercury Technologies of Minnesota, Inc.**

**Comment No. 0027-1:** We are certain, based on experience rather than estimates, that the estimate used in the Report and the accompanying Model grossly overstated mercury emissions from mercury-bearing lamp recycling. By only using mercury emissions from four-foot fluorescent lamps, the Report significantly underestimated the quantity of mercury-bearing lamp generated both now and into the foreseeable future. Also, the Report appears to focus primarily on mercury-bearing lamp from commercial sources as distinguished from industrial and consumer sources. Furthermore, the Report attempts to present the total mercury quantity found in mercury-bearing lamps, but does not quantify total quantity of mercury-bearing lamps as hazardous waste. As a matter of fact, the entire mercury-bearing lamp is considered a characteristic hazardous waste under the Resource Conservation and Recovery Act (RCRA) if it fails the toxicity characteristic leachate procedure (TCLP) test.

**Response:** EPA agrees that the Model does not estimate the total population of all mercury-containing lamps and, thus, underestimates the total amount of mercury emitted from the management and disposal of all mercury-containing lamps. See response to Comment No. 0023-1 for the Agency's view on this issue. EPA also agrees that the study does not consider lamps from all types of floorspace and that the study underestimates total mercury emissions from these types of floorspace. The Agency will note this limitation in the final Report. Finally, the Agency agrees that the study does not consider the entire mercury-bearing lamp waste in its estimates. See response to Comment No. 0023-2.

**Comment No. 0027-2:** EPA itself noted, when the Agency issued its proposed rule, that it does not have data to assume that mercury-bearing lamps would not present a problem in landfills. EPA's review of the data from Fresh Kills landfill was clearly inadequate to project mercury releases from the nation's many active landfills. The occurrence of mercury releases into landfill leachate and in off-gas from landfills needs to be accurately determined before a realistic model of total emissions from mercury-bearing lamp disposal can be formulated.

**Response:** EPA disagrees. EPA acknowledges the limitations of the Model's approach to estimating mercury emissions from Subtitle D landfills, but believes that, based on the approach, the Model nonetheless captures the majority of mercury emissions from such landfills. Please note that the Model was designed to examine mercury air emissions only. Further, information on leachate concentrations of mercury in general appears to confirm that typical leachate mercury levels are low, and mercury associated with lamps is unlikely to result in leachate problems. The Agency agrees, however, that in certain cases mercury contamination resulting from landfills has resulted in environmental damage.

**Comment No. 0027-3:** Approximately thirty States have adopted or plan to adopt the Universal Waste Rule (UWR) approach for managing mercury-bearing lamps. A UWR would tend to minimize the crazy quilt of State mercury-bearing lamp management programs and streamline the regulations, while, at the same time, maintaining existing Subtitle C safeguards. We, in Minnesota, operate under some of the most stringent mercury-bearing lamp management requirements in the United States. We feel that recycling rates would significantly increase over time and that recycling prices could fall under a federal UWR.

**Response:** EPA agrees that this outcome is a possibility under a Federal UW program. No further response is required.

**Comment No. 0027-4:** The Report states that the Model will determine “the total quantity of mercury entering the disposal system” through estimating the total number of 4-foot fluorescent lamps entering the disposal system. Yet the Report fails to address other sizes and types of fluorescent lamps and other mercury-bearing lamps that are generated, in very large quantities.

**Response:** EPA agrees. See response to Comment No. 0023-1.

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**0029**                    **Northeast Lamp Recycling, Inc.**

**Comment No. 0029-1:** The Model established its baseline from an estimated use of 4-foot fluorescent lamps and omitted any other sizes and types, specifically 8-foot fluorescent and HID lamps, which contain higher concentrations and levels of mercury, on an average, than the source used. There is detailed information available from lamp manufacturers which specifically track the total amount of lamps sold nationally. In a combined effort with Green Lights and market research groups, future projections could have been more accurately forecasted which in turn would have substantiated a more definitive result.

**Response:** EPA agrees that the Model analyzes only four-foot lamps. See response to Comment No. 0023-1.

**Comment No. 0029-2:** Whether overlooked or neglected, the Agency did not address any of the immediate health risk and environmental impact to both short and long time exposure. According to the Agency for Toxic Substances and Disease Registry (ATSDR), inorganic or organic mercury poisoning can permanently damage the brain, kidneys, and developing fetus. While mercury contamination has declined over the last ten years, it remains a major concern of environmental groups. A highly-stable element, mercury does not break down easily, and small amounts can contaminate a relatively large water supply.

Forty-six States issued public health warnings in 1994 advising citizens to avoid or limit fish consumption because of chemical contamination in thousands of water bodies across the country -- a 20 percent increase from the previous year. Sixty percent of the health warnings against fish consumption are related to mercury contamination of the fish.

**Response:** EPA emphasizes that the purpose of the Model is not to measure human health or ecological risk, but to estimate the amount of mercury emitted through lamp management and disposal.

**Comment No. 0029-3:** It is NLR's belief that the Agency and RTI has wrongly estimated the emission rates from recycling facilities. Presented on page 2-19 are emission percentages from a recycling facility in the State of Florida which estimated their secondary emissions to be around 3 percent. However, the manufacturer of the equipment where this data was gathered estimates their emissions to be < 0.3 percent. This excessive differential is believed to be attributed to miscommunication or a typographical error between RTI and the Florida facility. Additionally, to develop a range of emission rates, data should not have been concluded from one source but should have been obtained from various recycling facilities. As a condition of NLR's PTO (permit to operate) samples of ambient air levels are obtained from several locations throughout the facility, including stack emissions, 3 times-daily. In the thousands of samples obtained, stack emission rates have always been undetectable. NLR believes that other recyclers achieve these same results based on today's sophisticated recycling processor and various communications with operational facilities. This further accumulation of "representative samples" would have solidified the EPA's determination of their findings.

**Response:** EPA agrees that the study's recycling emissions rates need to be revised. See response to Comment No. 0023-9.

**Comment No. 0029-4:** As a direct result of CE adoption, 100 percent of the lamps will be broken during transportation, resulting in the highest mercury emissions. Lamp recyclers have already established transportation and packaging procedures that limit breakage of the lamps

during transportation and therefore have dramatically limited the amount of mercury-emissions. While NLR agrees with the Agency's findings, NLR strongly disagrees with the EPA assessment of a projected mercury-contamination rate to be to 6.8 percent. NEMA and MRT have previously estimated a 20 percent emission rate.

**Response:** EPA disagrees with this projected estimate of 20 percent. The Agency agrees that NEMA did, as part of a letter, make the referenced statement. The Agency, however, employed plausible emissions estimates, and does not consider the 20 percent estimate plausible. This is primarily a result of the CHEMDAT 7 modeling performed by RTI, which we believe presents a reasonable upper bound.

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### 0031 U.S. Mercury-Containing Lamp Recycling Industry Representatives

**Comment No. 0031-1:** In its Report, EPA has chosen to use a central mercury “emissions factor” of three percent from recycling activities based on information attributed to the National Electrical Manufacturers Association (NEMA) and the State of Florida. However, in the strongest possible terms, the coalition disputes the accuracy of this estimate. The three percent figure was taken from a Begley and Linderson report entitled “Management of Mercury in Lighting Products,” which has been widely circulated by NEMA. Instead, EPA should use data from the “Preliminary Risk Assessment” for its central estimate; that is, 0.2 - 0.4 percent for primary emissions, and 0.8 percent for potential secondary emissions. The EPA should also consider that since the “Preliminary Risk Assessment” was completed, MRT has asserted in a 1995 letter to CEQ that primary emissions from recycling facilities are 0.1 percent, with 0.3 percent the worst case estimate.

**Response:** The primary source for the three percent emissions rate used in the Model was information received from the State of Florida, and the Report conservatively assumed that all of the glass and end caps would be recycled and subjected to hot recycling process. Based on the comments received and additional data received during the comment period (available in the docket established for this action), EPA has revised the recycling portion of the Model, as presented below.

First, because many commenters seemed to confuse the primary (elemental) and secondary (divalent) recycling emissions rates, (i.e., some commenters stated that emissions of three percent would be a violation of the facilities air permit). In fact, as discussed in the Report,

EPA believes that emissions from recycling facilities are generally low and that the majority of emissions arise from mercury emitted during the recycling of the glass and end caps (i.e., secondary emissions). This is supported by available information, e.g., comment letter from the State of Florida (Docket No. F-97-FLEA-FFFFF).

To eliminate further confusion, EPA has split the recycling emissions into primary and secondary sources of emissions. This is done by modifying the existing recycling unit to "Primary Recycling Emissions," and adding a new unit "Secondary Recycling Emissions." Primary recycling emissions includes all air emissions associated with handling the bulbs; the separation of the lamps into glass, end caps, and powder; and retorting the mercury. Secondary recycling emissions includes emissions from recycling the glass and end caps. The following paragraphs focus on: (1) secondary emissions, (2) primary emissions, and (3) total emissions.

### Secondary Emissions

In selecting an emissions rate for primary recycling the Agency considered data from commenters, such as the State of Florida, and also considered both the quantity of mercury in the glass and end caps, and the fate of the recycled materials (e.g., fate of the material recycled in a thermal process). Florida notes that an average recovery for facilities operating in their State is 98.5 percent, and it is reasonable to assume that the mercury content of the glass is 1.0 ppm, while the mercury content of the end caps is 2.0 ppm. A theoretical emissions rate can be derived as follows:

Mass of lamp = 300 g (From RTI Report)

Mass of glass = 93 percent (From RTI Report)

Mass of end caps = 5 percent (From RTI Report)

Mercury content of glass = 1 ppm (From State of Florida)

Mercury content of end caps = 2 ppm (From State of Florida)

Mercury dose = 21mg (From State of Florida)

Using this information we are able to derive an overall emissions rate for the glass of 1.3 percent (based on the overall dose of 21 mg), and an emissions rate for the end caps of 0.07 percent, for an overall emissions rate of 1.4 percent.

Reports from recyclers reviewed by the State of Florida indicate that 77 percent of the glass was recycled and the remaining 23 percent was shipped to Subtitle D landfills. While an informal survey conducted by Florida reveals recycling alternatives for the glass that do not involve a thermal process (e.g., cold mix asphalt, cold process concrete, and landfill cover), Florida has no information on the relative volumes of glass treated in hot processes vs. cold processes. It was conservatively assumed that all of the glass not shipped to Subtitle D landfills could be treated by a thermal process. Therefore, the 1.3 percent emission rate for the glass was adjusted to 1.02 percent. We should note that Florida believed the assumption of full end cap recycling in thermal processes was reasonable, and therefore the Agency has maintained the end cap emissions rate at 0.07 percent. The glass emissions rate was added to the end cap emissions rate to produce an overall central emissions rate of 1.09 percent, which is applied to the divalent fraction of the mercury.

The low emissions rate for divalent mercury was developed using the same approach, but assumed that none of the glass was exposed to thermal recycling process. This results in an emissions rate of 0.07 percent for the end caps and zero percent for the glass, for an overall emissions rate of 0.07 percent. Again, we apply this to the divalent portion of the mercury.

The high emissions rate for divalent mercury is maintained at six percent.

In conclusion, the overall emissions rates for secondary recycling emissions are shown in the table below:

**Emissions Factors For Secondary Recycling Emissions**

Central Estimate		High Estimate		Low Estimate	
Elemental	Divalent	Elemental	Divalent	Elemental	Divalent
0 percent	1.09 percent	0 percent	6 percent	0 percent	0.07 percent

Please note that all of the elemental mercury is assumed to be emitted during the primary recycling operations. Thus, the emissions factors for elemental mercury are zero.

Primary Emissions

The primary recycling emissions rate is derived both from the efficiency of typical controls, and consideration of the overall recovery rates. Because recycling facilities are typically equipped with emissions control devices, the Agency believes that emissions of divalent mercury from a properly operating facility should be negligible. The Agency assumed a 90 percent control efficiency on the vapor phase/elemental mercury for the central estimate, an 85 percent control efficiency for the high estimate, and no emissions for the low estimate. The emissions factors from Primary Recycling Emissions are shown below:

**Emissions Factors For Primary Recycling Emissions**

Central Estimate		High Estimate		Low Estimate	
Elemental	Divalent	Elemental	Divalent	Elemental	Divalent
10 percent	0 percent	15 percent	0 percent	0 percent	0 percent

These emissions factors are based primarily on the control efficiency of the carbo absorber and particulate air pollution control devices (e.g., HEPA filters). While we assign no divalent mercury emissions to the primary process, we note that poorly operated facilities could have very high emissions rates, and there are examples of lamp recycling facilities causing widespread contamination.

Total

EPA summarizes the total mercury emissions rate from primary and secondary lamp recycling in the table below:

**Total Emissions Factors For Primary and Secondary Recycling Emissions**

Central Estimate		High Estimate		Low Estimate	
Elemental	Divalent	Elemental	Divalent	Elemental	Divalent
10 percent	1.09 percent	15 percent	6 percent	0 percent	0.07 percent

**Comment No. 0031-2:** In its proposed MCL rule, EPA referenced considerable uncertainties over MCL breakage rates, but in the Report chose a projected 6.8 percent number as the high estimate, instead of using the 20 percent (for Subtitle D transportation), emission rate for MCL breakage that MRT has estimated. The 20 percent breakage rate appears to have also been supported by NEMA in a 1993 letter to EPA indicating that "... mercury vapor rates from broken lamps, were essentially flat after 40 days, and that 80 percent of the mercury remained in the lamp."

**Response:** EPA agrees that there is uncertainty about the breakage rate for Subtitle D transportation, but believes that, in general, all lamps undergoing Subtitle D transport are broken (i.e., the breakage rate is 100 percent). EPA did evaluate the effect that best management practices would have on the CE policy option. As part of this evaluation, and to test the sensitivity of the Model to various parameters, EPA varied the breakage rate within the CE option. The Agency continues to believe that implementation of CE would result in 100 percent breakage, unless some additional steps are taken to prevent breakage.

Further, the Agency disagrees with the 20 percent emissions factor cited by the commenter. In the Model, the Agency uses a maximum transportation emissions rate of 6.8 percent for the divalent portion of the mercury. This was based on modeling performed by RTI. While the validity of that modeling approach has been called into question, the Agency continues to believe it represents a reasonable high-end estimate, in particulate when combined with the 100 percent elemental mercury emissions factor (please note that the total emissions factor used by the Agency is seven percent). Florida, in its comments, presents a mass balance approach to determining transportation emissions and concludes that emissions during transport may be between nine percent and 7.2 percent. Given the potential sources of error in both the modeling performed by RTI, and the mass balance performed by Florida, the Agency has concluded that the estimate of seven percent (i.e., 100 percent of the elemental mercury, and 6.8 percent of the divalent mercury) presents a reasonable upper bound.

[Note: The commenter uses MCL to identify mercury containing lamps.]

**Comment No. 0031-3:** By only using mercury emissions from four-foot fluorescent lamps, the Report significantly underestimates the number of hazardous waste MCLs generated both now and into the foreseeable future. Also, the Report appears to focus primarily on MCLs from commercial sources as distinguished from industrial sources.

**Response:** EPA agrees that the study does not estimate the number of eight- or 12-foot lamps or lamps from non-commercial floorspace. See responses to Comment No. 0023-1 and 0027-1 for EPA's justification of these issues.

**Comment No. 0031-4:** While the Report presents total mercury amounts in MCLs, it does not quantify total amounts of MCLs as hazardous waste. However, the entire MCL is considered hazardous waste under the Resource Conservation and Recovery Act (RCRA) if it fails the toxicity leachate characteristic procedure (TCLP) test.

**Response:** The Agency agrees that the total mass of waste (glass, end caps, etc.) is much larger than the mass of mercury, but does not see this as a limitation of the Report. See response to Comment No. 0023-2.

**Comment No. 0031-5A:** Contrary to the Report's assertions, there is no discernible connection between mercury releases from the burning of coal to produce energy for lighting and mercury releases from MCL disposal.

**Response:** The Agency agrees with the commenter, to the extent that lighting decisions, and hence lamp populations, are independent of the policy options. However, we note that numerous commenters, primarily lamp manufacturers and utilities, have contended there is indeed a direct relationship among lamp disposal options and mercury emissions from electric utility boilers.

**Comment No. 0031-5B:** The Report fails to reflect the fact that a clear majority of MCLs will be disposed of in unlined, municipal solid waste (MSW) landfills. This is because less than one-third of the nation's active landfills are lined (MCLs would be allowed in unlined landfill because, as discussed in the Agency's proposed rule for the management of MCLs, EPA would consider "partial" programs as well as "full" program approvals to be "EPA-approved" State programs). Additionally, the Report's assumption that MCLs will only go to MSW landfills and not MSW incinerators appears unrealistic given the fact that MSW destinations points are based largely on market conditions.

**Response:** The Agency agrees that in certain cases mercury contamination resulting from landfills has resulted in environmental damage. However, information on leachate concentrations of mercury in general appears to confirm that typical leachate mercury levels are low, and mercury associated with lamps is unlikely to result in leachate problems.

Further, the study does assume that, under the base case and policy options, a portion of MCLs from CESQGs and noncompliant generators would be sent to MWCs. See pages 2-12 to 2-14 of the draft Report.

**Comment No. 0031-6:** EPA does not have competent data to make the assumption that MCLs do not present a problem in landfills and identified this as a significant data gap in its proposed MCL rulemaking. Since then, EPA has examined mercury data from Fresh Kills landfill, but the results of this one study are clearly not sufficient to project mercury releases from the nation's 3,000 active MSW landfills. Therefore, the occurrence of mercury releases into landfill leachate and in collected and uncollected off-gas from landfills needs to be accurately documented and correlated before a comprehensive mathematical model of total emissions from MCL disposal can be formulated.

**Response:** The Agency agrees that there is large uncertainty associated with landfill emissions rates. Because the Subtitle D landfill emissions factors in the Model span five orders of magnitude, the Agency believes that this range captures the likely emissions rates. EPA also believes that it has used the best available data on landfill emissions in calculating emissions rates, i.e., the Tetra Tech and RTI reports cited in the study and available in the docket.

**Comment No. 0031-7:** On average, recycling rates are projected to increase to over 50 percent under UWR, according to questionnaire results. Respondents indicate that recyclers will be able to significantly increase capacity in a relatively short amount of time by utilizing additional shifts, with the industry having a total annual capacity to process over 600 million MCLs through the maximum utilization of three eight-hour shifts. In addition, the number of employees is expected to reach over 1300 as recycling facilities expand their operations to process more MCLs under UWR.

Conversely, under the CE, recycling rates are expected to fall dramatically, in States without more stringent MCL management regulations than the federal government. Recyclers are expecting to experience a sharp drop in revenues under the CE option and a reduction in the industry work force to 200 or 300 employees, according to respondents. While revenues drop, operating costs remain constant and large capital investments will still have to be paid off.

**Response:** The Agency agrees with the commenter that recycling rates would likely increase under UW programs. The recycling rate used by the Model in the UW options was approximately 56 percent of all non-CESQG lamps.

The Agency has not determined whether recycling rates would drop significantly under the CE option. The Agency's Model uses a recycling rate of about ten percent under CE, which is equal to the recycling rate under the baseline.

**Comment No. 0031-8:** It is not uncommon to witness landfill fires. These fires often burn for days or weeks, burning on the surface and deep within the mass of garbage, and are difficult to put out. When these fires occur there is no way to contain the products of combustion and any toxic chemicals there may be in the landfill. Although there are no known studies that measure mercury emissions from landfill fires, one might intuitively assume that when there is mercury in landfills, it will be rapidly released during a fire.

**Response:** The Agency agrees that landfill fires can occur, but finds that it is inappropriate to base the emissions factor for the Model on these events. The Model is based on studies of normal operating conditions at waste management sites. The Model is not designed to account for non-routine events like fires. See the response to Comment No. 0023-6.

**Comment No. 0031-9:** A recent California EPA study revealed that landfill leachate is more aggressive at solubilizing and mobilizing mercury than either the Resource Conservation and Recovery Act (RCRA) Toxicity Characteristic Leaching Procedure (TCLP) test or the California WET test would indicate. The California study does present evidence that there are a complex set of chemical reactions in a landfill, which could result in migration of mercury. (Mercury combines with organic molecules in landfills, making it more soluble and mobile.) More importantly and a greater risk to public health is the fact that mercury in landfills is subject to anaerobic formation of organic compounds such as methyl and di-methyl mercury.

**Response:** The Agency agrees that circumstances exist in landfills that can mobilize mercury. The Agency did not base any emissions rates used in the Model on the TCLP or WET tests. The Agency also agrees that mercury compounds can form during lamp waste management and disposal. However, the Model has not been designed to account for all possible mercury transformations that may occur — e.g., inter-species transformation — as this was beyond the scope of the study. The Agency has revised the final Report to discuss such limitations.

**Comment No. 0031-10:** The State of Massachusetts estimates that MCLs are one of the two largest contributors of mercury emissions from MSW incinerators in their State. Although new requirements are expected to reduce mercury emissions by 85 percent, a Massachusetts Department of Environment Protection official expects that it will take “... several years for the new equipment required under those regulations to be installed and verified to be working” and that mercury products “... will continue to contribute significant quantities of mercury to the waste stream” over this time period.

**Response:** The Agency agrees that MWCs are large sources of mercury emissions. The Model accounted for the new regulations requiring an 85 percent reduction. The Agency believes that the final Report's high MWC emissions rate of 16 percent (i.e., 84% reduction) is adequate to represent the upper-bound. These assumptions have been reviewed by EPA's Office of Air Quality, Planning, and Standards (OAQPS).

**Comment No. 0031-11:** The Report concentrates on mercury, which is the primary hazardous substance associated with fluorescent lamps. However, relatively small quantities of mercury in lamps are associated with quite large quantities of hazardous waste in the form of disposed lamps. Since about 700 million lamps, weighing about 0.6 lb. per lamp, are replaced each year, the mass of lamps disposed of each year is about 210,000 tons.

**Response:** Comment noted. See response to Comment No. 0023-2.

**Comment No. 0031-12:** The Report considers only 4-ft (linear) lamps. It does not consider management of 8-ft lamps, curved lamps, HID lamps, and other special configurations.

**Response:** Comment noted. See response to Comment No. 0023-1.

**Comment No. 0031-13:** The Report calculates the number of lamps disposed per year via a complex methodology based on estimates of lighted floor space, by building size category. A far simpler and more accurate approach would be to use NEMA data for lamps produced and sold in the U.S. plus Dept. of Commerce data for lamps imported annually into the U.S.

**Response:** Comment noted. See response to Comment No. 0004-1.

**Comment No. 0031-14:** In the Model, multiple sets of parallel calculations are made in order to utilize basic data from several sources. In many cases, the data from each source varies widely from the others, and there is no way to determine which source is more accurate. Consequently, when a mathematical model such as this is based on sequential calculations using data of unknown accuracy, there can be little confidence in results calculated by the model.

**Response:** EPA does not agree that the results of the analysis are meaningless. The estimation of mercury emissions from the disposal and recycling of used fluorescent lamps was conducted using the best available data related to the numbers of lamps disposed, the proportions of lamps flowing through different management scenarios, and estimated emissions from various unit operations.

Because of the limited nature of the data, exhaustive analysis of the potential variability and uncertainty in emissions could not be performed. Consistent with current EPA policies related to the analysis of uncertainty, sensitivity analyses were used to investigate the effects of key variables (breakage rates and compliance) on emissions. The results of this analysis are summarized in Exhibit 3-3 of the Report. While exhaustive quantification of uncertainty is not possible, the findings of the emissions estimates and sensitivity analysis strongly support the reasonableness of the overall conclusion of the analysis: Municipal waste combustion, breakage rates and transportation emissions are major determinants of emissions, and emission rates vary only slightly between the regulatory options.

**Comment No. 0031-15:** It is not logical to state that the current status of lamps as a potential RCRA waste could possibly affect the transition. If anything, the replacement of T12 lamps by the more energy efficient T8s, which contain significantly less mercury, is strictly an economic issue which is not linked to their final disposition as hazardous waste.

**Response:** EPA agrees. No response is required.

**Comment No. 0031-16:** The equation for the binomial distribution to estimate the fraction of 4 ft. lamps entering the waste management system is incorrect. We solved the equation for three cases: N=1 yr., N=2 yr., and N=3 yr. Since the “fraction” obtained for the latter two cases is greater than 1, there has to be an error.

For	N=1	Fraction 1 = 0.140
	N=2	Fraction 2 = 1.05
	N=3	Fraction 3 = 151

Since “Fractions” 2 and 3 are not fractions, I did not solve the equation for N=4, etc.

**Response:** The Agency appreciates the comment regarding an error in the binomial distribution formula, and acknowledges that the formula contained typographical errors. The correct formula for the portion of lamps entering the waste management system as a result of failure is:

$$\text{Fraction of failed lamps} = \frac{N!}{K!(N-K)!} P^K (1-P)^{(N-K)}$$

Where:

K = cohort year, which ranges from 1 to 6,  
 N = maximum lamplife (N=6), and  
 P = probability a lamp will not fail in each year (P=0.67)

The following table presents the fraction of failed lamps in each cohort year.

Cohort Year (N)	Fraction of Failed Lamps
1	0.004
2	0.033
3	0.132
4	0.297
5	0.356
6	0.178

**Comment No. 0031-17:** The equation presented is apparently designed to calculate the energy savings possible in the U.S. with an all-T8 lamp population as opposed to an all-T12 population. The equation contains terms  $f^*$  and  $(1/f)^*$ , but the term  $f$  is defined, but not  $f^*$ . However the equation is correct if (a) the use of “\*” represents the reciprocal of  $f$  and (b), provided these reciprocal values are used in the equation.

**Response:** The Agency disagrees with the commenter that the formula to calculate the energy savings for a T8 lamp population is incorrect. The equation is correct as published. The symbol “\*” used in the equation denotes multiplication of the terms on either side of it. For example, the meaning of “ $f \cdot e_s$ ” is that “ $f$ ” is multiplied by “ $e_s$ .”

**Comment No. 0031-18:** In estimating emissions from Subtitle C landfills, it is assumed that intact lamps are crushed in the stabilization process, with escape of any vapor phase mercury only. I believe that this is an over-simplification and that the stabilization step is additionally capable of emitting both divalent mercury and (especially) particulates. Thus, if best management practices are to be used on lamps destined for stabilization and “C” landfills, then efficient emission controls must be employed.

**Response:** The commenter is correct in noting that the Agency assumed that emissions associated with Subtitle C landfills would be primarily from the crushing of intact bulbs. In principle the Agency agrees there may be other types of emissions associated with stabilization processes, but is unaware of any means to estimate these emissions.

**Comment No. 0031-19:** The fact that discarded fluorescent and other mercury containing lamps are a form of hazardous waste that can be recycled and put back into commerce (raw material avoidance) is consistent with overall EPA goals but is not considered in the Report.

**Response:** EPA agrees, but the purpose of the Model is to estimate emissions from various policy options. Thus, the comment is noted, but is outside the scope of the Model.

**Comment No. 0031-20:** The EPA should not further delay a decision to regulate spent mercury containing lamps as hazardous waste. After all, other waste sources containing mercury (including thermostats, switches, and batteries) are fully regulated by RCRA. The EPA could expedite and make the UW regulation more economically feasible by adopting streamlined procedures for managing these hazardous wastes.

**Response:** The purpose of the Model is to estimate emissions from various policy options. Thus, the comment is noted, but is outside the scope of the Model.

**Comment No. 0031-21:** If this Report is intended to be the basic document for selection of an environmentally optimum management system for spent or discarded mercury containing lamps, then conversion of T12 lamps to T8, and the concomitant decrease in emissions from coal-fired utility boilers should not be a prime consideration.

**Response:** EPA does not agree. The purpose of the Model is to estimate emissions from various policy options. On numerous occasions, lamp manufacturers, utilities and other groups have contended that the overall T8 penetration rate, and thus, mercury emissions from electric generation are linked to the RCRA policy options. Therefore, the Agency examined this linkage as part of the Report and Model.

**Comment No. 0031-22:** Many of the special lamps, and especially the HID lamps, contain much more mercury than the 4-ft lamps. Also, the Report appears to concentrate on lamps from commercial sources (wholesale and retail trade, services, finance, insurance, real estate, etc.), as distinguished from industrial sources (manufacturing, materials processing, equipment repair and maintenance, metals fabrication, etc.). Accordingly, the Report and its resulting Model may be somewhat deficient.

**Response:** EPA disagrees. See response to Comment No. 0023-1.

**Comment No. 0031-23:** Although mercury emissions from the disposal of mercury containing lamps are an important consideration in choosing an optimum disposal procedure, there are other, equally important considerations.

- a) Documented occurrence of mercury vapor in off-gas from landfills.
- b) Documented occurrence of elemental mercury in leachate from landfills in concentrations greater than the MCL/RAL standard of 0.002 mg/l. Even the levels below this standard greatly exceed the federal ambient water quality standard of 12 ng/l that is designed to protect against bioaccumulation in aquatic systems.
- c) Solid waste landfills are anoxic biological systems that can generate the volatile and highly toxic compound dimethyl mercury.

**Response:** The commenter's overall contention that there are other considerations in selecting a policy option is noted, but is outside the scope of the Model. Some of the commenter's concerns regard the mercury emissions rate from landfills. The Agency notes that some commenters believe the Agency's landfill emissions rate is too high (See for example NEMA), while others believe it to be too low. Overall, the Agency believes the emissions rates used for landfills as described in response to Comment No. 0002-4 are appropriate.

**Comment No. 0031-24:** Page ES- I Last Paragraph. Per the text, "generators would qualify for the exemption if they satisfy two conditions:" However, four conditions are listed. I believe that the first two listed conditions are primarily what the Report authors intended.

Page ES- I Footnote. The footnote serves to promote a point of view, and should therefore be deleted from the Report. Furthermore, I do not believe that the opinion offered is correct.

**Response:** EPA disagrees. The page specifies two conditions under the CE option: (i) generators must send the lamps either to a municipal landfill that is permitted by a State/Tribe with an EPA-approved municipal solid waste permitting program or to a State permitted, licensed, or registered reclamation facility and (ii) generators must keep records. Given these two conditions, generators would be able to ship their lamps as part of their municipal waste stream, as described on page ES-2. Further, EPA believes the footnote on page ES-1 is valid based on information maintained at the Agency.

**Comment No. 0031-25:** P1-3 In the 2nd paragraph it is stated that the Model will estimate "the total quantity of mercury entering the disposal system" by estimating the total number of 4-ft (linear) lamps entering the disposal system. Since a significant number of lamps are 8 linear feet

long, or possess curvature and are not linear or are HID lamps, or are otherwise not the conventional 4-ft (linear) lamps, the Report and Model cannot claim that the Model copes with the total quantity of hazardous waste with mercury characteristics entering the disposal system from fluorescent lamps. In fact, some of these lamps contain higher levels of mercury than the 4-ft (linear) lamps. The Model, therefore, is not adequate in this respect.

**Response:** EPA agrees that the Model does not estimate the total quantity of mercury from all spent mercury-containing lamps. See response to Comment No. 0023-1.

**Comment No. 0031-26:** P1-3 Again, in the 2nd paragraph it is stated that the Model estimates net emissions from the disposal process by subtracting mercury emissions avoided by generating incrementally less electrical power from coal combustion, as a result of installation of energy-saving (T8) fluorescent lamps. The subsequent avoidance of mercury emissions from decreased electrical power generation based on combustion of coal is not relevant to the selection of an environmentally desirable mode of mercury containing lamp disposal. Therefore, this consideration should not be included in the construction of the Model.

**Response:** The Agency disagrees. See response to Comment No. 0031-21.

**Comment No. 0031-27:** P1-3, 1st bullet. The Report admits, "A major obstacle in developing the Model was the scarcity of reliable data. Many of the data and assumptions in the Model are based on the Agency's best professional judgment and conversations with industry and states." I believe that any mathematical Model in which there are sequential operations, and in which virtually every operation is based on assumptions, judgment, and possibly speculation, cannot yield results that can be accepted with any feeling of confidence. Accordingly, I believe that the data presented later in the Report, i.e., Table 31, Annual Mercury Disposal Emissions from Lamps (1998-2007) (Kg); Table 3-2, Cumulative Mercury Lamps Disposal Emissions by Scenario and Activity (Kg); and Table 30, Sensitivity Analysis for Lamp Breakage and Compliance under CE, is grossly inaccurate. Furthermore, presentation of calculated results to as many as five significant figures implies accuracy that may not even be implicit in the first significant figure.

**Response:** EPA disagrees that the Model is grossly inaccurate or provides questionable results. See response to Comment No. 0002-3. Further, EPA acknowledges the uncertainty in certain of the Model's data and assumptions, but disagrees that presentation of several significant figures is misleading. The Report provides a detailed discussion on how the Agency derived its emissions estimates so that the reader fully understands the assumptions and data limitations behind such estimates. Further, the Model includes emissions factors to two significant figures, as indicated in the Report's tables on emissions factors.

**Comment No. 0031-28:** Section 2.1, MERCURY INPUT, p. 2-1. In this section, the quantity of mercury entering the management system is calculated from a rather complex and not completely understandable estimation method based on estimates of floor space lit with fluorescent lamps in several size categories of buildings. This estimate is based on a 1986 estimate of square footage of building space lit by fluorescent lamps, and updated to 1992 "by assuming an annual growth rate of 1.024 percent" (source of this assumed rate is not given). However, only commercial floor space was estimated, omitting floor space lit by many industrial and numerous residential users. Furthermore, in Table 2-1., Building Categories, the median size (in square ft.) of each building group is given, and presumably used in subsequent calculations. Statisticians generally prefer use of average, or mean, values as measures of central tendency. Specifically in this situation, I believe that the mean value of building size, not the median, should be the preferred parameter to use in these calculations.

In any event, rather than using a cumbersome approach for estimating the number lamps disposed of in any year, it would be far simpler to use NEMA data for the number of lamps shipped in each year and then determine the split of each annual total into replacement lamps and new installations.

**Response:** EPA disagrees. The comment regarding the presentation of median building sizes is noted, but medians were employed as a presentation technique for the Report because the data are not normally distributed. The Model does not use either median or average building sizes as part of the calculation procedure. Instead the Model deals with issues regarding the distribution of space within a size category, by using the total fluorescent lit space within the size category as the basis of the calculation.

During the selection of the methodology for estimating the number of lamps disposed, several options were considered, including the one suggested by the commenter. Two factors led the Agency to reject the methodology selected by the commenter. First, a straight growth rate using the NEMA or Department of Commerce data would account for neither transitions from T12s to T8, nor group relamping. The effect of these factors is that the number of lamps disposed grows at a rate larger than the growth rate of floor space, and the Agency believes that it would be difficult to justify a straight line extrapolation as accounting for these crucial factors.

Second, the methodology suggested by the commenter would not be capable of partitioning the disposed lamp population into CESQG and LQG/SQG fractions. This partitioning depends upon the total disposal volume on a per-building basis, which cannot be done without some direct linkage to lit space. Thus, the methodology suggested by the commenter was not selected as the basis of the modeling approach.

The methodology employed by the Model links space and lighting directly, and is thus capable of accounting for lighting changes and is also capable of accounting for CESQG disposal.

**Comment No. 0031-29:** Section 2.1.2. 1, P 2-2. A mathematical error is observed in the sentence "Assuming that lamps are operated between 4000 and 5000 hours each year, and have a typical life of 20,000 hours, their life span is between four to six years." The more correct life span is between four and five years.

**Response:** EPA disagrees. The Model estimates failure rates using the binomial distribution, and not an average.

**Comment No. 0031-30:** Section 2.2 P 2-8, 2nd paragraph. If the electric generation of  $2.825 \times 10^{12}$  kwh is derived from the use of coal-fired system, only, then the emission rate of 0.016-mg mercury/kwh is probably correct. However, if the above electric power is the total derived from all sources (burning of coal- fired system and natural gas, plus nuclear and hydroelectric sources), then the mercury emission rate for coal burning only, is low.

**Response:** The mercury emissions rate was derived as follows:

Total U.S. electric generation in 1991 - 2,825,023,000,000 kwh  
Mercury emissions from utility boilers - 46.3 megagrams  
Emissions factor (mg/kwh) - 0.016

As discussed in the Report, there was uncertainty as to the type of generation avoided by the installation of more efficient lighting. Given this uncertainty, the Agency elected to employ the aforementioned emissions factor, which includes non-coal generation.

**Comment No. 0031-31:** Section 2.2, p 2-9 Top Paragraph. Throughout the Report reference is made to "elemental, divalent and particulate emissions" of mercury. This is a rather unusual breakdown of mercury emissions since:

- Elemental mercury can be in vapor or liquid form. I suspect that the vapor form is referred to in this Report, whether derived from lamp gases or from flue gas emissions.

- Divalent mercury is mercury bound to other elements as compounds in a liquid, solid or gaseous state. I suspect that this Report refers primarily to: (a), divalent mercury present in the solid phosphor compounds that are used in the fluorescent lamps, and (b), mercury compounds in boiler flue gas emissions. Particulates in this case probably represent both elemental and divalent mercury forms, bound to other substances and forming small discrete particles.
- Particulates from combustion of coal in boilers will differ significantly from those emitted from the breaking of fluorescent lamp.

**Response:** EPA agrees that the Model simplifies the speciation of mercury in lamps for purposes of analysis. The Agency notes that, when developing the Model, the Agency encountered considerable uncertainty about the mercury speciation. For example, the Mercury Study: Report to Congress (Volume III, December 1997) provides that there remains "considerable uncertainty as to the actual speciation factors for each point source type (p. 4-4)." At the same time, the Agency believes that mercury vapor emissions are of primary concern in the management and disposal of lamps and thus decided to focus on the vapor emissions. Finally, the Model's speciation assumptions are consistent with available reports and studies on mercury emissions, which are available in the docket established for this action. However, the Agency will note in the final Report that limitations exist in the Model's speciation assumptions.

**Comment No. 0031-32:** P2-9, 2nd paragraph. In the sentence "Yet, lamp manufacturers and utilities have indicated that, for many parts of the country, the marginal demand for electricity during business hours would be satisfied by gas and oil units, not necessarily coal-fired units." The term "business hours" is not defined. In any event, the period of peak power demand is roughly from 2 PM to 7 PM, mostly on weekdays. I do not believe the period of peak power demand corresponds to "business hours" of 8 AM to 4 or 5 PM. Furthermore, in some commercial and industrial situations, lamps are operated around the clock or nearly, continuously.

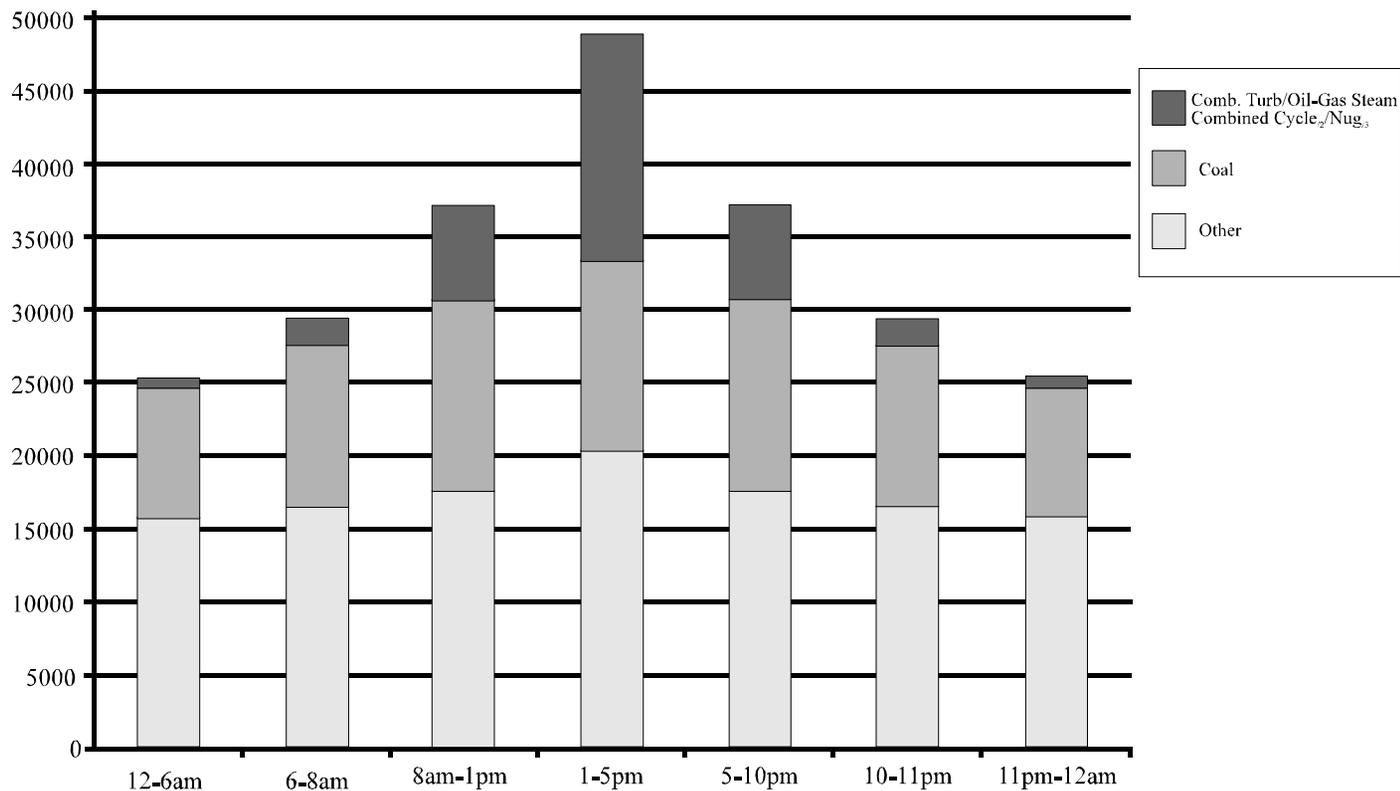
**Response:** The Agency agrees that in many types of facilities, lighting is operated continuously. The basic thrust of the discussion in the Report is that in many cases installation of energy efficient lighting will not result in reduced generation from coal fired units, but rather reduced generation from oil and gas fired units, which have very low mercury emissions. Thus, using the mercury emissions savings from utility boilers with 0.016 mg/ kwh (which includes all types of generation), the savings may be overestimated in many cases (i.e., the installation of energy efficient lighting results in reduced generation from gas-fired units)

In determining how to model this complex situation, consideration was given to alternative approaches, in particular linking a dynamic model of the U.S. generation system (e.g., the Integrated Planning Model - see <http://www.epa.gov/capi>) to the emissions Model. For a variety of reasons, it was decided that this was impractical and the approach described in the Report was employed in the Model. The net result, as illustrated in Figures 1 and 2, of using a single value of 0.016 mg/kwh, is that the mercury emissions savings are probably overestimated. Note that peak demand in the two exhibits occurs between 1 p.m. and 5 p.m., which falls within "business hours."

As shown in Figure 1, within the PJM NERC region, units are never marginal (i.e., reductions in load never result in energy reductions derived from the combustion of coal, unless the load reduction is sufficiently large to displace the combustion turbines, the oil/gas steam, and the dispatchable NUGs. As shown in Figure 2, current dispatch within ERCA is such that energy savings outside the 1-5 p.m. time frame do result in reduced generation from coal fired units, and hence reduced mercury emissions.

Given the complexity of the many factors involved (regional influences, time of day effects, future deregulation of the utility industry) the Agency elected not to employ a dynamic approach to estimate savings, but rather a simplified approach that provides reasonably equivalent results for purposes of the study.

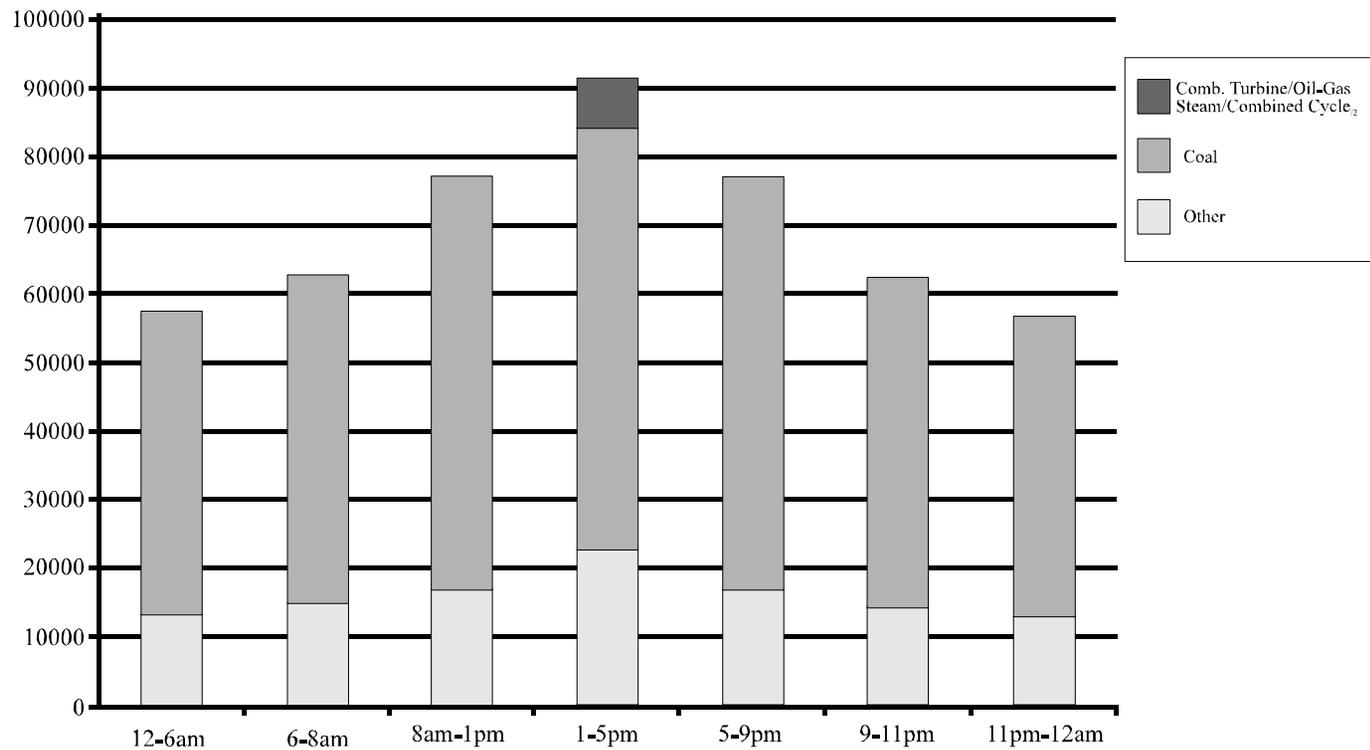
Figure 1: Illustrative PJM Summer Dispatch by Time of Day<sup>1</sup>



Footnotes:

1. Derived by ICF Resources from IPM ru. Represents illustrative typical summer daily dispatch pattern.
2. Utility owned.
3. Most dispatchable NUGs are combined cycle units.
4. Must Run includes non-dispatchable NUGs and fossil-steam units operating for area protection or minimum load reasons during off-peak periods.

Figure 2: Illustrative ECAR Summer Dispatch by Time of Day



Footnotes:

1. Derived by ICF Resources from IPM ru. Represents illustrative typical summer daily dispatch pattern.
2. Utility owned.
3. Most dispatchable NUGs are combined cycle units.
4. Must Run includes non-dispatchable NUGs and fossil-steam units operating for area protection or minimum load reasons during off-peak periods.

**Comment No. 0031-33:** Section 3.3, p 3-9. According to the conclusion, " Table 3-4 presents net mercury emissions over the baseline for the policy options." This table showed zero utility emissions savings for all options, and therefore was not meaningful.

**Response:** The Agency disagrees. One of the purposes of the Model was to estimate net mercury emissions. Table 3-4 fulfills this purpose by demonstrating the Agency's belief that no relationship exists between the use of energy efficient lighting and the policy options.

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**0032**            **Texas Utilities Services, Inc.**

**Comment No. 0032-1:** Texas Utilities disagrees with EPA's assumption that the policy option selected will not affect the rate of relamping. Maintaining mercury-containing lamps as hazardous waste will result in the continued forfeiture of emissions savings due to the reluctance of the regulated community to participate in Green Lights and similar energy-efficient relamping programs. While these programs result in significant reductions in mercury emissions, EPA should not overlook the extent to which the CE option could provide additional emissions reductions of fine particulates, carbon dioxide, sulfur dioxide and nitrogen oxide due to increased energy conservation and energy-efficiency.

EPA itself stated that, "regulating the disposal of lamp wastes as hazardous wastes under full Subtitle C requirements may discourage participation in energy-efficient lighting programs." 59 Fed. Reg. 38289. Over the course of the last several years, a growing number of individual electric utilities have either put off indefinitely their decision to join Green Lights or have greatly scaled back their participation because of the heavy economic burdens and operating problems of managing the replaced bulbs under RCRA's Subtitle C regime. As EPA itself acknowledged, "the additional costs associated with managing, transporting, and disposing of lighting wastes as hazardous wastes can create an additional disincentive to join Green Lights and make the initial investment in energy-efficient light technologies." Id. at 38290.

Texas Utilities believes the combination of handling, transporting, and disposal costs; paperwork; and the administrative burden involved with handling the lamps as hazardous waste has been a disincentive for participation in energy-efficient lighting programs.

**Response:** EPA disagrees that relamping rates will be affected by the policy option it adopts. See response to Comment No. 0002-1.

**0033 Minnesota Office of Environmental Assistance and Minnesota Office of Pollution Control**

**Comment No. 0033-1:** With respect to critical assumption A, recycling emissions rates, we believe that the Agency has made a serious and perhaps fatal error in relying on secondary sources rather than primary sources to estimate recycling emission rates. In “Management of Mercury in Lighting Products,” Begley and Linderson state that the emission rate from recycling is “...cautiously estimated at three percent of the processed mercury.”

The National Electrical Manufacturers Association (NEMA), General Electric (GE), and Osram Sylvania Inc. (OSI) have repeatedly used this figure to argue against recycling in comparison with Subtitle D landfilling. Specifically, GE (FLEA-S0005, pg. 7) and OSI (FLEA-S0014: pg. 2 of FLEA-S0014B; pg. 3-4 of FLEA-S0014C; and pg. 7 of FLEA-S0014C which references Tab C, Reference 6 of a larger packet submitted by OSI) refer to this emissions rate in their submittals to the EPA that are in the docket for this NODA. In the Final Report (pg. 2-19 and 2-20), EPA cites these submittals and accepts these secondary references as the basis of its “central” recycling emissions rate.

However, Mercury Recycling Technologies (MRT), the manufacturer of the equipment, estimates that its recycling emissions rate is an order of magnitude lower at 0.3 percent and has repeatedly communicated to NEMA, GE, and OSI that the three percent figure in Begley and Linderson is erroneous. We believe that this information has also been transmitted to EPA. To ensure that this is in the docket, we have enclosed a letter from MRT to the Coalition of Lamp Recyclers regarding this issue (Attachment A). We also enclose an MRT worksheet on recycling emissions provided to us by a recycler who uses MRT equipment (Attachment B), which estimates recycling facility releases of 0.1 percent release from crushing and distilling, 0.2 percent release from breakage (with 20 percent emissions upon breakage), and 0.7 percent remaining in residuals. We also dispute the accuracy of the three percent figure because footnote 59 in Begley and Linderson refers solely to a residential lamp recycling scheme utilizing crushers, known to have higher emissions than recycling schemes that maintain whole lamps. NEMA, GE, and OSI advocate the widespread use of crushers, so this high estimate is consistent with the type of lamp recycling system that they envision.

We also believe that the EPA has mischaracterized Florida's estimates/standards for mercury emissions from recycling. We understand that Florida will discuss this in detail in their comments. Based on our discussions with Florida, we understand the three percent figure to represent potential secondary emissions if glass residuals are heated sufficiently to drive off mercury that may be embedded in the glass. This does not represent current practice and can be

regulated. Compare, however, this three percent residual figure to MRT's estimated residual of 0.8 percent. This is a significant unresolved discrepancy. Tin coatings are now used in higher efficiency lamps and they will reduce the amount of mercury embedded in glass, increase mercury recovery, and decrease the mercury content of residuals. (pg. 3-4)

**Response:** EPA agrees that the Model's recycling emissions rates need to be revised. EPA has revisited Florida's emissions rates and modified the central and low emissions factors as appropriate. See response to Comment No. 0031-1.

**Comment No. 0033-2:** With respect to critical assumption B, emissions rates from Subtitle D landfills, we believe that there is virtually no data which can support any credible estimate. EPA has been considering lamp management options since 1991 and has known that credible data are needed. Yet EPA has done little or nothing to collect new and reliable data regarding the fate of mercury in Subtitle D landfills and has apparently concluded that emissions are insignificant in comparison to acute human health concentration standards, rather than in comparison to its chronic ambient water quality standard or an estimate of total emissions. The sole exception to this has been the use of data from Fresh Kills, which was collected incidental to this rulemaking and may not be adequate to answer the question. In comparison to EPA's 2.4 pounds estimated annual emissions from Fresh Kills, the State of New Jersey estimates total landfill emissions in that State range from 40 to 160 pounds per year. "Low" is a relative term and does not apply to mercury since it can and does reconcentrate in the environment. (pg. 5)

**Response:** EPA disagrees. The commenter should not interpret the Model as indicating the Agency's viewpoint about the significance of mercury emissions as a health risk. The Agency is well aware of the threats posed by mercury in the environment. The EPA recently published a Mercury Study Report to Congress (December 1997) that examines many of the health effects resulting from mercury exposure, including anthropogenic mercury. On the other hand, the purpose of the Model was not to assess health risks in relation to health-based standards, but to estimate the mercury emissions that might be produced under the policy options. Further, EPA acknowledges the shortage of reliable data on landfill emissions rates, but believes that a number of reliable data sources are available. These sources were used in developing the study (and are available in the docket). See response to Comment No. 0002-4 for additional discussion of the landfill emissions rates used.

**Comment No. 0033-3:** With respect to critical assumption C, emission rates from CE/Subtitle D breakage, we dispute the finding/assumption that breakage results in an emission rate of about 2.8 percent. NEMA, in a letter to EPA OSW (Richard Guimond and Sylvia Lawrence), dated June 18, 1993 (Attachment D), states on page 6 that “NEMA found that mercury vaporization rates from broken lamps were essentially flat after 40 days, and that 80 percent of the mercury remained in the lamp.” This is a 20 percent emission rate from broken lamps.

EPA's report “Management of Used Fluorescent Lamps: Preliminary Risk Assessment” (EPA 1993) develops two estimates for mercury release from lamp breakage in a Subtitle D scenario, 6.61 percent (pg. 159) and 8.37 percent (pg. 160). These estimates were developed from the “waste pile model” and the “open dumpster model.” It is noted that the release rates estimated with these models are highly dependent on external convection currents (wind or truck movement). The models were run with temperature bounds of 15° to 25°C (59° to 77°F), and of course, emissions could be significantly higher at higher temperatures often seen within landfills and in the summer in the north and year-round in the south.

MOEA and MPCA have rerun the Electronic Emissions Model with CE/Subdivision D transport emission rates of six percent and 20 percent over a range of recycling emissions rates, and emissions under the “Base Case” and “CE” scenarios are extremely sensitive to these rate changes. These rates also significantly affect emissions under the various UW scenarios which include a significant portion of lamps managed under Subtitle D. These rates can also be used as a proxy for higher Subtitle D landfill emission rates, which are not well understood but have certainly been measured. Table 4 shows the results of these runs. (pg. 5-6)

**Response:** EPA is aware of the NEMA letter dated June 18, 1993. EPA notes that the emissions data in the letter do not coincide with the NEMA Report used in developing the Model. The Agency used the data in the NEMA report since that report provides a greater level of detail on the relevant data obtained. Further, EPA agrees that, depending on wind, temperature and other conditions, actual mercury emissions from lamp transport could differ from the estimates in the Model. The Agency has attempted to include in the Report as much information on the emissions factors for each management activity as reasonably practicable. For each activity, the Report discusses the data source and primary assumptions, limitations, and calculations used to derive emissions factors. The Agency believes the current level of detail is sufficient to clarify the Agency's approach to deriving emissions factors. In addition, interested parties can visit the EPA RCRA docket to obtain further information on the data sources used.

**Comment No. 0033-4:** CE supporters have argued that lamps contain less mercury than they prevent in coal plant mercury emissions through efficiency gain; this Model was developed in part to address those allegations and concludes that coal power plant mercury emissions are independent of the regulatory scenario. The June 18, 1993 NEMA letter to EPA referenced above discusses this issue. The MOEA, under its former name, the Minnesota Office of Waste Management (MOWM), responded to that argument (and others raised by NEMA) and presented an analysis of the issue. The analysis concludes that, under real world conditions, using fluorescent lamps and not recycling them will release more mercury to the environment than using incandescent. This letter and its attached analysis from the MPCA, sent to the EPA on September 17, 1993, are included in these comments (Attachment E). (pg. 6)

**Response:** EPA thanks the commenter for the information on incandescent lamps. EPA agrees that lamps recycling can be beneficial at reclamation facilities that operate in compliance with applicable regulations. EPA believes that the UW option would encourage lamp generators to recycle their lamps, minimizing the amount of mercury sent to landfills. Note that analysis of incandescent lamps is outside the scope of the study.

**Comment No. 0033-5:** With respect to critical assumptions D and E, EPA has run the Model with certain assumptions about “Base Case” lamp management and the fate of lamps under the various predictive scenarios. Like other commenters, we believe that the recycling rate assumption of 3.2 percent is understated in the “Base Case” scenario. The lamp recyclers ‘comments to the docket on this issue’ will provide a more realistic number and rate. EPA has estimated only four percent recycling under the CE scenario, which we believe are already exceeding. Others may comment on this.

Further, in the UW Model, EPA has assumed a rather high proportion of lamps would be sent to Subtitle C landfills, 28 percent of lamps handled as UW and 22.4 percent of total lamps. This is significantly higher than the base case estimate of 16.8 percent of lamps sent to Subtitle C landfills. We believe that the proportion of lamps sent to Subtitle C landfills under the UW option is simply far too high. Minnesota has documented that characterization and Subtitle C disposal is much more expensive than UW recycling. Even GE, in its comments on this issue, has correctly pointed out (pg. 7) that recycling is significantly less expensive than Subtitle C landfilling. Virtually no lamps generated in Minnesota are sent to Subtitle C landfills.

**Response:** EPA agrees with the first comment and has revised the recycling rate under the baseline to ten percent. EPA believes such a rate is more accurate in light of the comments provided. EPA also agrees with the second comment and has revised the Model’s disposal trees to partition CESQG and non-CESQG lamps. The result is that far fewer lamps are estimated to be disposed in Subtitle C landfills under the UW option.

**Comment No. 0033-6:** We question EPA's use of building size categories and square footage to estimate quantities of bulbs and their regulatory status. It is not clear whether this method captures all commercial, institution, industrial, and government building uses. Moreover, it does not account at all for single ownership of multiple buildings, where single ownership will likely put those lamps into SQG/LQG status rather than the CESQG status that might be inferred from building size alone. (pg. 9)

**Response:** First, EPA agrees that the Model estimates mercury emissions only for lamps used to light commercial floorspace. This limitation is stated in the Report. Nonetheless, EPA finds that the Model's results could be extended to other types of floor space, such as industrial. Industrial generators of lamps face the same regulatory requirements for lamp waste management and disposal as commercial generators. Second, EPA acknowledges that the approach taken to predict the regulatory status of lamps does not take into account single ownership of multiple buildings. Nonetheless, the Agency finds that the Model's estimates adequately approximate the relative percentages of regulated and exempt lamps and has decided not to revise its approach.

**Comment No. 0033-7:** Minnesota questions the assertions of the industry that they have dramatically reduced the mercury content of the average lamp. The latest USGS industrial consumption figures for mercury show the lighting industry reporting 1996 consumption of 29 metric tons. This is unchanged since 1994. Prior to 1993, annual consumption by the lighting industry rose steadily from about 24 metric tons in the early 70's to about 47 metric tons in 1989. Annual purchases fluctuated significantly between 30 and 50 metric tons from 1989 to 1993. (pg. 9)

**Response:** EPA is unaware of all of the reasons for the increase in mercury consumption over the years, but suggests that there may be many reasons (e.g., increase in the number of lamps sold). Information on mercury content of lamps in the Model was obtained from a number of lamp manufacturers. EPA reviewed the data obtained and accepts their validity.

**Comment No. 0033-8:** Even if mercury levels are low in current production, we believe it can also be safely presumed that there are large quantities of high mercury lamps that have not yet been discarded. With annual lamp production in the 500 to 600 million range and a life of 4 to 6 years, there could be 2-3 billion high mercury lamps in circulation that will require environmentally sound disposal. Bearing this out, a "Lamp Issue Briefing" prepared by GE for EPA, dated February 13, 1996, notes that there are 2 billion 4-foot fluorescent lamps in service with an average mercury content of 23 mg, and that "at least a decade is needed to fully replace installed base." This briefing paper also notes that there are an additional 800 million lamps (40

percent) in the installed base. Also in this briefing paper, GE recommends adoption of "Exclusion with Best Management Practices, expiring 2001." Under such a system, most of these high mercury lamps in the installed base would be discarded in Subtitle D facilities before the issue is revisited. (pg. 9-10)

**Response:** EPA met with GE on July 31, 1996, and received a follow-up letter dated August 20, 1996, that summarized information on, among other things, annual lamp sales and disposal rates, number of lamps in the "installed base," and lamp mercury content. EPA considered this information, along with information from other manufacturers, when developing the Model.

EPA agrees with GE that a large installed base exists. In the Model, the Agency developed an "installed base" during the period 1992 to 1997, i.e., the Model uses this period to estimate the annual number of lamps disposed of leading up to the modeling period of 1998 to 2007. In 1997, the Model assumes that about 731 million lamps were disposed of. Given GE's assumption about lamp life (i.e., 4 to 6 years), one could assume that the Model's "installed base" in 1997 is equivalent to the 2 to 3 billion lamps in the installed base estimated by GE.

Further, as discussed on page 2-4 of the Mercury Report, the Model assumes that lamp mercury content for T8s before 1996 was 30 mg/lamp and 30 mg/lamp for T12s between 1992 and 1996. The Model further assumes that mercury content in manufactured lamps will decrease in subsequent years for both T12s and T8s. As such, the Model assumes that lamps in the "installed base" have a mercury content that exceeds the GE estimate of 23 mg/lamp.

**Comment No. 0033-9:** We do agree with GE's claim that there are simpler ways to calculate or estimate the quantity of lamps removed from service, disposed of, and recycled, though we do not agree with GE's assertion that EPA has overestimated the number of waste lamps by 60 percent. Based on industry data we have received, and the industry's failure to dispute other published data, we believe the data in Table 2-5 is off by no more than 10 percent and is some of the better data in this Report. One must also keep in mind that 4 foot lamps represent about 75 percent of the fluorescent market, the other 25 percent continue to be made and discarded with higher mercury content. Nor do any of these figures include HID lamps, which contain more mercury per lamp. If HID lamps represent 20 percent of total production, then there may be 700 million of these in the installed base. (pg. 11)

**Response:** The EPA agrees that, because the Model does not include all lamp types potentially subject to the rule, it does not provide a comprehensive estimate of all potential lamp mercury emissions. The purpose of the Model is to estimate mercury emissions from the management and disposal of 4-foot fluorescent lamps. EPA acknowledges that there are many ways to estimate the number of lamps entering the waste management system.

**Comment No. 0033-10:** We disagree with the emissions rates for recycling and for CE/Sub. D transport. We also believe the landfill emissions data collected to date on mercury are not sufficient to support any conclusions about landfill emissions. We have rerun a number of scenarios with different rates. We also ran the “Baseline 100 percent Subtitle C compliance” scenario and the “UW Gradual-100 percent compliance” scenario because we believed that these should be the benchmark scenarios for environmental protection. The results of these scenarios were not presented or discussed in the EPA Report. This is rather peculiar since EPA concluded and stated very clearly in the “Preliminary Risk Assessment” (EPA 1993) that lamps are hazardous waste.

The results of these runs, and their comparisons to EPA's runs, can be found in the attached tables. In Table 3, showing lower recycling rates, changing the central emission rate to the more realistic levels of 0.3 percent and one percent has a dramatic effect on the scenarios with high recycling, and has virtually no effect on the “Base Case” and “CE” scenarios. For example, emissions under the “UW-Gradual 100 percent compliance” are cut 70 percent and 52 percent respectively with these central emission rates. Emissions are cut 50 percent and 40 percent for “UW-Rapid.” For “Baseline 100” and the two other UW scenarios, estimated emissions drop 22 percent to 35 percent with these rates. These changes are dramatic, and demonstrate how sensitive these scenarios are to assumptions about recycling emissions.

Table 4 shows the same scenarios run with CE/Sub. D transport emission rates set at six percent and 20 percent, and the full range of recycling emissions rates shown above. The results are equally dramatic here. The “Base Case” scenario shows about 1.5 to 3.5 times more emissions and the “CE” scenario shows 1.6 to 4.3 times more emissions than the EPA runs. The “Baseline 100 Sub. C” and “UW-Gradual 100” scenarios are not affected by the higher transport emission rates. UW-Gradual, UW-Moderate, and UW-Rapid, show a range of results, as these scenarios are affected by both sets of rates. UW-Gradual is the worst, showing 1.1 to 2.9 times as much mercury emissions. UW-Moderate is slightly better, and UW-Rapid shows a range of 0.64 to 1.9 times as much emissions. These results demonstrate how sensitive all of the “real world” scenarios are to these breakage emission rates. Industry's estimates for breakage upon release are continually changing and we believe their claims are unrealistically low for the real world of MSW disposal.

**Response:** EPA agrees that some uncertainty exists in its emissions estimates for recycling, landfilling, and CE transport. However, the Agency believes that these estimates are based on the best available and most reliable data, e.g., specially prepared studies and feedback from lamp waste handlers. Note also that the Model is designed so that users can input their own data and rerun scenarios if they disagree with the Model's estimates.

In addition, the Agency disagrees that 100 percent compliance under the base case or UW option need be analyzed in the Report, since such a compliance rate appears to be unrealistic. Feedback from States and lamp waste handlers indicates that a large portion of lamp generators are unaware of applicable rules or seem to be purposely in violation. EPA expects that the UW standards might increase compliance, but not to 100 percent.

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#### **0034 Florida Department of Environmental Protection**

**Comment No. 0034-1:** We have serious concerns about the EPA's assumption that only 0.2 percent of the lamp's total mercury will be in the vapor phase. If the lamp being discarded is only a year or two old, then the elemental portion of the mercury in the lamp may far exceed the divalent portion incorporated into the powder. Since many companies are on a two-year relamping schedule, this assumption could lead to serious underestimates of mercury emissions from these newer lamps under the CE option.

**Response:** EPA disagrees. The Agency agrees that lamps discarded as part of a group relamping program may have higher fractions of vapor phase mercury and that this could lead to comparably higher transportation emissions, in particular under the CE option. The Agency does not believe, however, that this represents a serious limitation of the Model. The vast majority (75%) of lamps are discarded during spot relamping and have reached the end of lamp life.

**Comment No. 0034-2:** The DEP believes that a properly operating recycling facility in compliance with Florida Rule 62-737 may have a baseline recovery rate of approximately 98.5 percent of the mercury contained in a lamp. Additionally, secondary emissions of one percent or less may be obtained by facilities which consistently maintain an average residual mercury content on recovered glass at 1.0 ppm and/or which ship its recovered glass to facilities which process the glass using non-thermal methods, including Subtitle D landfilling. Lastly, primary emissions at properly operating recycling facilities should be negligible.

**Response:** EPA agrees that revision was needed. The EPA used information submitted by Florida DEP on this subject to revise the Model's recycling emissions rates and to respond to Comment No. 0031-1.

**Comment No. 0034-3:** The EPA has assumed that mercury emissions from the stabilization process would be zero, but bases this on a total lack of information. In its earlier analysis of drum-top crushing, however, significant mercury emissions were assumed even though this equipment had carbon filters to absorb mercury emissions.

**Response:** The Model assumed that any intact lamps arriving at a Subtitle C landfill would be crushed in the stabilization process, and 100 percent of the elemental mercury would be emitted at that point. This is higher than the drum-top crushing emissions rates cited by the commenter. However, as noted above, there is uncertainty if other types of emissions are associated with the stabilization process.

**Comment No. 0034-4:** As indicated by EPA and concluded from field investigations conducted by DEP, drum top crushers can produce emissions when not in operation, from feed systems, and leaks. Generators that operate drum top crushers may store waste in containers for a period of 90 days or more. Longer periods of storage in drum top crushers may also be observed where generators operate these devices as treatment in drums.

**Response:** The Agency agrees that drum top crushers can produce emissions when not in operation, and also has observed long storage periods associated with at least one crushing operation.

**Comment No. 0034-5:** Florida provides a mass balance to estimate emissions from broken lamps during transportation. The conclusion is that transportation emissions may range from about seven percent to about 86 percent. Florida DEP states that fielded measurements should be the preferred means for determining the emissions factors.

**Response:** EPA agrees that the Florida data provides a range of emissions estimates. The mass balance approach employed by Florida first uses recent test data to estimate mercury emissions from landfills, in conjunction with the leachate concentrations provided by RTI. It is concluded that these releases are small (less than one percent). Landfill mining studies are used to determine the amount of sequestered mercury, and it is concluded that sequestered mercury is about 90 percent of the mercury mass. The conclusion is that nine percent of the mercury is unaccounted for. If the total mass of that mercury is ascribed to lamps broken in transport, the transport emissions rate is slightly in excess of 86 percent. In a second case, Florida assumes that some of the missing mass is attributable to thermometers. Using this case, Florida calculates emissions from broken lamps at seven percent.

We note that this calculation depends upon knowing the mass of mercury from various sources (batteries, lighting, etc.) with a reasonable degree of precision, which is unlikely to be the case. Regardless of the precision issue, attributing all of the missing mass to lamps does not appear to be reasonable. Therefore, the Agency discounted the 86 percent estimate. The seven percent calculation is approximately the value of the high estimate used in the emissions Model.

**Comment No. 0034-6:** The nine percent "transportation emissions" estimate by difference from the mass balance exercise above suggests that the emissions range for lamps broken during transport to Subtitle D landfills reported in the EPA Final Report may be underestimated by as much as a factor of 80. The DEP has estimated the amount of mercury in Florida MSW discarded in 1995 by product category source (Figure 2). These estimates account for any recycling of a product category: recycled quantities are deducted from the discards since they are not discarded into Florida MSW. For example, the 1.11 tons of mercury from Electric Lighting does not include mercury-containing lamps which were recycled in Florida during 1995. Roughly 20 percent of mercury-containing lamps which were discarded in Florida during 1995 were recycled.

**Response:** EPA disagrees. The Agency, in reviewing the heavy dependence upon mass balances — in particular the assumption that landfill emissions and landfilled quantities — understands the limitations of such an analysis. The Agency notes the commenter's argument, but continues to believe that emissions rates due to breakage during transportation are lower than those derived by the commenter. This view is supported by other reports obtained, such as those from NEMA and Tetra Tech. These documents are available in the docket established for this action.

**Comment No. 0034-7:** On page 2-16 of the EPA Final Report, a statement about intact lamps found at a Florida municipal waste combustor contained minor errors. The intact lamps were found in waste loads dumped on the tipping floor for inspection, not "on the pit" as reported in the Report. These data were from the DEP "Waste Cleaning and Mercury-Containing Lamp and Device Demonstration Project" conducted in the Hillsborough County and Tampa, Florida area between June 1994 and May 1996, as related to EPA staff via DEP memorandum dated October 1, 1996 not from the documents referenced in Footnote 17 on page 2-16.

**Response:** EPA agrees. The Report has been revised to address the comment about the tipping floor.

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**0035 Environmental Light Recyclers**

**Comment No. 0035-1:** Section 1, pg. 1, paragraph 1, sentence 3: This statement is no longer accurate. The lamp recycling industry, lamp manufacturing industry, and State and Federal environmental protection and enforcement agencies are very active in getting the information to concerned parties describing the hazardous nature of mercury-containing lamps.

**Response:** EPA disagrees. Based on conversations with States, lamp generators and contractors, the Agency believes that many generators are unaware that their mercury-containing lamps may be subject to regulation as a hazardous waste. Therefore, the Agency has decided against revising the Report's statement.

**Comment No. 0035-2:** Section 1, pg. 1-1, subparagraph 4: I can find no evidence to indicate that lighting retro-fit projects have been postponed or not undertaken because of strict enforcement or the imposition of State laws banning the landfill disposal of lamps. Before policy decisions are made which may change the status of mercury-containing lamps to conditionally exempt, States which may change the status of mercury-containing lamps to conditionally exempt and States which have stringent laws and rules enforcement policies should be consulted regarding their observations on this point and their findings seriously considered and published. As stated in this Report, EPA can find no basis within the contention that tighter regulation and additional monetary concerns will slow private and public sector conversion to more energy efficient lighting systems. To the contrary, private sector conversion is and will continue to be driven by "costs of doing business" concerns and public sector conversion will be driven by the availability of resources allocated by legislative action for facilities improvements and renovations.

**Response:** EPA agrees. See response to Comment No. 0002-1.

**Comment No. 0035-3:** Section 1, pg. 1-3, subparagraph 4, bullet 3: The assumption of a four-year lamp service life is questionable. As the mercury level in each lamp is reduced, there is a point at which lamp performance for both light output and longevity are significantly degraded.

**Response:** EPA disagrees. Based on conversations with lamp manufacturers, the Agency believes that a four-year lifespan is representative of most lamps in use.

**Comment No. 0035-4:** Pg. 2-2, Section 2, paragraph 2.1.2.2: Very few building owners move or eliminate light fixtures during retro-fit projects unless they are replacing old fixtures with new ones. Delamping rates should be adjusted as required to reflect a closer to one-for-one T-12 to T-8 conversion ratio.

**Response:** EPA disagrees. Based on conversations with Green Lights staff, the Agency believes that the Model's delamping rate of 0.85 is accurate and can be applied generally.

**Comment No. 0035-5:** Pg. 2-3, Section 2, paragraph 2.1.2.4: 40 Code of Federal Regulations classifies mercury (D009) as a toxic hazard regardless of species. Why, for the purposes of this Model and Report, is the Agency attempting to “split hairs” and redefine the toxic characteristic definition of mercury?

**Response:** The Mercury Study, Report to Congress indicates that mercury deposition rates vary among species of mercury. Thus, the Agency decided to examine lamp mercury emissions by species. This decision has no bearing on the definition of toxicity characteristic.

**Comment No. 0035-6:** This Report and Model have apparently missed an important secondary energy savings potential and, as an added benefit, an additional opportunity to reduce utility boiler mercury and other emissions - the energy saved through reuse of the glass, aluminum and mercury generated by recycling all waste fluorescent lamps.

**Response:** EPA agrees about the many uses of the outputs of lamp recycling; however, such uses are outside the scope of the Model.

**Comment No. 0035-7:** The Report authors' conclusion that Subtitle C and Subtitle D interment of lamps “would account for minimal lamp mercury emissions” is essentially correct; however, it can also be concluded from this line of logic that mercury scrubbers and other emission control devices required on municipal waste combustors, industrial and utility boiler smokestacks, and other such emission sources are not required if all detrimental emissions are allowed to leak into the atmosphere prior to the exhaust stream reaching the scrubbers.

**Response:** The Agency disagrees. The draft Model indicates that landfilling accounts for a relatively small percentage of total mercury emissions (e.g., Subtitle C landfilling accounts for about 0.8 percent of cumulative mercury emissions under the base case's central estimates). On the other hand, the draft Model indicates that MWCs are one of the primary sources of lamp mercury emissions under the base case and policy options (e.g., MWCs account for about 35% of cumulative mercury emissions under the base case's central estimates). The Agency believes the Report's conclusions on landfills are consistent with these findings.