OFFICE OF INSPECTOR GENERAL

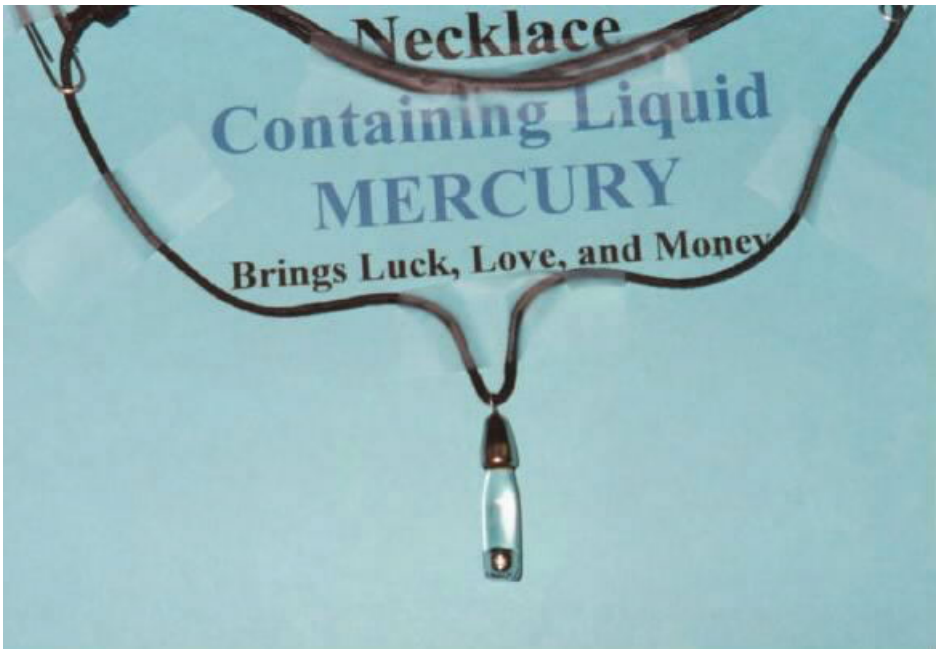
Catalyst for Improving the Environment

Public Liaison Report

EPA Is Properly Addressing the Risks of Using Mercury in Rituals

Report No. 2006-P-00031

August 31, 2006



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Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
EPA	U.S. Environmental Protection Agency
OIG	Office of Inspector General
TSCA	Toxic Substances Control Act

Cover Photo: A necklace containing liquid mercury in the pendant. Photo courtesy of EPA's January 2005 report, *Ritualistic Use of Mercury Simulation: A Preliminary Investigation of Metallic Mercury Vapor Fate and Transport in a Trailer*.

U.S. Environmental Protection Agency
Office of Inspector General

2006-P-00031
August 31, 2006

At a Glance

Catalyst for Improving the Environment

Why We Did This Review

In February 2005, a representative of the Mercury Poisoning Project, a private organization that provides the public with information on the dangers of being exposed to mercury, identified concerns related to the ritual use of mercury. He asked the U.S. Environmental Protection Agency (EPA) Office of Inspector General to evaluate EPA actions to address the problem. The representative also asked us to look into whether EPA had falsified the results of a study to measure mercury vapors, or had deliberately designed the study to fail.

Background

Some people use mercury as part of folk remedies and religious practices to: attract luck, love, or money; protect against evil; or speed the action of spells. These uses may pose health risks because mercury vapors can cause health problems, such as damage to the nervous system.

For further information, contact our Office of Congressional and Public Liaison at (202) 566-2391.

To view the full report, click on the following link:
www.epa.gov/oig/reports/2006/20060831-2006-P-00031.pdf

EPA Is Properly Addressing the Risks of Using Mercury in Rituals

What We Found

EPA staff and the Mercury Poisoning Project representative agree that the ritual use of mercury poses a health risk. Those who use mercury in folk remedies and religious practices, as well as others who live in buildings where such rituals are performed, may be exposed to mercury vapors. However, EPA and the representative differ in how EPA should address the risks. The representative believes EPA's actions are insufficient and wants EPA to:

- regulate the use of mercury; and
- be prepared to address what he believes are many homes throughout the United States that are contaminated by the ritual use of mercury.

On the other hand, EPA staff:

- believe that EPA regulations are not warranted at this time, and starting the process to establish such regulations would drive the practice underground; and
- have addressed the issue by providing community education and outreach, sponsoring research and environmental monitoring, and purchasing 63 portable mercury analyzers for measuring mercury levels.

We agree with EPA's assessment about regulating the ritual use of mercury, and believe the actions taken by EPA are consistent with current legal requirements.

In 2002 and 2003, EPA performed a study measuring the levels of mercury vapors from "spills" of differing amounts of mercury. One experiment simulated the ritual use of mercury. According to the representative, if the experiments had been performed differently, the results may have been more realistic. However, the report details the experiments as they were performed, and identifies the related assumptions. We found no evidence that the study was inadequately designed or the results falsified.

Although we are not recommending additional actions by EPA, we are reporting the results of our work to further emphasize that the ritual use of mercury poses a health risk.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
INSPECTOR GENERAL

August 31, 2006

MEMORANDUM

SUBJECT: EPA Is Properly Addressing the Risks of Using Mercury in Rituals
Report No. 2006-P-00031

TO: Susan Parker Bodine
Assistant Administrator for Solid Waste and Emergency Response

This is our report on the subject review conducted by the Office of Inspector General (OIG) of the U.S. Environmental Protection Agency (EPA). It describes efforts by EPA to address the risks of using mercury in folk remedies and religious practices, i.e., ritual uses. This report represents the opinion of the OIG.

On June 28, 2006, we issued a draft of this report for review and comment. You generally agreed with our conclusions, and suggested some changes to clarify and correct information in the report. We made revisions based on your comments as we determined appropriate.

The estimated cost of this report – calculated by multiplying the project's staff days by the applicable daily full cost billing rates in effect at the time – is $62,274.

Action Required

Because this report contains no recommendations, you are not required to provide a written response; we are closing this report upon issuance. We have no objection to the further release of this report to the public. For your convenience, this report will be available at http://www.epa.gov/oig.

If you or your staff have any questions regarding this report, please contact me at 202-566-0847 or roderick.bill@epa.gov, or Paul McKechnie, Product Line Director for Public Liaison, at 617-918-1471 or mckechnie.paul@epa.gov.

Bill A. Roderick
Acting Inspector General

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Chapter 1
Introduction

Purpose

In February 2005, a representative of the Mercury Poisoning Project (the representative) asked the U.S. Environmental Protection Agency (EPA) Office of Inspector General (OIG) to address concerns about the ritual use of mercury. The Mercury Poisoning Project is a private organization that provides the public with information on the dangers of being exposed to mercury. The representative said there was widespread mercury contamination in Latino and Caribbean homes in the United States as a result of rituals. Because of this belief by the representative, he wanted the OIG to determine whether EPA had adequately investigated whether such contamination poses an environmental health threat and, if so, had EPA substantively acted to address its dangers. Regarding a study EPA performed simulating the ritual use of mercury in a trailer, the representative alleged that EPA had falsified the study results, or had deliberately designed the study to fail.

Background

Mercury, in its liquid metal form, is used in some folk remedies and religious practices. Certain Latino and Afro-Caribbean traditions, including Santeria, Palo, Voodoo, and Espiritismo, use mercury to: attract luck, love, or money; protect against evil; or speed the action of spells. This is done through a variety of uses, including wearing in amulets, sprinkling on the floor, or adding to a candle or oil lamp. In addition, some people add it to detergent or cosmetic products. Mercury can be obtained from religious supply stores known as botanicas.

Inhaling mercury vapors is hazardous to human health. At high exposures, through inhalation, mercury vapors can produce severe lung, gastrointestinal, and nervous system damage. Using mercury in cultural and religious practices (i.e., ritual uses) can expose people to mercury vapors. At room temperature, uncontained mercury can evaporate and become an invisible, odorless toxic vapor. At higher temperatures, these concentrations increase. Very small amounts of mercury (even a few drops) can raise air concentrations of mercury to harmful levels, particularly in poorly ventilated spaces. The longer people breathe the contaminated air, the greater the risk to their health.

EPA staff have been aware of dangers from the ritual use of mercury for over a decade. In 1993, EPA issued *RM2 Assessment Document for Cultural Uses of Mercury*, which identified concerns about the ritual use of mercury. At that time, EPA considered regulating such use under the Toxic Substances Control Act

(TSCA). Instead, EPA chose to implement a public education campaign that the three national Hispanic organizations they consulted had encouraged. The danger posed by the ritual use of mercury was recognized again in December 1997, when EPA released an eight-volume *Mercury Study Report to Congress*. Volume 3 of this study identified mercury used in some ritualistic practices as a miscellaneous source of mercury exposure.

Scope and Methodology

We performed this review in accordance with *Government Auditing Standards*, issued by the Comptroller General of the United States, except that we limited our review of management controls and compliance to those directly relating to the issues identified by the representative.

We performed our work from September 2005 through April 2006. As part of our work, we interviewed EPA employees from the Office of Solid Waste and Emergency Response and the Office of Prevention, Pesticides, and Toxic Substances. In addition, we reviewed a variety of documents provided by the representative, EPA staff members, and others. We also reviewed documents obtained through the Internet, particularly the Websites of EPA, the Centers for Disease Control and Prevention, and the Agency for Toxic Substances and Disease Registry (ATSDR).

On June 28, 2006, the OIG issued a draft report to the EPA Assistant Administrator for Solid Waste and Emergency Response for review and comment. The Assistant Administrator responded on August 4, 2006. She agreed with the conclusions presented, and offered comments to clarify and correct information in the report. We include the Assistant Administrator's memorandum in Appendix A. As appropriate, we revised the report based on these comments, as well as less formal comments provided by staff from the Office of Prevention, Pesticides, and Toxic Substances.

Although we are not recommending additional actions by EPA, we are reporting the results of our work to further emphasize that the ritual use of mercury poses a health risk.

Chapter 2
EPA Is Addressing Health Risks Posed by Ritual Use of Mercury

EPA staff agree with the representative that vapors from the ritual use of mercury are dangerous to people, and the vapors continue to be emitted for some time. However, while regulating such use might be possible under an existing law, EPA staff do not agree with the representative that regulations would be appropriate. This is primarily because EPA staff believe starting the process to establish such regulations would drive the practice underground. EPA is instead taking other actions to address the risks, including community education and outreach, research and environmental monitoring, and responding to mercury releases.

Few Legal Requirements Specifically Relate to Ritual Use of Mercury

The Federal Government regulates mercury in a variety of ways, but these requirements do not directly address the ritualistic use of mercury. Mercury is designated as a hazardous air pollutant under the Clean Air Act and a pollutant under the Clean Water Act, and has a safe drinking water standard under the Safe Drinking Water Act. Mercury is also regulated by the Occupational Safety and Health Administration, which established a limit in the workplace of no more than 0.1 milligrams of mercury per cubic meter of air as an 8-hour weighted average. Although the Agency for Toxic Substances and Disease Registry has proposed residential mercury limits, no one has established similar limits for residential air. Further, with the exception of radon, EPA does not have clear statutory authority under the Clean Air Act to regulate indoor residential air.

Mercury is designated a hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act, with a reportable quantity of one pound. Under this Act, a spill or release of a hazardous substance may be cleaned up to protect the public health or welfare, or the environment. Thus, EPA can take actions to clean up a spill or release of mercury. EPA has responded to a number of such incidences, and has guides on what to do in these situations. General cleanup instructions are also available to the public on EPA's Website at http://www.epa.gov/epaoswer/hazwaste/mercury/faq/spills.htm.

The Consumer Product Safety Commission has the authority under the Federal Hazardous Substance Act to require precautionary labeling for products containing mercury. Through enforcement letters, the Consumer Product Safety Commission has taken action against major suppliers of mercury to botanicas and botanica wholesalers. The large number of small distributors makes further enforcement activities resource-intensive.

A current law under which EPA might be able to regulate the ritual use of mercury is TSCA. TSCA provides that chemical substances and mixtures that present an unreasonable risk of injury to health or the environment may be regulated. Since TSCA included elemental substances in its definition of a chemical substance, mercury would be covered under the law and thus could be regulated.

Under section 6 of TSCA, when chemical substances present an unreasonable risk of injury to health or the environment, the EPA Administrator may issue regulations to: prohibit or limit activities that use the substance, limit how much may be used, require warnings or instructions, require records, establish requirements for disposal of the substance, or require notices about the risks posed and information about replacing or repurchasing the substance. Before promulgating regulations, the Administrator must consider the effects, benefits, and economic consequences, and select the least burdensome restriction(s) that adequately protect against the risk. TSCA section 6 requires a high standard of support, including a risk assessment.

EPA Staff Believe Regulatory Action Is Not Warranted

Little of the information needed for a risk analysis of the ritual use of mercury is available. Studies have confirmed that mercury is used for rituals in the home, and there are elevated levels of mercury in some buildings. Also, the New York/New Jersey harbor is believed to be contaminated by mercury, in part, because of ritual uses; however, the extent to which ritual uses contributed to this contamination could not be determined. One study found 5 of 100 children had elevated levels of mercury, while none of 347 children in another study had elevated levels. None of these studies were national in scope. In addition, no studies have directly connected elevated mercury levels in a person (or related adverse health effects) to the ritual use of mercury.

For several reasons, EPA Staff believe regulating the ritual use of mercury would not be appropriate:

> **It would drive the practice underground.** One of the most important reasons is their belief that taking actions to start the regulatory process will drive the sale of mercury underground. EPA drew this conclusion in its 1993 assessment document. The same conclusion was reached in a 2001 article in Environmental Health Perspectives.[1] The authors of this article reported that a member of their team was able to buy mercury at botanicas where botanica employees had previously told other team members they did not sell mercury. From this, the team concluded that the stricter the enforcement actions, the further underground mercury sales and use will

[1] *Assessing Elemental Mercury Vapor Exposure from Cultural and Religious Practices*, Environmental Health Perspectives, Volume 109, Number 8, August 2001, pages 779-784, Donna M. Riley, et al.

go. Similar sentiments were expressed to the EPA-sponsored Task Force on Ritualistic Uses of Mercury, and in two other recent reports.[2]

It might violate the Constitution. Because some of the rituals are associated with religious practices, restricting the use of mercury might be challenged as a violation of the First Amendment.

It can be addressed by local authorities. EPA believes the ritual use of mercury is not a national problem, but is localized, making action under TSCA more difficult.

The United Nations is addressing mercury on a world-wide level. The United Nations has begun a program to reduce the use of mercury, which may decrease the ritual use of mercury in the United States. The United Nations program has several components, including conducting studies on the amount of mercury being traded and supplied worldwide, and improving the communication of the risks of mercury to vulnerable groups.

EPA Has Taken Actions

EPA has taken multiple actions to address the ritual use of mercury. In January 1999, EPA's Office of Emergency and Remedial Response convened a multi-agency Task Force on Ritualistic Uses of Mercury to recommend an appropriate course of action. In forming the multi-agency task force, EPA hoped to gain a better understanding of these practices and traditions, and their potential public health and environmental impacts. In December 2002, EPA issued the *Task Force on Ritualistic Uses of Mercury Report* (2002 Task Force Report).[3] This report recommended that EPA provide community outreach and education; assist with research and environmental monitoring, including providing guidance on instruments that measure mercury; and continue responding to mercury releases. EPA is doing these things; details follow.

Education and Outreach

EPA has actively pursued greater community education and outreach. In 1994, EPA published the "Information Fact Sheet: Hazards to Consumers Using Metallic Mercury in the Home Environment," providing examples of unsafe household use related to rituals. In April 2004, EPA published a pamphlet, "Protect your Family from Mercury in your Home." This pamphlet noted that if mercury is used in a folk remedy or spiritual practice, and "If you store or use mercury, it is best to do it outside. If you must have it inside, keep it in

[2] *HIDDEN DANGER - Environmental Health Threats in the Latino Community*, October 2002, Natural Resources Defense Council; and *Cultural Uses of Mercury Program*, February 2005, National Association of City and County Health Officials.
[3] OSWER 9285.4-07, EPA/540-R-01-005, at http://www.epa.gov/superfund/action/community/mercury.pdf.

unbreakable, disposable containers. Never put it on the floor, furniture, or carpet." Such a pamphlet was recommended by the 2002 Task Force Report. EPA is also preparing a video for use in schools. The reports referenced above had such recommendations. The representative has also advocated education programs.

Research and Environmental Monitoring

The 2002 Task Force Report also recommended research and environmental monitoring. As part of the research, EPA provided funds for a report by the National Association of City and County Health Officials. The report suggested steps to be taken by local public health agencies to address the ritual use of mercury, including methods for identifying and engaging susceptible populations, building partnerships with leaders within those populations, and working with the leaders to give joint messages. In addition, EPA recently provided funds for surveys and focus groups about the ritual use of mercury among Latino residents in Lawrence, Massachusetts. The study includes indoor air testing of homes and botanicas.

EPA has funded general research on mercury, such as how it is affected by atmospheric processes, reducing people's exposure to mercury, and the effects of such exposure. At the request of EPA, the National Health and Nutrition Examination Survey is collecting information about mercury levels in human hair, blood, and urine, and EPA is evaluating these results as they become available. However, because of study limitations, any elevated mercury levels found cannot be tied directly to ritual uses. Although survey participants are interviewed, there are no questions about the ritual use of mercury; the survey is intended to identify mercury trends in the general population of the United States.

EPA performed a study of newer instruments to measure mercury vapor levels; another recommendation in the 2002 Task Force Report. Additional research funded by EPA, although not specifically looking at the effect of ritual use of mercury, is underway on measuring the harmful effects of mercury. One study is being conducted by the University of Miami; the other by the New York Department of Environmental Conservation.

Equipment for Responding to Mercury Releases

The complainant noted his belief that when responding to releases due to the ritual use of mercury, there will be a need for portable instruments to measure mercury levels as well as air filtering equipment to remove mercury vapors without evacuating homes. He believes it is inevitable that a large number of contaminated homes will be found throughout the United States, and it is prudent for EPA to stockpile instruments and equipment now.

We believe that the current EPA inventory of mercury analyzers is sufficient to respond to most situations that would require measuring mercury in the air. EPA owns 63 analyzers that measure mercury vapors, and plans to buy 2 more. These analyzers cost from $10,000 to $20,000 each. Most of EPA's inventory consists of one of the following two types:

Table 2.1: Relationships of Measures

Metric Measurements for Small Amounts of Mass (or Weight) That Equal 1 Gram
1,000 milligrams
1,000,000 micrograms
1,000,000,000 nanograms

Source: *Federal Standard 376B, Preferred Metric Units for General Use by the Federal Government*, January 27, 1993

- The Jerome 431-X mercury vapor analyzer, a portable, hand-held unit that can measure mercury vapors from 0.003 to 0.999 milligrams per cubic meter.
- The Lumex RA-915+ mercury analyzer, a light-weight portable unit that can measure mercury in the ambient air as low as 2 nanograms per cubic meter.

EPA also owns Mercury Tracker 3000 analyzers. The Mercury Tracker 3000 is a portable instrument that continuously samples mercury vapors. It measures mean concentrations from 0.1 to 2,000 micrograms per cubic meter over a time interval selected by the user.

EPA has conducted minimal testing of filtering equipment. However, its Environmental Technology Verification Program is capable of such testing. The program develops testing protocols and verifies the performance of innovative technologies that have the potential to improve protection of human health and the environment. Technology vendors are welcome to participate. Among the protocols already approved under the program is a protocol to evaluate general ventilation filters, which may be applicable to mercury filtering equipment.

Conclusion

Mercury vapors resulting from ritual uses can pose a health risk. Persons involved in such rituals should be aware of these risks through precautionary labels. These labeling requirements are enforced by the Consumer Product Safety Commission, not EPA. To further increase awareness of the risk, EPA and others provide community education and outreach materials. EPA's education and outreach is important and should be continued because, although the ritual use of mercury may be a minor source with regard to the overall use in the general population, the vapors resulting from ritual uses can produce highly elevated mercury levels. Besides education and outreach, EPA has funded some research on the issue. Thus, within the current legal framework, EPA has addressed the health risks posed by the ritual use of mercury. Although we are not recommending additional actions by EPA, we are reporting our results to further emphasize that the ritual use of mercury poses a health risk.

Chapter 3
EPA Did Not Falsify Results of Study Measuring Mercury Vapors

We found no evidence that a study conducted by EPA to measure the levels of mercury vapors resulting from spills was designed to mislead, nor did we find that the results were falsified, as alleged. EPA performed this study, part of which simulated mercury released during ritual use, in response to a recommendation in the 2002 Task Force Report. Before starting experiments, the study team talked with others (including the representative) so the work would correctly reflect the ritual use of mercury. EPA used analyzers to measure the mercury vapors in the air during the experiments, and EPA's report presented measurement averages. Mercury levels are affected by several variables, making it difficult to compare the results of experiments to real situations.

EPA Study Measured Mercury Vapors

EPA conducted a study[4] with the objectives to (1) assess what happens to mercury vapors in a home, including those resulting from cultural uses of mercury; and (2) evaluate instruments that quickly monitor mercury vapors. This study did not explore potential health risks. EPA also used data collected to develop models to predict how long and at what levels mercury would contaminate indoor air. EPA conducted this study from January 14, 2002, through March 27, 2003.

In the study, EPA performed 10 experiments that simulated the following scenarios concerning mercury:

- Spilling or sprinkling 2 to 15 grams of mercury on a carpet in a large and a small room of a trailer.
- Placing different weights of mercury inside two candles to determine the relative importance of weight versus surface area on the level of mercury vapors.
- Spilling mercury from a broken thermometer on a carpet in a small room.
- Shaking drops of liquid mercury, or beads, to simulate mercury being disturbed by household activities, such as children playing.

The study found that intentionally sprinkling mercury for ritual purposes, or accidentally spilling mercury, may produce indoor air concentrations above the

[4] The related report, *Ritualistic Use of Mercury Simulation: A Preliminary Investigation of Metallic Mercury Vapor Fate and Transport in a Trailer*, OSWER 9285.4-08, EPA/540/-04/006, dated January 2005, is at http://www.epa.gov/superfund/action/community/merc_rep05.pdf.

ATSDR-proposed residential occupancy level. This is the level considered safe and acceptable for people to stay in a building after a mercury spill, provided no visible mercury is present and the mercury source has been removed. In some cases, the initial mercury concentration in the air also exceeded the ATSDR-recommended indoor action level for isolation, a concentration at which steps should be taken to prevent people from being exposed to the mercury.

The indoor air mercury vapor level depended on the total exposed surface area of the mercury, the amount of mercury used, and the size of the room. The indoor air mercury level decreased over time and, in most cases, eventually fell below the ATSDR-proposed residential occupancy level. Increases in indoor air mercury concentration were observed when the mercury source was physically disturbed or shaken, more mercury was added, physical activity occurred near the source, or temperatures exceeded 90°F. Periodically applying a small amount of mercury over a long time in the same room could lead to continually exposing people to levels of mercury vapors above the proposed residential occupancy level.

EPA developed a model to describe the relationship between the level of mercury vapors in the air and the evaporation of the mercury source over time. The model assumes all environmental factors are stable (constant), including temperature, ambient air pressure, and the effects of static electricity. It also assumes that the mercury source remains undisturbed. However, the model cannot predict the final level of mercury vapors due to a lack of information on how time, temperature, etc., affect elemental mercury exposed to air. Although it cannot predict the final level, the model indicates that after reaching a maximum value, mercury vapor levels continuously decrease to a final level typically less than 5 percent of the maximum level after 50 to 60 hours, assuming the mercury is undisturbed.

EPA developed a second model to give a rough estimate of the average level of mercury vapors in indoor air over various time intervals. This approach is based on periodic activity in a room producing additional mercury vapors. The model may not be appropriate for situations in which the mercury is disturbed on a regular basis or is repeatedly applied.

EPA Changed Report to Address Some Concerns of Representative

In his complaint to the OIG and his comments on the draft EPA study report, the representative claimed that EPA falsified the study results simulating the ritual use of mercury. In his comments on the draft report, the representative said the study "seriously understates the mercury vapor levels present in actual dwellings where mercury has been put to ritualistic use." According to him and his reference to a study[5] on gaseous elemental mercury, EPA's results were inconsistent with measurements from real incidents. The representative believed

[5] *Gaseous Elemental Mercury as an Indoor Air Pollutant*, Environmental Science & Technology, Volume 35, Number 21, September 2001, pages 4170-4173, Anthony Carpi and Yung-Fou Chen.

EPA deliberately designed the study to fail, and criticized the people involved for preparing a report that was unrealistic. Thus, he believed the results did not provide useful estimates of residential exposure, which was one of the study objectives. According to the representative, EPA should repeat the study using different floor types and include simulations of people moving about in the room.

EPA's January 2005 final report was very similar to the July 2004 draft report on which the representative commented. Noteworthy additions included clarifying what happened during the experiments and noting qualifications about the results. Other changes addressed concerns of the representative, but the report recommendations were not changed as suggested. In addressing the representative's comments, EPA replaced its objective about estimating residential exposure with an objective on evaluating monitoring instruments. EPA added a reference to the study on gaseous elemental mercury, and included a paragraph to explain why the results were not comparable, i.e., the sampling design and methodology used in the study on gaseous elemental mercury differed substantially from that used in the EPA study. Further, EPA added a sentence stating it was unlikely mercury in an actual home would be undisturbed.

Study Team Obtained Input on Study Design

We believe that EPA intended the study to simulate the ritual use of mercury, and did not design it to produce specific results. When developing work products, EPA believes it can be beneficial to have interaction of subject matter experts from within and outside EPA, so it encourages staff to obtain peer input when planning scientific work. However, for this particular study, peer input was not required as it would have been if, for example, the study was expected to produce controversial findings. Even so, at least twice before the study started, EPA staff discussed the study with the representative, who was very enthused about what EPA was going to do. They exchanged emails about the proposed work and the representative visited the site of the study to tour the trailer.

In addition, since an important goal of the study was to simulate the use of mercury for ritual purposes, a team member contacted a practitioner to determine how mercury is used in rituals in the home. Experiment 1 was designed to mimic the ritual uses described by the practitioner. EPA staff noted several variables in Experiment 1 could have been changed. For example, the practitioner offered to visit the study site and spread the mercury. The study team declined the offer, believing it would create a credibility problem for the study. The experiments could have used different types of floors or furniture, or tried to disturb the mercury in different ways, which may have led to different results. However, the report describes conditions existing during the experiments.

No Indication Report Data Was Falsified

We found no indication that EPA falsified report data. EPA used real-time monitoring instruments to take readings on the concentration of mercury vapors in the air for all 10 experiments in the study. In addition, the air was sampled and analyzed by a laboratory using the modified NIOSH (National Institute for Occupational Safety and Health) Method 6009, which is the standard for mercury analysis. Averages of the instrument readings were presented in the report. Although we did not review the actual readings, we reviewed documents showing reading averages. For one experiment, we compared the averages for the first 44 hours of monitoring to the concentrations identified in the report. We found that the report correctly showed the average of the readings, although the first concentration level shown exceeded the average of the 10-minute averages by a small amount – 0.05 micrograms per cubic meter.

A different study[6] on mercury evaporation produced results similar to the EPA study. The author measured the evaporation rates of two drops of mercury at room temperature. The smaller drop weighed about 0.2 grams and had a diameter of roughly 3 millimeters; the larger, nonspherical drop had a mass about 10 times larger. For the larger drop, but not the smaller one, the size of the drop decreased over time in a linear manner. A member of the EPA study team reviewed this study and concluded that results for the larger drop were similar to what happened to drops in the EPA study that were 0.5 centimeters in size. Given the room volume and air exchange rate identified in the study, the level of mercury vapors and the rate at which the mercury decreased, as measured in the study, were in agreement with those predicted by the models in the EPA report.

It Is Difficult to Evaluate Whether Study Results Were Unrealistic

Results from EPA's study were not consistent with data collected from some actual mercury spills. EPA's Experiment 3 simulated breaking a thermometer. The initial mercury reading in the trailer was 7,200 nanograms per cubic meter. After 162 hours (or 6.75 days) without remediation, the level declined to 80 nanograms. Data from an actual broken thermometer incident, however, showed that mercury vapors were 5,000 nanograms after 7 days.

Table 3.1 notes mercury vapor measurements taken from the sites of four actual incidents in which a mercury-containing thermometer was broken in a residential setting. The period of time after the thermometer was broken and the mercury vapor level at that time is shown.

[6] *The evaporation of a drop of mercury,* Am. J. Phys., Volume 71, Number 8, August 2003, pages 783-786, Thomas G. Winter.

Table 3.1: Mercury Vapor Readings from Four Residential Spills

Location of Spill	Time Since Spill	Mercury Vapor Level (nanograms per cubic meter)
Dresser in bedroom	5 days	14,270
Vinyl floor in kitchen	7 days	5,000
Tile floor in bathroom	6 months	523
Tile floor in bathroom	15 years	45

Sources: Articles cited in Footnotes 1 and 6 of this report, and a 2004 ATSDR Health Consultation

The measurements in the first three incidents substantially exceeded the final measurement in EPA Experiment 3. However, many variables affect measurements of mercury vapors, such as room size, temperature, and air flow. Thus, these readings may not be comparable and, without further study, the differences do not prove the EPA experiment was unrealistic.

Conclusion

The report on EPA's study simulating the ritual use of mercury describes the work performed and related assumptions. We found no indications that the study was designed to produce specific results, or that the data was falsified. Therefore, we are not making any recommendations.

Status of Recommendations and Potential Monetary Benefits

RECOMMENDATIONS						POTENTIAL MONETARY BENEFITS (in $000s)	
Rec. No.	Page No.	Subject	Status[1]	Action Official	Planned Completion Date	Claimed Amount	Agreed To Amount
No recommendations							

[1] O = recommendation is open with agreed-to corrective actions pending;
C = recommendation is closed with all agreed-to actions completed;
U = recommendation is undecided with resolution efforts in progress

Appendix A

Agency Response to Draft Report

August 4, 2006

MEMORANDUM

SUBJECT: Response to Draft Public Liaison Report:
EPA Is Properly Addressing the Risks of Using Mercury in Rituals
Assignment No. 2005-1655

FROM: Susan Parker Bodine/s/
Assistant Administrator

TO: Paul D. McKechnie
Director of Public Liaison
Office of Congressional and Public Liaison

The purpose of this memorandum is to provide a written response on the findings of the June 28, 2006 Draft Public Liaison Report: EPA Is Properly Addressing the Risks of Using Mercury in Rituals Assignment No. 2005-1655. We have reviewed the draft report and agree with the conclusions presented in the report. Below you will find some general comments that are intended to clarify or correct points presented in the draft report.

Page 3:

- Summary of legal requirements pertaining to mercury in residential air: The OSHA PEL of 0.1 mg/m3 for occupational exposure is not currently listed in the OSHA "Z" tables of legally enforceable standards.

- There is a NIOSH Recommended Exposure Limit (REL) of 0.05 mg/m3 (not legally enforceable). While it is true that no legally enforceable residential limits have been established, there are several published advisories or recommendations worthy of note, specifically:

    - ATSDR's proposed residential occupancy level of 1.0 µg/m3 as the mercury level considered "safe and acceptable" for occupancy of any structure after a spill;
    - ATSDR's recommended indoor air action level of 10 µg/m3 at which measures should be taken to isolate residents from potential mercury exposure;
    - ATSDR chronic minimal risk level, or MRL, of 0.2 µg/m3;
    - USEPA reference concentration, or RfC, of 0.3 µg/m3.

- Both the ATSDR MRL and EPA RfC are estimates of the chronic (long-term) daily human exposure that is likely to be without appreciable risk of adverse, non-cancer health effects.

Page 4, bottom:

- "Studies have confirmed that…New York/New Jersey harbor is believed to be contaminated by mercury, in part, because of ritual uses." While studies have been conducted of mercury contamination of the harbor, the belief that it derives in part from ritual uses is based on inferences drawn from a single survey of mercury disposal practices among NYC mercury users, rather than direct evidence.(1)

- A major NY Academy of Sciences study(2) of mercury in the NY/NJ harbor, provided an estimate of mercury releases from religious/cultural use (representing less than 4% of total mercury releases in the harbor watershed), but noted the very low confidence level (90% error) associated with this estimate, and stated: "Given the large error bars and the lack of a full understanding of the extent of the problem and no data on how this mercury makes its way to the Harbor, religious and cultural uses will not be dealt with further in this document."

- Thus, the ritual use of mercury as a significant source of NY/NJ harbor mercury contamination has not been "confirmed." (It should also be noted that one reference[3] bases a claim of excess mercury in influent to NYC wastewater treatment plants "apparently associated with ritualistic mercury use" on a presentation by the NYC Department of Environmental Protection.[4])

- References for the footnotes above:

    - 1. Johnson, C. 1999. Elemental mercury use in religious and ethnic practices in Latin American and Caribbean communities in New York City. *Pop. Environ.* 20 (5): 443-453.
    - 2. de Cerreno, A.L., M. Panero, S. Boehme. 2002. Pollution Prevention and Management Strategies for Mercury in the New York/New Jersey Harbor. New York: New York Academy of Sciences.
    - 3. Wendroff, A.P. 2005. Magico-religious mercury use in Caribbean and Latino communities: Pollution, persistence, and politics. *Environ. Practice* 7(2): 87-96.
    - 4. New York City Department of Environmental Protection. 2004. Mercury track-down Washington Heights. Power point presentation.

Page 7:

- The description of EPA mercury analyzers should be revised. The Jerome 431-X mercury vapor analyzer cannot measure mercury down to the nanogram/m3 range, as stated in the IG Report. The description of this instrument should be revised to read as follows:
    - The Jerome 431-X mercury vapor analyzer is a portable, hand-held unit that reports mercury vapor in mg/m3 (measuring range from 0.003 to 0.999 mg/m3).

- The description of the Lumex RA-915+ should be changed to read as follows:

- The Lumex RA-915+ is a lightweight portable unit that can measure mercury in ambient air in ng/m3 (detection limit of 2 ng/m3).

- Add the following additional bullet to the description of EPA's mercury response inventory:
  - The Mercury Tracker 3000 is a portable, direct-reading instrument that provides continuous measurement of mean mercury vapor concentrations in µg/m3 (from 0.1 to 2000 µg/m3) over a user-selected sampling time interval.

Page 9, end of first paragraph:

- This confuses two separate ATSDR recommended residential mercury levels and should be revised as follows:
  - The study found that intentional sprinkling of metallic mercury for ritual purposes, or accidentally spilling mercury, may produce indoor air concentrations above the ATSDR proposed residential occupancy level. This is the level considered safe and acceptable for occupancy of a structure after a mercury spill, provided no visible metallic mercury is present and the mercury source has been removed. In some cases, the initial mercury concentration in air also exceeded the ATSDR recommended indoor action level for isolation, a concentration at which measures should be taken to prevent exposure to residents.

Page 9, bottom and 10, top:

- The complainant asked the Agency to add a reference to the report, i.e., the Carpi and Chen study of mercury in dwellings. We recommend the IG report should stress the reasons why the results of the EPA study were not comparable to the Carpi and Chen study, i.e., the sampling design and methodology used by Carpi and Chen differed substantially from that used in the EPA Trailer study. Furthermore, Carpi and Chen's methodology is open to question; for example, the paper did not explain how specific residences were selected, or whether residents were told the purpose of the study (or the results of the sampling) before being interviewed.

- Also, the ascertainment that a mercury spill had actually occurred was strictly anecdotal, relying on tenant reports of spills (in one case, from many years earlier). If no spill could be recalled, the investigators simply *assumed* that one must have occurred. Areas of increased airborne mercury in one apartment were attributed to emissions of mercury from a small area of a wooden floor, even though there was no reported history of a spill; other possible sources (e.g. the location of this section of floor relative to windows) were not considered.

- For these reasons, their study cannot be viewed as a study against which the EPA Trailer Study is to be compared; nor is any inconsistency of results between these two studies an indication of malfeasance.

Page 10, bottom:

- "We found no indication that EPA falsified report data. EPA used real-time monitoring instruments to take readings on the concentration of mercury vapors in the air…" In fact, the EPA not only used two types of real-time monitoring instruments, but also took air samples for laboratory analysis by NIOSH method 6009, the "standard" for mercury analysis, providing further evidence that study data were valid.

- Although the IG "did not review the actual readings" (page 11), a data package containing all readings for experiment 3 was provided to the IG Office along with the EPA Trailer Report.

Page 11:

- There is no reference provided for the data from four spills involving mercury thermometers. As the IG Report correctly notes, "…many variables affect measurement of mercury vapors, such as room size, temperature, and air flow. Thus, these readings may not be comparable…" In the absence of additional information on these variables, as well as flooring type, degree of disturbance of the mercury, sampling methodology and sampling interval, one cannot conclude that the EPA Trailer Report should have provided similar results.

Page 11:

- The reference to the Winter study of evaporation of a mercury droplet should include the following at the end of the existing paragraph:

    - When Winter's parameters for room volume and air exchange rate are used with the mercury concentration prediction model in the EPA report to predict mass loss rates and mercury concentrations, the results are in good agreement with Winter's measured mass loss rates and estimated maximum Hg vapor concentrations.

If you have any questions regarding these comments, please contact Suzanne Wells at (703) 603-9925 or Raj Singhvi at (732) 321-6761. Thank you for the opportunity to comment on the draft report.

Appendix B

Distribution

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