Health Consultation

MERCURY SPILL
(A/K/A CHALMETTE SPILL SITE)

ST. BERNARD PARISH, LOUISIANA

EPA FACILITY ID: LAN000606813

FEBRUARY 13, 2008

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared By:

Louisiana Department of Health and Hospitals
Under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Table of Contents

Table of Contents i
List of Acronyms ii
Summary and Statement of Issues 1
Background 1
Site Description and History 1
Mercury Removal Process 2
Personal Property Screening 2
Data Collection 2
Data Evaluation 3
Evaluation Process 4
Exposure Pathway 4
Mercury Background 4
Child Health Considerations 5
Conclusions 6
Recommendations 6
Public Health Action Plan 6
Preparers of this Report 7
Certification 8
References 9
Appendix 10

List of Acronyms

ACGIH	American Conference for Industrial Hygienists
ATSDR	Agency for Toxic Substances and Disease Registry
BEI	Biological Exposure Index
EERS	Emergency and Rapid Response Services
FDA	Food and Drug Administration
HGV	Health Guidance Values
HSEES	Hazardous Substance Emergency Events Surveillance Program
LDEQ	Louisiana Department of Environmental Quality
LDHH	Louisiana Department of Health and Hospitals
LOAEL	Lowest Observed Adverse Effect Level
MRL	Minimal Risk Levels
ug/m3	Microgram per cubic meter
ug/L	Microgram per liter
NC	Not Collected
Ng/m3	Nanogram of mercury per cubic meter
NIOSH	National Institute for Occupational Safety and Health
OPH	Office of Public Health
OSC	On-Scene Coordinator
OSHA	Occupational Safety and Health Administration
SEET	Section of Environmental Epidemiology and Toxicology
START-3	Superfund, Technical, Assessment and Reponse Team
USEPA	United States Environmental Protection Agency

Summary and Statement of Issues

On June 27, 2007, a registered nurse at Children's Hospital in New Orleans contacted the Louisiana Department of Health and Hospitals (LDHH), Office of Public Health (OPH), Section of Environmental Epidemiology and Toxicology (SEET) to report a young child with an elevated urine mercury level. Children's Hospital also reported to the Louisiana Department of Environmental Quality (LDEQ) a mercury spill in the home of the young child. On June 28, 2007, SEET's Hazardous Substance Emergency Events Surveillance Program (HSEES) received a report of the spill in the home from the Louisiana State Police. LDEQ contacted the United States Environmental Protection Agency (USEPA) who investigated the spill on June 28, 2007. Because of the high levels of mercury in the home and the severity of the poisonings in the family, a multi-agency response was initiated. Several conference calls with LDHH, the Agency for Toxic Substances and Disease Registry (ATSDR), and the EPA took place during the remediation and assessment process of the home to ensure that mercury levels were below levels of health concern prior to reoccupancy of the home.

Background

Site Description and History

The data examined in this health consultation includes indoor air monitoring samples collected by the Superfund Technical Assessment and Response Team (START-3) contractors during the period June 28, 2007 through October 3, 2007 (1).

EPA began its assessment of the residence on June 28, 2007 by screening for mercury vapor using a Lumex RA- 915+ Mercury Vapor Analyzer. The Lumex is a high sensitivity and selectivity portable atomic absorption spectrophotometer that has a detection limit of 2 nanogram of mercury per cubic meter of air (ng/m3) (2). During the assessment, EPA Representatives observed mercury vapor concentrations in the air of up to 60 microgram per cubic meter (µg/m3). The initial mercury vapor levels detected in the cooled areas of the house (kitchen, living room, bedrooms) were approximately 32 to 44 µg/m3. The highest readings, 55 to 60 µg/m3, were observed in non-cooled areas of the house (i.e. garage and attic). Although EPA representatives assessed every room in the house including the attic and garage, the source of mercury was not identified. During the assessment, EPA representatives observed beaded elemental mercury on several surfaces including vertical surfaces throughout the house.

The site was secured and the family was advised not to enter the house because of the high mercury levels detected by the air sampling. On June 29, 2007, under On-Scene Coordinator (OSC) warrant authority for emergency action, EPA initiated an emergency removal action which involved the removal and disposal of mercury-contaminated household items, such as building materials and personal property. The purpose of the emergency removal action was to remove free elemental mercury and mercury-contaminated items from inside of the house thereby preventing further merucy contamination inside of the home and to achieve ATSDR's suggested re-occupancy cleanup level after a removal action of less than 1.0 ug/m3 of mercury vapor for indoor ambient air (3).

Mercury Removal Process

On June 30, 2007, the Emergency and Rapid Response Services (ERRS) began the physical removal of gross mercury contamination from within the residence by removing the visible mercury beads with a specialized mercury vacuum and by removing the carpet and padding (3). EERS bagged the potentially contaminated personal property, staged it in the backyard of the house, and then began to decontaminate the hard surfaces within the house (ie., floors and walls) with HgCS-102, which is a specialized mercury cleaning solution that removes mercury by way of sulfur amalgam formation. Throughout the gross contamination removal process, EERS continued to vent the house toward the backyard and out of the garage. On July 4, 2007, the house was put through a heating and venting process as prescribed by EPA Region 5 Mercury Response Guide Book. The house was heated to a temperature of 85 degrees Farenheit for a minimum of eight hours. After heating, the house was vented for at least two hours and then closed up for at least one hour, and then the indoor ambient air was monitored to determine the level of mercury vapor contamination. START-3 recorded the mean value of three 10-second readings from the Lumex. These readings were taken at an approximate elevation of 3 feet, which simulated a modified breathing zone. Mercury vapor levels remained above the 1.0 ug/m3 cleanup level. The initial heating and venting process continued until July 7, 2007. From July 7 through July 31, 2007, multiple rounds of screenings, on-going decontamination, removal of personal property and appliances, and clean up were undertaken as the levels of mercury rose when the house was closed up and the temperature elevated (See Table 1 and Figure 1 in Appendix).

Personal Property Screening

Between July 3, 2007 and July 25, 2007, START-3 screened bagged and sealed personal items from inside the home and placed them in a non-contaminated environment in accordance with the EPA Region 5 Mercury Response Guide Book (3). The air space surrounding the bagged items were allowed to reach equilibrium for at least one hour at which time the headspace of the bags were measured with the Lumex. The personal items were then segregated into separate bags based on surface type (porous or non-porous), item type, and value. The Lumex readings were compared to the ATSDR-recommended acceptable indoor air concentration limit for personal effects of 10 ug/m3. Items that had readings below the 10ug/m3 action level were placed in an on-site Conex box for storage, and items with readings above the action level were put through a decontamination process in order to reduce the mercury contamination. Non-porous items were treated with HgCS-102 and allowed to dry, and porous items were allowed to vent from several hours to several days. After decontamination, the items were put through the Region 5 item screening process again. Items still above the action level were either disposed of or treated again in an attempt to reduce the mercury contamination to acceptable levels. All items with final readings below the 10 ug/m3 action level were placed in an on-site Conex box for storage.

Data Collection

Indoor air samples of the residence were collected by START-3 from June 28, 2007 through October 3, 2007 by screening for mercury vapor using a Lumex RA- 915+ Mercury Vapor Analyzer. START-3 recorded the mean value of three 10-second readings which were taken at

an approximate elevation of 3 feet, simulating a modified breathing zone. Various areas throughout the residence where air samples were collected and monitored included the living area, the 3 bedrooms, the 2 bathrooms, the hallway, the attic, the garage, the kitchen, the floors, the walls of the living room, and the baseboards throughout the home. Other areas in the house where samples were taken included the washing machine in the garage, the two bathtubs, the bathtub drains, and the refrigerator. During the sampling process, multiple rounds of clean up were undertaken as the levels of mercury rose when the house was closed up and the temperature elevated. The cleanup of the residence included the removal, cleaning and/or disposal of all home furnishing, cleaning of drains, and baseboards. By August 2007, EPA had lowered the mercury levels in the rooms of the house to 1ug/m3.

On August 1, 2007, once removal and remediation of the residence was complete, eight confirmatory samples were collected by START-3. Samples collected for laboratory analyses included 1 duplicate sample and 1 field blank, and 6 samples from different locations within the affected home. The house is a single story home with three bedrooms, two bathrooms, hallway, kitchen, dining room, living room, attic and an attached garage. Samples were collected under normal living conditions over a six hour period with SKC pumps. These pumps were equipped with a low flow attachment and placed at areas in the house of potential exposure pathways. The samples were collected at an indoor ambient temperature between 75 and 85 degrees Fahrenheit. The samples were collected in the centers of bedroom #2, bedroom #3, and the living room. In bedroom #1, the sample was collected half the distance from the center of the room to bathroom #1. A fifth sample was collected half the distance from the dining room to the kitchen. The hallway sample, the sixth sample, was collected half the distance from the center to bathroom #2. One duplicate air sample and one field blank were collected in the living room (4). All of the confirmatory samples were analyzed by Aerotech Environmental Laboratories utilizing NIOSH Method 6009. As seen in Table 2, all confirmatory samples had mercury levels below ATSDR's mercury indoor air action level for reoccupancy of 1.0 ug/m3.

On October 3, 2007, EPA monitored the mercury vapor levels within a conex box that was being used to store the resident's personal property. The personal property was screened during the removal process and the personal property was determined safe to keep since the mercury vapor level was less than 1 ug/m3 (1).

Data Evaluation

The Agency for Toxic Substances and Disease Registry (ATSDR) recommends that breathing zone mercury levels not exceed 1 microgram per cubic meter of air (ug/m3) for long term exposures as would be likely in a residence. ATSDR also recommends that the breathing zone of a residence not exceed a mercury vapor concentration of 1 ug/m3 once the home has been remediated and ventilated (5). If levels exceed that guidance value, additional cleanup to remove residual source mercury and mercury vapor is required. The suggested action level of 1 microgram per cubic meter of air is extrapolated from health guidance values (HGVs) which were independently developed by ATSDR and EPA. The HGVs are based on both animal studies and human epidemiology studies which describe the health effects of the inhalation of mercury-contaminated air. ATSDR's chronic minimal risk level (MRL) is based on a 1983 study of workers which were exposed to an average Lowest Observed Adverse Effect Level (LOAEL) of 26 ug/m3 over an average of 15 years. The ATSDR chronic inhalation Minimal

Risk Level (MRL) for mercury vapor in air is 0.2ug/m3 (5). An MRL is defined as an estimate of the daily exposure level to a hazardous substance that is likely to be without appreciable risk of adverse, non-cancer health effects. Since the workers were only exposed during working hours, a 40 hour per week exposure, the LOAEL was adjusted to account for continuous exposure.

The Occupational Safety and Health Administration (OSHA) has set limits of 25 ug/m_3 for metallic mercury vapor in workplace air to protect workers during an 8-hour shift and a 40-hour work week (5). For the occupational exposures, the Biological Exposure Index (BEI) Committee of the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that workplace exposures should result in urinary mercury concentrations below 35 ug/g creatinine and end-of-workweek whole blood mercury concentrations should be less than 15 ug/L. Workers who have urine mercury levels above 35 ug/g creatinine are removed from the workplace exposure and subsequent reentry urine mercury levels must be below 10 ug/g creatinine (6).

Evaluation Process

Throughout the cleanup and ventilation of the house from June 28, 2007 through July 31, 2007, air monitoring data were collected. The mercury contaminant concentration readings detected in the air fluctuated throughout the removal and cleanup process (See Table 1 in Appendix).

On August 1, 2007, once removal and remediation was complete, eight confirmatory samples were collected by START-3 and then analyzed by Aerotech Environmental Laboratories. All confirmatory sample results were below ATSDR's mercury indoor air action level for reoccupancy of 1.0 ug/m3.

On October 3, 2007, EPA monitored the mercury vapor levels within a conex box that was being used to store the resident's personal property. The property was determined safe to keep since the mercury vapor level was less than 1 ug/m3, ATSDR's residential reoccupancy level.

Exposure Pathway

The main routes of exposure for elemental mercury are ingestion, dermal absorption and inhalation of mercury vapors. The inhalation of high levels of elemental mercury is the most hazardous route and can cause permanent neurological damage and kidney impairment.

Mercury Background

Mercury occurs naturally in the environment and exists in several forms: metallic mercury (also known as elemental mercury), inorganic mercury, and organic mercury. Metallic mercury, the elemental or pure form of mercury, is a shiny, silver-white metal that exists as a liquid at room temperature and is used in thermometers, batteries, and some electrical switches (2). Elemental (metallic) mercury was the form of mercury found in the home. At room temperature, some of the metallic mercury will evaporate and form mercury vapors which are colorless and odorless. The higher the temperature, the more vapors will be released from liquid metallic mercury.

The vapor from metallic mercury is readily absorbed through the lungs and rapidly diffuses to all tissues in the body, particularly the kidney and the brain (7). All forms of mercury cross the placenta and may affect the developing fetus (8). Mercury vapor has an affinity for the central nervous system. Excretion is through the urine and feces.

Mercury poisoning is confirmed through the measurement of mercury in blood and urine. Elevated blood mercury levels indicate recent exposure; the initial half-life for blood mercury without further exposure is 3 days as mercury rapidly moves from the blood to tissues. The half-life of elimination for whole body mercury is 60 to 90 days (8). Following the inhalation of elemental mercury vapor, urinary mercury levels decline with a half-life of approximately 1-3 months (9). Urinary mercury levels indicate the total mercury body burden since mercury is largely excreted by the kidneys (8,9).

Vulnerable subpopulations have been identified as young children (particularly under 6 years), pregnant women, women who might become pregnant, and nursing mothers (7). Both the EPA and the Food and Drug Administration (FDA) advise this group to avoid consuming fish known to contain elevated levels of mercury.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health.

Children who breathe metallic mercury vapors for an extended period of time may develop a disorder known as acrodynia, or "pinks disease." The symptoms of this disorder include severe leg cramps, irritability; and abnormal redness of the skin, followed by peeling of the hands, nose, and soles of the feet. Itching, swelling, fever, fast heart rate, elevated blood pressure, excessive salivation or sweating, rashes, fretfulness, sleeplessness, and/or weakness may also be present. This disorder may also occur in teenagers and adults (10). Exposure to mercury vapors is more dangerous for children than for adults, because inhaled mercury vapors easily pass into the brain and nervous system of young children and may interfere with the development process. Exposure to high levels of mercury vapor can cause acute poisoning and/or death. Some of the initial symptoms which result from acute inhalation of mercury vapor are chills, nausea, general malaise, chest tightness, chest pain, difficulty breathing, cough, kidney damage, stomatitis, gingivitis, salivation, diarrhea, and death (2).

Conclusions

The St. Bernard Parish home contaminated with mercury was considered an Urgent Public Health Hazard because mercury vapor was present at concentrations that could cause adverse health effects after short-term exposure. The situation called for immediate intervention to prevent serious health effects and perhaps permanent damage. Since the mercury spill has been remediated, but the source of the mercury was never identified, the home currently poses an indeterminate public health hazard. The house should be monitored over time for mercury levels. Biomonitoring of the children should continue until their blood and urine mercury levels are at background levels. The children should not be allowed to reoccupy the house until their urine levels are below 5ug/g creatinine for 2 consecutive months assuming the levels in the home do not rise again.

Recommendations

Prior to reoccupancy of the home, SEET recommends that the urine mercury levels of the two youngest children be monitored monthly until the mercury levels return to a background level of 5ug/g creatinine for at least two months.

When the children do move back to the house, their urine mercury levels should be monitored for at least 3 months to make sure they do not increase.

SEET recommends that the house be monitored over time for mercury levels.

SEET also recommends that the family do not consume fish that contain high levels of mercury and to avoid any situations where mercury may be present.

SEET recommends that the children be referred for neurocognitive testing which can be conducted at the Louisiana State University Health Sciences Center.

Public Health Action Plan

SEET consulted with Dr. Larry Lowry, Ph.D, co-director of the SW Center for Pediatric Environmental Health at the University of Texas in Tyler, Texas regarding the long term care of children exposed to mercury.

SEET provided recommendations and assistance to the family's treating physician.

The information produced within this health consultation will be sent to the treating physician, Dr. Lowry, and the residents of the home.

SEET plans to present this case as part of the Grand Rounds to increase awareness among physicians.

SEET will continue to conduct surveillance of mercury and other heavy metal poisonings.

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Certification

This health consultation for Anderson Island was prepared by Louisiana Department of Health and Hospitals under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodology and procedure existing at the time the health consultation was initiated.

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The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

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Appendix

Table 1: USEPA's Region VI Pollution Report Data

	SUMMARY OF POLREP REPORTS	
DATE	AREA	MERCURY AIR READING (ug/m3)
6/28/2007	Garage and Attic	55-60
6/28/2007	Living Area	32-44
6/30/2007	Initial readings throughout house	1-3
6/30/2007	Readings in various rooms	≤ 65
7/1/2007	Initial reading throughout house	>140
7/1/2007	End of day reading	8-25
7/2/2007	Initial reading throughout house	>140
7/2/2007	End of day reading	4-25
7/3/2007	Living Area	4
7/3/2007	Garage	28
7/3/2007	Washing Machine in garage	>40
7/4/2007	Living Area	5-11
7/4/2007	Garage	4
7/4/2007	Attic	10
7/4/2007	End of day reading	30-40
7/5/2007	Living Area	39-53
7/5/2007	Attic	24
7/5/2007	Garage	5
7/5/2007	After venting of house	0.5 - 1.9
7/6/2007	Living Area	0.2 - 1.3
7/8/2007	Bedroom	0.5
7/8/2007	Living Area	0.2-0.6
7/9/2007	Living Area	0.2-1.5
7/9/2007	Bedrooms after heated and sealed	1-2
7/10/2007	Initial readings throughout house	0.2-1.5
7/10/2007	One of 3 bedrooms after sealed off	0.8
7/10/2007	Living, dining and hallway areas	12
7/10/2007	all bedrooms isolated and sealed	3-7
7/10/2007	Baseboards	1-1.5
7/10/2007	Floors	1-2
7/11/2007	One of 3 bedrooms after sealed off	0.8
7/11/2007	Garage	1.4
7/11/2007	One of 2 bathrooms after sealed off	0.9
7/11/2007	Remainder of house	0.5-1.0
7/11/2007	Attic	<1.0
7/11/2007	Refrigerator	> 25
7/12/2007	Living and dining rooms, hallway	7
7/12/2007	Baseboards of living/dining rooms	>140
7/12/2007	One Bathroom	0.5
7/12/2007	Other bathroom	5
7/12/2007	One Bedroom	2.6
7/12/2007	Other bedroom	0.4

	SUMMARY OF POLREP REPORTS	
DATE	**AREA**	**MERCURY AIR READING (ug/m3)**
7/12/2007	Bedroom floor	2.6
7/13/2007	Bedroom #1	0.3
7/13/2007	Bedroom #2	0.4
7/13/2007	Bedroom #3	0.3
7/13/2007	Garage	0.7
7/13/2007	Kitchen	1.8
7/13/2007	Baseboards in living room	>140
7/13/2007	Bathtub #1	14
7/13/2007	Bathtub #2	130
7/14/2007	Initial reading throughout house	1.0
7/15/2007	Initial reading throughout house	<1.0
7/16/2007	Bathtub drains	78
7/16/2007	Northern wall of living room	>140
7/16/2007	Into walls from the attic	1.1 - 2.5
7/17/2007	Interior reading during venting of house	0.3 - 0.5
7/18/2007	Interior reading during heating/venting	0.2 - 0.6
7/19/2007	After heating/venting of house	0.2 - 0.9
7/20/2007	Initial monitoring of house	0.6 - 1.3
7/23/2007	Initial monitoring of house	0.08 - 0.6
7/24/2007	Initial monitoring of house	0.1 - 0.4
7/31/2007	Initial monitoring of house	0.3 - 0.5
7/31/2007	End of day reading	0.8 - 0.9
10/3/2007	Initial reading inside conex box	1.2
10/3/2007	Reading 3 minutes later in conex box	0.2 - 0.4

Figure 1:

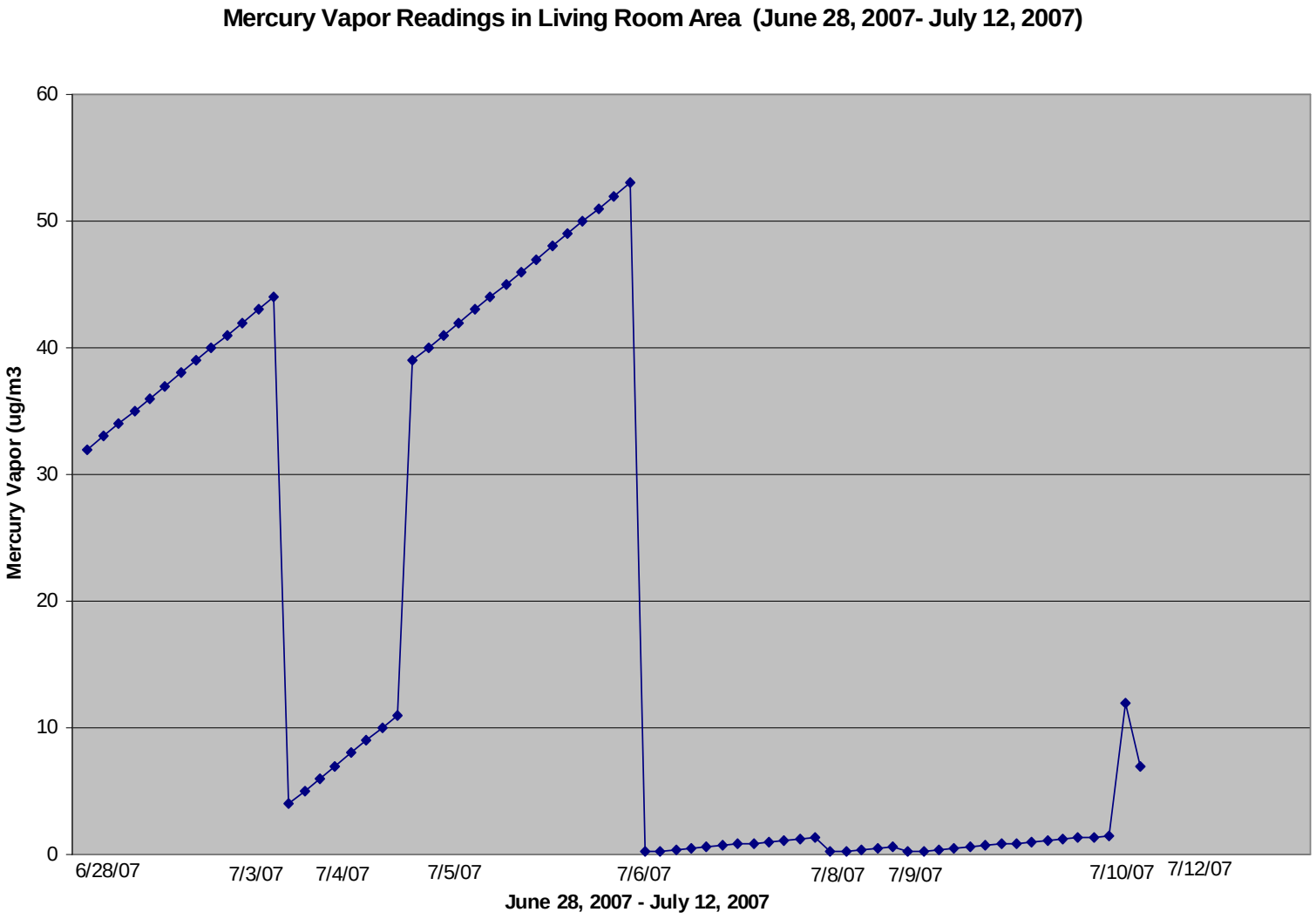
Mercury Vapor Readings in Living Room Area (June 28, 2007- July 12, 2007)
Mercury Vapor (ug/m3
60
50
40
30
20
10
0
6/28/07
7/3/07
7/4/07
7/5/07
7/6/07
7/8/07
7/9/07
7/10/07
7/12/07
June 28, 2007 - July 12, 2007

Table 2: Analytical Mercury Confirmatory Laboratory Results

Lab Number	Sample Room Locations	Date Sampled	Date Analyzed	Concentration (ug/m3)	Reporting Limit (ug, Total)	Test Method
01A	Bedroom 1	8/1/2007	8/3/2007	0.72	0.043	NIOSH 6009
02A	Bedroom 2	8/1/2007	8/3/2007	0.73	0.043	NIOSH 6009
03A	Bedroom 3	8/1/2007	8/3/2007	0.68	0.043	NIOSH 6009
04A	Dining/Kitchen	8/1/2007	8/3/2007	0.63	0.043	NIOSH 6009
05A	Hallway/Bathroom 2	8/1/2007	8/3/2007	0.70	0.043	NIOSH 6009
06A-Duplicate	Living Room	8/1/2007	8/3/2007	0.71	0.043	NIOSH 6009
07A-Field Blank	Living Room	8/1/2007	8/3/2007	0	0.043	NIOSH 6009
08A	Living Room	8/1/2007	8/3/2007	0.73	0.043	NIOSH 6009