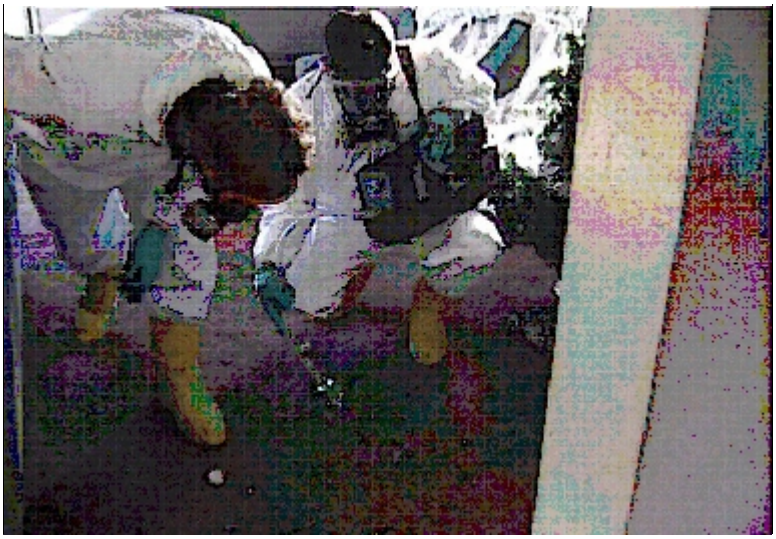
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 9

DRAFT MERCURY RESPONSE GUIDE



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SEPTEMBER 2005

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Disclaimer

This Mercury Response Guidebook (guide) was based on a version developed by the Region 5 USEPA following emergency responses to the Springfield Mercury site in 1997 (16 mercury contaminated homes) and the Mulberry Street Mercury site in 2000 (6 mercury contaminated homes). It has been revised for the Region 9 START and USEPA based on the Region 9 sites, which are summarized in Appendix A. This guidebook is based on lessons learned and is not necessarily USEPA Region 9 policy.

A good reference for public information is the USEPA mercury website located at www.epa.gov/mercury.

1.0 General Information

Metallic elemental mercury is a hazardous chemical that can cause serious health problems. Children (especially very young children) and fetuses are most vulnerable. The Agency for Toxic Substances and Disease Registry (ATSDR), part of the United States Public Health Service, and the United States Environmental Protection Agency (USEPA) have jointly issued an national alert to the general public warning about the continuing pattern of metallic elemental mercury exposure in children and teenagers and in persons using certain folk medicines, or participating in certain ethnic or religious practices.

It is important for the general public to understand that either short-term or long-term exposures to metallic elemental mercury can lead to serious health problems. Human exposure to metallic elemental mercury occurs primarily from breathing contaminated air. Other forms of mercury can be absorbed by drinking contaminated water, eating food (usually fish containing mercury), and from skin contact. At high levels, mercury can cause effects on the nervous system and the developing fetus. Other forms of mercury can damage other organs. Even at low levels, metallic elemental mercury can cause health problems. *Metallic elemental mercury exposure can cause harm before symptoms arise*. Once released into the environment, mercury is very hard to clean up. If it is left unattended where exposures can occur, it can have dangerous effects on human health.

1.1 What is Mercury?

Mercury occurs naturally in the environment and can be found in several different chemicals forms: elemental, inorganic, and organic.

1.1.1 Elemental Mercury

Elemental mercury, also referred to as metallic mercury, is a shiny, silver-white, odorless liquid, that is used in thermometers, thermostats, switches, dental fillings, and batteries, and is also used industrially to produce chlorine gas and caustic soda. Elemental mercury will evaporate readily at room temperature to form a colorless, odorless gas. Since it evaporates into the air, exposure to elemental mercury is mainly a concern for inhalation of vapors. This is a particular concern when elemental mercury is spilled in homes, where even a relatively small amount of mercury can result in the accumulation of very high levels of mercury vapors in the indoor air.

1.1.2 Inorganic Mercury

Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts," which are usually white powders or crystals. Mercury salts are used in skin-lightening creams and as antiseptic creams and ointments. Inorganic mercury does not readily evaporate and is therefore not a concern for inhalation of vapors. However, since it can absorb across the gastrointestinal tract and the skin surface, there is a concern with exposure through ingestion or skin contact with inorganic mercury.

1.1.3 Organic Mercury

Mercury also combines with carbon to make organic mercury compounds. The most common form is methyl mercury, which is produced mainly by small organisms in the water, soil, and sediment. Increasing emissions of mercury into the environment can increase the levels of methyl mercury that these small organisms make. The most significant source of human exposure to organic mercury is in our diet, particularly fish products. Since organic mercury is also well absorbed through the gastrointestinal tract and through the skin, exposure to organic mercury is mainly a concern for ingestion or skin contact.

1.2 How Does Mercury Affect Health?

The nervous system is extremely sensitive to the toxic effects of all forms of mercury. Exposure to high levels of elemental, inorganic, or organic mercury can permanently damage the brain, kidneys, and the developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems. Short-term exposure to high levels of metallic elemental mercury vapors may also cause lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.

Mercury absorbed through the lungs, gastrointestinal tract or the skin can accumulate in the brain and kidney, and is slowly excreted from the body through the urine. Exposure to mercury can be verified by testing of blood, urine, or hair samples. Individuals that have elevated levels of mercury in their body can be treated with "chelating agents" to increase the rate of excretion from the body.

Personnel and resident health monitoring is generally performed by the local health department.

2.0 Mercury Vapor Action Levels

Provided below are recommended cleanup and health and safety action levels which can be used during mercury projects.

2.1 Recommended Cleanup Action Levels

2.1.1 Air

ATSDR has suggested action levels for mercury vapors. The action levels are based on data available in ATSDR's Toxicological Profile for Mercury (1999), Hazardous Substance Databank of the Toxicology Data Network at the National Library of Medicine, and data collected by the USEPA. Table 1 summarizes the current ATSDR suggested action levels.

Table 1: ATSDR Suggested Action Levels for Mercury
Mercury Response Guidebook
USEPA Region 9

Indoor Air Concentration (ng/m^3)	Use of the Action Level	Method of Analysis
<1,000	Residential occupancy level	Modified NIOSH 6009 or real-time air monitoring with Lumex or equivalent
10,000	Isolate residents from the exposure	Real-time air monitoring with Jerome or Lumex equivalent
10,000	Acceptable level in a modified test procedure to allow personal effects to remain in the owner's possession	Real-time air monitoring with Jerome or Lumex equivalent
3,000	Re-occupancy after a spill in an occupational or commercial setting (i.e. school) where mercury is not usually handled	NIOSH 6009
25,000	Occupational settings where mercury is handled	Real-time air monitoring with Jerome or Lumex equivalent
25,000	Response worker protective equipment upgrade	Real-time air monitoring with Jerome or Lumex equivalent
10,000,000	IDLH. Response workers protective equipment upgrade.	Real-time air monitoring with Jerome or Lumex equivalent

It is worth noting that during screening activities at the PWL site in Gardnerville, Nevada, the Region 9 USEPA toxicologist recommended that the USEPA reference concentration (RfC) of 300 ng/m^3 be used as the re-occupational action level instead of the ATSDR recommended level of 3,000 ng/m^3. During the Knox Street removal, ATSDR was contacted to discuss potential action levels. ATSDR stated that 300 ng/m^3 was a good goal however 1,000 ng/m^3 was the current recommended re-occupancy level. All the above ATSDR values along with additional rationale can be found in

Appendix B

2.1.2 Soil

There are seven potential action levels with regard to mercury contaminated soil. These action levels are as follows:

Region 9 USEPA Preliminary Remediation Goals:

- Residential Soil - 23 mg/kg
- Industrial Soil - 310 mg/kg

Arizona Soil Remediation Levels:

- Residential Soil - 6.7 mg/kg
- Non-Residential - 180 mg/kg

The Federal RCRA Hazardous Waste Determining
Toxicity Characteristic Leaching Procedure :

- TCLP $\geq$0.2 mg/L

California Hazardous Waste Determining Levels:

- STLC $\geq$0.2 mg/l
- TTLC $\geq$ 20 mg/kg

2.2 Worker Exposure Levels

Table 2 contains the current regulated and recommended mercury vapor exposure limits for workers.

Table 2: Worker Exposure Published Action Levels Mercury Response Guidebook USEPA Region 9	
Agency	**Action Level**
Occupational Safety and Health Administration (OSHA) This number represents a Ceiling not a time weighted average	100,000 ng/m^3 (0.1 mg/m^3)
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) - Time weighted Average	25,000 ng/m^3 (0.025 mg/m^3)
NIOSH Immediately Dangerous to Life and Health (IDLH)	10,000,000 ng/m^3 (10 mg/m^3)
National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) - Dermal	50,000 ng/m^3 (0.05 mg/m^3)

Provided other conditions are appropriate (sufficient oxygen, etc.), it is Region 9 START's policy that work performed with mercury vapor concentrations below one-half the lowest published exposure rate (in this case, the ACGIH TLV of 25,000 ng/m^3) does not require respiratory protection. Mercury vapor concentrations between one-half and ten times the lowest published exposure rate require Level C respiratory protection and mercury vapor concentrations in excess of ten times the lowest published exposure rate require Level B respiratory protection. Therefore, personnel working on site are to consider the following exposure limits when selecting personal protective equipment (PPE).

Table 3: Recommended Respiratory Protection Based on Mercury Vapor Concentrations Mercury Response Guidebook USEPA Region 9		
Level of Protection	**Action Level**	**Range of Concentration**
Level D	< ½ TLV	< 12,500 ng/m^3 (< 0.012 mg/m^3)
Level C with mercury vapor cartridges	½ TLV to 10 times TLV	12,500 ng/m^3 to 250,000 ng/m^3 (0.12 mg/m^3 to 0.25 mg/m^3)
Level B	> 10 times TLV	250,000 ng/m^3 (> 0.25 mg/m^3)

If the ambient concentration of mercury vapor exceeds the exposure limits, PPE should be upgraded accordingly. NIOSH-approved mercury specific cartridges must be used with the respirators. The MSA Mersorb® - P100 Indicator Type Combination Cartridges should be used with the MSA respirators and the Mercury Vapor/Chlorine with P100 should be used with the Scott respirators.

Both of these cartridges are equipped with end-of-service-life indicators (ESLI). For the Mersorb cartridge, as the indicator gets saturated with mercury, the indicator changes color (from orange to brown). Note that ESLI are required by OSHA for chemicals with poor warning properties.

3.0 Mercury Monitoring and Sampling Equipment

Metallic elemental mercury will be the primary chemical form of mercury encountered on the majority of emergency responses and time critical removals. Human exposure to metallic elemental mercury occurs primarily though breathing air and therefore most assessments will focus on determining mercury vapor concentration in ambient air. The Mercury Screening and Sampling Equipment Guidebook contains step by step instructions on how to use a Mercury Vapor Analyzer (MVA). Quick reference sheets for the Lumex and Jerome MVAs are included in Appendix J

3.1 Mercury Monitoring/Screening in the Field

Any residential home potentially having mercury contamination should be pre-screened by USEPA or START personnel using a MVA. Readings should be compared to appropriate site action levels to determine if action needs to be taken. Two instruments in Region 9 which can be used for screening are the Lumex RA-915+ MVA (Lumex) and the Jerome 431-X MVA (Jerome). The detection limits of the Lumex are expressed in nanograms per cubic meter (ng/m^3, commonly referred to as parts per trillion) and the Jerome are expressed in milligrams per cubic meter (mg/m^3, commonly referred to as parts per million). The following conversion is used to convert the expressions.

- 1 mg/m^3 = 1,000,000 ng/m^3
- 1 ng/m^3 = 0.000001 mg/m^3

Example: A reading of 0.03 mg/m^3 is equivalent to a reading of 30,000 ng/m^3.

3.1.1 Lumex RA-915+ Mercury Vapor Analyzer

The Lumex is a portable atomic absorption spectrometer designed to determine the mercury vapor content in ambient air, water, soil, natural and stack gases, etc. It has a built-in compressor and internal rechargeable source as well as a car adapter for field monitoring in remote areas. This instrument can detect low level mercury vapors. Eagle Instruments (Eagle), USEPA Region 9's equipment contractor, maintains three Lumex: two in the San Francisco and one in the Signal Hill USEPA warehouse.

Lumex RA-915+ Features

- The sensitivity of the Lumex is 2 ng/m^3 (0.000002 mg/m^3)
- The range of detection is 2 ng/m^3 to 20,000 ng/m^3 (0.000002 mg/m^3 to 0.02 mg/m^3). In "high concentration" mode the range is 500 ng/m^3 to 200,000 ng/m^3 (0.0005 mg/m^3 to 0.200 mg/m^3).
- The accuracy is +/- 20% in both the regular and high concentration modes
- There are no known interferences with this instrument.
- The sample volume is set at 20 liters per minute (l/min).
- Data collection and data logging are done in real-time and stored as a separate file.
- The instrument has two attachments which allow it to analyze for mercury in soil and water.

If required, additional Lumex can be obtained from the manufacturer:

Distributor	OhioLumex Company 9263 Ravenna Road, Unit A-3 Twinsburg, Ohio 44087 (888) 876-2611 http://www.OhioLumex.com
Purchase price	Approximately $25,000
Rental price	Approximately $1,000/week or $2,900/month

According to a study conducted for the USEPA Environmental Response Team Center (*Comparison of Real-Time and Laboratory Analysis of Mercury Vapor in Indoor Air: Statistical Analysis Results*), Lumex results of 300 ng/m^3 or greater were comparable to NIOSH Method 6009 results provided that factory calibrations of the Lumex were measured from a standard mercury gas source in the laboratory environment. Statistical analysis indicated that time-averaged Lumex results may be used instead of the NIOSH Method 6009 method to meet action levels of 300 to 1,000 ng/m^3 for indoor mercury spills during emergency responses. The Lumex can also provide real-time monitoring to determine the initial extent of metallic mercury contamination and to identify "hot spots". A copy of this study is provided in Appendix C.

Lumex Soil Analysis

The RP-91C attachment can be used with the Lumex to analyze mercury in soil samples. The analysis involves the thermal decomposition of mercury from a bound state to the atomic state. The mercury compounds are partially decomposed through vaporization in one section of the atomizer. The second section of the atomizer is heated to 800˚C to fully decompose the mercury compounds. The Mercury concentration is then measured by the Lumex. The detection limit for mercury in soil using the the RP-91C is 0.5 µg/kg. Instructions for using the RP-91C attachment are included in the Mercury Screening and Sampling Equipment Guidebook.

During the Rinconada removal assessment, a Lumex with the RP-91C attachment was used to field-analyze soil samples for mercury. Soil samples were also submitted to a fixed-base laboratory for analysis of mercury by USEPA Method 7471A so that a correlation between field screening data and laboratory data could be calculated. The START evaluated the Lumex data and the laboratory data by linear regression analysis. The correlation coefficient (R^2) for the Lumex test was 0.8779 and the linear equation for the data was: Lab Data = 0.5341*Lumex data+(12.548). The R^2 value, the measure of the degree to which the two data sets show a linear correlation, indicates an excellent correlation between the two data sets.

Lumex Water Analysis

The RP-91 attachment can be used to with the Lumex to analyze mercury in water samples. The analysis involves the reduction of mercury within a sample to the atomic state using a reducing solution and then transporting the mercury atoms into an analytical cell by an air flow (the "cold vapor" technique) The mercury concentration is then measured by the Lumex. The detection limit for mercury using the RP-91 is 5 ng/l. Instructions for using the RP-91 attachment are included in the Mercury Screening and Sampling Equipment Guidebook. Ohio Lumex does not sell the reducing solutions or standards for water analysis.

3.1.2 Jerome 431-X Mercury Vapor Analyzer

The Jerome is a portable hand-held MVA used to detect and measure mercury vapor in the air. This instrument uses a gold film sensor, which is inherently stable and selective to mercury; therefore,

common interferences such as water vapor are eliminated. The USEPA Region 9 maintains two Jeromes, one in San Francisco and one in the Signal Hill USEPA warehouse.

Jerome 431-X Features

- The sensitivity of the Jerome is 3,000 ng/m^3 (0.003 mg/m^3)
- The range of detection is 3,000 ng/m^3 to 999,000 ng/m^3 (0.003 mg/m^3 to 0.999 mg/m^3)
- The accuracy is ± 5% at 100,000 ng/m^3 Hg (0.100 mg/m^3 Hg)
- The instrument can be used for health and safety monitoring (instrument detection limit of approximately 5,000 ng/m^3 (0.005 mg/m^3)
- Useful for gross mercury contamination assessment

If required, additional Jerome's can be obtained from the manufacturer.

Distributor	Arizona Instrument 1912 West 4th Street Tempe, Arizona 85281 (800) 390-1414 http://www.azic.com
Purchase Price	Approximately $10,000
Rental Price	Approximately $540/week or $1620/month

Realistically, the Jerome is only accurate when mercury vapor concentrations are greater than 10,000 ng/m^3 (0.01 mg/m^3). Thus, all residential air sampling should be confirmed utilizing NIOSH Method 6009 or a Lumex. Upon initial pre-screening using the Jerome, if mercury vapor concentrations greater than 10,000 ng/m^3 are consistently seen, immediately inform the local health department to consider temporarily relocating the residents.

3.1.3 XRF

USEPA Region 9 has several types of portable X-Ray Fluorescence (XRF) instruments. The Spectrace 9000 instrument, discussed below, has been demonstrated at many sites. More recently purchased XRF instruments, such as the Innov-X XRF, which uses x-ray tube technology as opposed to radioisotope technology, is currently being field tested. It is anticipated that as the radioisotope sources for the Spectrace 9000 become inoperable, instruments such as the Innov-X will be used as a replacement.

The Spectrace 9000 is a portable instrument that employs X-Ray Fluorescence (XRF) spectroscopy in a non destructive manner to determine total metal concentrations in soil. The Spectrace 9000 is most commonly used by START in a field laboratory, but can be used as a hand-held instrument for in-situ analysis. Region 9 START has developed a Standard Operating Procedure (SOP) based on USEPA Method 6200 for the use of Spectrace 9000 for metals analysis including mercury. Mercury analysis per the START SOP can generate 'field screening plus 10% verified' level data.

Spectrace 9000 Features

- The sensitivity range based on previous field analysis with the XRF is approximately 50 to

120 mg/kg. Detection limits can determined by either site specific or sample specific procedures.

- The range of detection is approximately 120 to 3,000 mg/kg. The Spectrace 9000 can be used to determine higher concentrations, but the correlation with laboratory verification samples may not be agreeable. In a previous field study, the correlation between field XRF and laboratory data was high ($R^2 = 0.95$).
- The accuracy is approximately ± 20% near 300 mg/kg based on a previous field study.
- Useful for ex-situ field screening of mercury in soils.
- Analysis may be affected by high arsenic concentrations.

It is understood by START that the Spectrace 9000 is no longer being manufactured and replacement radioisotope sources are no longer available for purchase.

Innov-X XRF Features

- The preliminary sensitivity and detection range based data gathered at one site in central California is approximately 10 to 1,000 mg/kg. More accurate detection limits may have been obtained by using a site-specific calibration.
- The Innov-X XRF may be used to determine concentrations of mercury greater than 1,000 mg/kg, but replicable results for mercury at higher concentrations has not yet been field tested. The preliminary correlation between field Innov-X XRF and laboratory data at the Rinconada Mine Creek site in summer of 2005 was "screening level" data as defined in USEPA Method 6200 ($R^2 = 0.86$).
- Useful for ex-situ field screening of mercury in soils. In-situ testing has been tested on a limited basis by the Region 9 START. Not enough data is available to draw conclusions regarding in-situ testing with the Innov-X XRF.

Information regarding the vendor may be found on the internet at: http://www.innov-xsys.com/

Other Considerations

Standard reference materials in the XRF analysis range may not be readily available. Sources typically have NIST-traceable mercury standards with concentrations lower than the XRF detection limit. In most cases, custom-made or site specific standards will need to be obtained.

3.2 Mercury Sampling For Off-Site Analysis

Depending on the sample matrix, various methods are used for the analysis of mercury. A comparison of the methods for different sample media is included in Appendix D.

3.2.1 Air

Air sampling can be conducted to confirm that residential cleanup activities are complete. Sites requiring minimal or no cleanup may not require confirmation air sampling (i.e. Apple Valley where only vacuum cleaner bags were above the site action level).

Air sampling should be conducted using NIOSH Method 6009 which utilizes cold vapor, atomic absorption spectrometry for measurement of elemental mercury. The approximate detection level for NIOSH Method 6009 is 3000 ng/m^3. If you want to get a lower detection limit you must use the modified NIOSH Method written by U.S. EPA's Environmental Response Team [ERT] (a copy is provided in Appendix E). Samples are collected using sorbent tubes attached to a personal sampling pump with flexible tubing. The pump should be set to sample at a rate of 0.15 to 0.25 L/min for a total sample size between 10 and 200 liters. The larger the sample volume, the lower the detection limit. Once you have determined an action level or detection level, consult a commercial laboratory for verification of required sample volume for analysis. More specific procedures on how to collect air samples are contained in the Mercury Screening and Sampling Equipment Guidebook .

The USEPA Region 9 maintains Bios AirPro 6000D, Bios MetaLite, and Gilan low flow, low volume air sampling pumps for mercury sampling. Typically, SKC 200 milligram sorbent tubes are used for mercury air sampling. The tubes are 6 x 70 millimeters in size and single-sectioned with Anasorb C300 sorbent coating.

Distributor	SKC (800) 752-9378	www.skcinc.com
Purchase Price	$80 per 1 box of 50 tubes	
Catalog No.	226-17-1A	

Table 4 provides a summary of START Region 9 basic ordering agreement (BOA) laboratories used for analysis of mercury in air samples.

Table 4: Summary of Region 9 BOA Laboratories for Mercury Air Analysis by NIOSH 6009
Mercury Response Guidebook
USEPA Region 9

Laboratory	Location/Contact	Cost	Turnaround Time
EMS Laboratories, Inc.	Nicky Ameli 117 West Bellevue Drive, Pasadena, CA 91105 (626) 568-4065 nameli@emslabs.com	$55/sample	5 business days
EMSL Analytical/ LA Testing	Charles LaCerra 107 Haddon Avenue, Westmont, NJ 80108 (856) 858-4800 clacerra@emsl.com	$45/sample	5 business days
Health Sciences Associates	Mike Chapman 10771 Noel Street, Los Alamitos, CA 90720 (714) 220-3922 mchapman@healthscience.com	$70/sample	5 business days
STL Aerotech	Karen Walters 4645 East Cotton, Phoenix, AZ 85040 (602) 437-3340 kwalters@aerotechlabs.com	$40/sample	5 business days

3.2.2 Soil and Sediment Sampling

UNDER CONSTRUCTION

3.2.3 Water Sampling

UNDER CONSTRUCTION

4.0 Mercury Contamination Assessment

Besides mine sites, Region 9 mercury spills generally involve residential or school settings, however, the procedures listed in sections 4 and 5 can be easily adapted to other sites. Assessment of a mercury site would likely require a site specific Sampling and Analysis Plan and is beyond the scope of this document.

When conducting a mercury assessment, the best screening tool is a Lumex MVA. It is recommended to use the mean of 3-10 second samples as a single data point[1] A general survey would measure mercury vapor concentrations in each room of the house. Specific areas to focus on include areas likely to contain the highest levels of mercury such as vacuum cleaners, washing machines and dryers, shoes and shoe storage areas. The height at which the measurement is collected should reflect the typical occupant breathing zone (i.e. children breathing zone versus adult), however, keep in mind that mercury vapors are heavy and you may need to collect samples closer to the floor to assess overall mercury contamination Appendix F contains a good screening checklist when assessing a residence.

It has been reported that the Lumex's Tygon® (vinyl) intake tube appears to retain some mercury when the Lumex is used in highly contaminated environments. It is for this reason that it is recommended to collect and record a fresh air sample prior to entering the exclusion zone and then to collect another upon existing the exclusion zone. The Lumex readings collected inside the exclusion zone should then be adjusted by the difference between fresh air measurements before and after sampling[2]

4.1 Site Access

Access agreements must be obtained from the tenants and owners of any residence which may require environmental air sampling or decontamination. The access agreements allow USEPA and contractors to enter the residential homes to conduct air sampling to determine the extent of contamination and to conduct possible cleanup efforts. Air sampling results for each residence are compared to action levels established by the ATSDR.

Access agreements are to be obtained by USEPA and/or local health officials from the tenants and the owners of each residence prior to pre-screening and air sampling. An example of a USEPA access agreement used by Region 5 is provided in Attachment G.

4.2 USEPA Relocation Program

The USEPA, the American Red Cross (ARC), or the local health department can provide a daily per diem (or food vouchers) and can contract local hotels to provide temporary relocation to evacuated residents. The ARC may be able to initially fund the temporary relocation and then be reimbursed by USEPA when the removal is completed.

Example: At the Saylor Way Mercury Spill site in Region 9, the residents of the mercury-

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[1] ATSDR -Health Consultation-Chemically Contaminated South Minneapolis Residence.... pp. 3

[2] Ibid.

contaminated house were relocated to a motel. The local chapter of the ARC initially funded the lodging for the family. The USEPA was able to provide added funding as the decontamination continued for an extended amount of time.

The Uniform Relocation Assistance and Real Property Acquisition Policies Act (URA), 42 U. S. C. Section 4601, was enacted in 1971 to ensure uniform and equitable treatment of persons who may be displaced from their homes and businesses during federal programs, such as disaster relief or national emergencies, or as a result of projects involving acquisition of a private property. URA provides for the issuance of relocation benefits to persons displaced in such actions. When an FOSC determines that activities at a response action will affect local residents, USEPA is authorized under Executive Order 12580, Superfund Implementation, to temporarily relocate the threatened individuals as part of the removal action. According to the URA, the USEPA FOSC makes the determination of the need for relocations that are carried out in conjunction with Superfund removal actions.

Under URA, persons being temporarily relocated as part of a CERCLA removal action are eligible to receive reimbursement for all reasonable out-of-pocket expenses incurred in connection with the temporary relocation. This may include reimbursement for any contaminated items which could not be decontaminated and had to be disposed.

Residents may be temporarily relocated into local hotels. Reimbursements made according to URA include housing reimbursement (at cost) and per diem benefits for food and incidental benefits for miscellaneous expenses. The ARC can assist by issuing vouchers to the family to assist in the cost of food. The per diem rates will vary according to the location of the incident.

5.0 Removal

Intro - extremely difficult to clean, several methods and sometimes numerous applications have to be employed. Prior to removal, it is important to document site conditions.

5.1 Pre-Decontamination Documentation

The pre-decontamination documentation of a residence includes extensive documentation with videotape and still photographs of the interior and exterior of the residence. It is important to conduct detailed video documentation of each residential home prior to any removal or decontamination activities. Dedicate a separate videotape for each house for the site files. The videotape will be used to prove what the interior and exterior house looked like prior to entry by USEPA contractors. This is very important and should be conducted slowly and with narration by the person video-documenting the home.

5.2 Screening Residential Clothing and Household Items

All clothing from each residential home should be screened using a MVA. The clothing and all other porous items should be bagged, sealed, removed to fresh air, and allowed to reach an equilibrium with the air volume before the bag is sampled. This process allows any mercury vapors to accumulate in the head space of the bag. The head space in the bag should then be tested by poking a small hole in the bag and inserting the MVA wand into the bag and taking a head-space reading. Any consistent Jerome MVA readings of greater than 10,000 ng/m^3 (0.01 mg/m^3), or site-specific level, on the instrument indicates that there is mercury contamination on the items within the bag. The Jerome MVA is not accurate below 10,000 ng/m^3; therefore, consistent Jerome MVA readings greater than 10,000 ng/m^3 indicate mercury-contaminated items. Any consistent Lumex MVA readings of greater than 10,000 ng/m^3, or site-specific level, indicates the items within the bag have mercury contamination.

Note: When filling the bags with clothes, do not put too many items in the bag or you will not obtain accurate readings. No more than six to eight items should be placed into a bag at one time. Only non-contaminated clothing is allowed back into the home. Keep the clothing in the bags until air sampling analytical results from within the residential home are below the action level.

Note: It has been determined that new opaque (dark) plastic bags can give off detectible levels of mercury. It is recommended that clear plastic bags be used whenever possible.

Example: At the Saylor Way Mercury Spill site in Region 9, the START documented the mercury-contaminated house interior conditions using a video camera prior to removing any items. After video documentation was complete, clothing and all other miscellaneous items were packed into plastic bags. The plastic bags were relocated to the front yard where they were exposed to the sun for approximately five minutes prior to screening. The bags were screened with the Lumex up to three times. If the Lumex results remained greater than 10,000 ng/m^3 after the third screening, the contents were considered contaminated and sent for disposal.

5.3 Decontamination Procedure

The decontamination procedure of a building or a residence requires all contaminated items to be decontaminated or removed for disposal. Items that can not be removed should be cleaned in place. All contaminated items requiring disposal should be documented with videotape, still photographs, and written documentation, as described in Section 6.

If there is visible free mercury in the soil or on the sidewalk, the best way to remove it is by excavating the area. Once excavation is complete, post-excavation soil sampling should be conducted for total mercury analysis.

5.3.1 Mercury Vacuum

Any free mercury is to be collected using a mercury-specific vacuum equipped with a high efficiency particulate filter and activated carbon. The vacuum exhaust should periodically be monitored to determine whether the exhaust filtration system is working properly.

Never use a regular vacuum or shop vacuum to collect mercury. Not only will this action spread the contamination, it will vaporize the mercury in the air causing a greater health risk. It also ruins the vacuum.

5.3.2 Mercury Cleaning Solutions

Porous material (carpeting, curtains, furniture) may need to be removed from the space and screened prior to using mercury cleaning solutions. Prior to addressing non-porous surfaces, considerations as whether baseboards, wall boards and flooring need to be removed should be discussed and evaluated. All non-porous surfaces and linoleum or tile flooring should be wiped down with a liquid and powder cleaning solution specific for mercury. Appendix H summarizes the amalgamation process.

Example: The cleaning powder that was used at Saylor Way Mercury Spill, HgX®, has a chelating compound and dispersing agent. A film forms over the beads of mercury and reacts to produce a non-vaporizing sulfide. The cleaning liquid that was used at Saylor Way Mercury Spill, HgCS-102®, is a clear liquid cleaner and coagulator. The cleaning liquid makes a sulfur amalgam with the metallic mercury. Functioning in the neutral state as a metal, sulfur acts as an attractant binder to the mercury in any form. The liquid coagulant, through nitric acid, causes vaporization of mercury and almost immediately captures the vapor into the liquid by the binding power of the sulfur compound.

5.3.3 Decontamination by Sealing

There have been a few sites where mercury contamination in the floor of a residential home could not be decontaminated. In that case, the FOSC utilized the option to seal the area of concern. This method is only acceptable when all visible mercury is recovered and the floor has been thoroughly decontaminated using an HgX™ solution and elevated mercury vapor levels continue to be obtained.

Example: At the Knox Street Mercury site, Lumex MVAs were used in an attempt to locate any mercury hot spots in the residence; the tile mastic was identified. ERRS crews removed the tile mastic from the kitchen and dining areas. A followup Lumex survey indicated mercury vapor concentrations as high as 4,000 ng/m^3. Based on these levels, the ERRS applied two coats of concrete primer/sealer. A subsequent Lumex mercury vapor survey indicated mercury vapor

concentrations below 1,000 ng/m^3. A final round of air confirmation samples were collected and analyzed; results were below 220 ng/m^3.

5.3.4 Heating and Venting

At the conclusion of the decontamination procedure heat the house or space from 80°F to 85°F for at least 8 hours, and if possible overnight, to volatilize any residual vapors in the residence. If the average summertime temperatures regularly exceed 85°F, you may need to consider heating the house to higher, more realistic temperatures. After heating the house for the given time period, reduce the thermostat to 70°F and vent the house for at least 2 hours. Isolate "clean" areas during the venting process. Venting can be conducted by opening all of the windows and using industrial fans at either end of the house to blow air into and through the house. Following two hours of venting, the windows of the house should be closed to allow the house to reach equilibrium. Post-decontamination air monitoring and sampling can then be performed once the house has reached equilibrium, approximately two hours after venting is completed.

In some instances the amount of Mercury venting from a home will pose a significant exposure issue. In those extreme cases you should consider operating negative pressure, ionized carbon, re-circulators within the home to scrub the air prior to venting the space.

Example: At the Saylor Way Mercury Spill site in Region 9,.....

5.4 Confirmation of Cleanup

Cleanup confirmation can be performed using the Lumex or by air sampling. It is recommended that air sampling be conducted to confirm that residential cleanup activities are complete. Sites requiring minimal or no cleanup may not require confirmation air sampling (i.e. Apple Valley where only vacuum cleaner bags were above the site action level).

The sampling height of the sorbent tube should be set at approximately three feet. This height simulates the breathing zone for children. The location of each sampling pump should be in the areas of the home where maximum exposure to mercury contamination would occur (e.g. living room, bedroom depending on location of the spill).

Example: At the Saylor Way Mercury Spill site in Region 9, confirmation air sampling was conducted to determine whether mercury contamination had been removed to below the site action levels. The location of each sampling pump corresponded to where maximum exposure to mercury contamination would have occurred, which in this case included the bedroom, the dining room, and the hallway.

5.5 Disposal

All contaminated items should be placed into roll-off boxes or drums and site security should be procured to guard the roll-off boxes and drums until disposal arrangements are made. The following disposal options may be considered:

- Elemental mercury can be recycled.

- Low-level mercury-contaminated household debris can be transported to a hazardous or special waste landfill.
    1. Wastes which are known to be contaminated with mercury at levels equal to or exceeding RCRA TCLP hazardous waste determining limit of 0.2 mg/l and land ban level of 260 mg/kg must go to a RCRA facility for treatment prior to being disposed at a hazardous waste landfill. The same applies to waste in the state of California which is equal to or exceeds the STLC (0.2mg/l) or the TTLC (20 mg/kg) values for mercury

    2. Wastes which are known to be contaminated with mercury at levels less than RCRA TCLP hazardous waste determining limit of 0.2 mg/l and land ban level of 260 mg/kg are considered non-hazardous special waste.

5.6 Waste Profile and Manifest

A waste profile and a manifest should be used for all mercury-contaminated household items and soil that are transported for off-site disposal. Typical basic shipping descriptions are as follows

Contaminated debris or soil with mercury concentrations equal to or exceeding RCRA TCLP hazardous waste determining limit of 0.2 mg/l and land ban level of 260 mg/kg would be shipped as

RQ, Waste Toxic solid, inorganic, n.o.s., 6.1, UN3288, PG III (mercury contained in soil)

or

R.Q., Hazardous Waste solid, nos., (D009), 9, NA3077, PGIII

It is always a good idea to call RCRA hotline and discuss proper shipping names. The RCRA Hotline number is (800) 424-9346.

6.0 Documentation Procedure for Contaminated Items

It is important to conduct detailed written and photographic documentation of all items determined to be contaminated. After all mercury-contaminated items are bagged and placed outside of the residential home, a detailed inventory should be conducted. This includes writing a description of each item, the condition of each item, and any pertinent size measurements which may affect the reimbursement cost of the item. In addition, the MVA reading of each contaminated bag should be included to prove that those items were mercury contaminated. An example of a Contaminated Items Documentation Log is provided as Appendix I.

After the items are inventoried, a picture of approximately four to six items per photo should be taken. Make sure to include the address of the residential home on a clipboard in the picture. If required, the pictures can be placed in a photo album in order as written on the written detailed description form. This will allow a third-party appraiser to easily match up each item's detailed description to the picture in the photo album.

6.1 Replacement Considerations

The Federal Emergency Response Program under Superfund is authorized to expend federal funds specifically to address the release into the environment of hazardous substances, and pollutants or contaminants which may present an imminent and substantial danger to public health or the environment. Hazardous material releases can also damage or contaminate private property, or property may be damaged in the response effort. In these circumstances, the USEPA may consider compensating private citizens for such property.

Most losses suffered by private citizens should be compensated by the party or parties responsible for the contamination. However, if a potentially responsible party (PRP) cannot be identified or is not viable, the USEPA may compensate for loss of private property. If the USEPA elects to compensate for property loss due to a hazardous substance release or the resulting response effort, some circumstances may limit eligibility for compensation under Superfund. Superfund may not cover losses due to the negligence of contractors; the contractors themselves would be responsible for such losses. Also, citizens that have been found to be PRPs at a site are generally not eligible for compensation.

Finally, if an educational institution or homeowner is determined to be responsible for the release, but not a viable PRP (ie; cannot pay cleanup costs), the USEPA may fund costs associated with the cleanup and basic restoration of the PRP's building or residence, but not costs associated with the PRP's furnishings or property (furniture, appliances, clothing, toys, etc.). The building or residence will be cleaned or restored only to the extent that it does not present a health threat to the residents and the building is habitable. The USEPA will not compensate for losses associated with moveable furnishings and private property. In general, this would include area and/or wall-to-wall carpeting placed over a finished floor (hardwood, tile, linoleum). Wall-to-wall carpeting placed over plywood flooring would be considered part of the building, and could be replaced to make the residence "habitable."

At the discretion of the FOSC, the USEPA may provide compensation through three methods: restoring property to its original condition; providing replacement property of similar value; and

reimbursing owners in cash for the value of lost property. In general, restoration should be the first option considered, followed by replacement. In some cases, the ARC or the local health department may have monies available to fund reimbursement costs.

A third-party appraiser will be required to be hired to place a value on the items determined to be mercury contaminated. The appraiser may charge a flat fee or an hourly rate for this service.

6.2 Restoration

It is important to conduct detailed video-documentation of the residential home(s) once ERRS has completed removal and decontamination activities. Use the video tape dedicated to the respective house which was used for pre-decontamination documentation. The detailed pre- and post-documentation of each home will be used for liability purposes to prove whether the USEPA was responsible for any damages to the home which occurred during the decontamination of the home.

If performed, the restoration phase for each residence will begin after the home has been properly decontaminated; post-decontamination air sampling activities are completed; and air sampling analytical results are found to be less than 1,000 ng/m^3 or the site-specific action level.

The restoration process for each decontaminated residence will begin by reviewing the START pre-decontamination video-documentation and any special considerations identified during the decontamination process. A list of items to be restored in each home should be itemized. A restoration subcontractor should conduct a pre-restoration inspection of each residential yard or house to inspect the condition of the structure and utilities, and to prepare an estimate of the total cost to restore the yard, carpeting, linoleum, or floor tile to its condition prior to contamination. The estimate will be reviewed, modified, if necessary, and approved by the FOSC prior to the initiation of any restoration work. Restoration of homes is designed to return each house in the condition prior to the decontamination process and to repair any damage caused by the decontamination procedures. This should be performed on a case by case basis. In some cases, the local governments may have the resources available to fund the restoration of areas requiring excavation during removal activities.

APPENDIX A

Summary of Significant Mercury Responses

APPENDIX B

ATSDR Suggested Action Levels for Indoor Mercury Vapors
in Homes or Businesses with Indoor Gas Regulators

APPENDIX C

Comparison of Real-Time and Laboratory Analysis of Mercury Vapor

APPENDIX D

Comparison of Methods for Mercury Analysis

APPENDIX E

SOP for Modified NIOSH Method 6009

APPENDIX F

Mercury Screening Form

APPENDIX G

USEPA Access Agreement

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 9
EMERGENCY RESPONSE BRANCH
75 Hawthorne Street
San Francisco, California 94105

CONSENT FOR ENTRY AND ACCESS TO PROPERTY

Name: _____

Address: _____

_____

_____ Phone: _____

Address of Property for which consent to access is granted:

_____

_____

_____

Relationship to property: _____
(i.e., owner, 5-year tenant, etc.)

I consent to officers, employees, and authorized representatives of the United States Environmental Protection Agency (USEPA) entering and having continued access to my property for the following purposes:

1. Air and wipe sampling;

2. Decontamination of structures, fixtures and furnishings contaminated by mercury;

3. Stabilization and disposal of contaminated structures, furnishings, and/or fixtures which remain contaminated, including in some cases, the removal of contaminated building components such as carpets, floors, walls, ceilings and paneling;

4. Installation of carpet, floors, and walls (if necessary due to #3 above);

5. Removal of contaminated soil, if necessary; and

6. Such other actions as the USEPA On-Scene Coordinator determines necessary to protect human health, welfare, or the environment.

I realize that these actions by the USEPA are undertaken pursuant to its response authorities under the Comprehensive Environmental Response, Compensation and Liability Act

of 1980, as amended (CERCLA), 42 U.S.C. § 9601 et seq.

I also realize that there may be a loss of or damage to of property during these actions. I addition, I realize USEPA will be utilizing my utilities, including heat, water, and electricity.

To the extent that USEPA does replace any item determined to be contaminated, I acknowledge that it makes no representations about the quality, aesthetics, safety, use or character of such item or its installation. Furthermore, USEPA makes no warranties as to such item or its installation, including but not limited to warranties of merchantability or fitness for purpose.

I also consent to local and state health officials reviewing this work, not otherwise covered by this agreement, entering and having access for the property, if any, due to the activities performed pursuant to this agreement.

This written permission is given by me voluntarily with knowledge of my right to refuse and without threats or promises of any kind.

I certify that this Consent for Entry and Access is entered into voluntarily and constitutes an unconditional consent and grant of permission for access to the property by officers, employees, and authorized representatives of USEPA for the purposes specified above at all reasonable times.

_____ _____

Date Signature

APPENDIX H

Amalgamation Process

APPENDIX I

Contaminated Items Documentation Log

Contaminated Items Documentation Log	
Address:	
Description of Items	**Hg Level (ng/m^3)**

APPENDIX J

Quick Reference Sheets for Operating Lumex and Jerome