Office of Research Facilities

Successful Implementation of the New NIH Facility Decommissioning Protocol:

Results of a Pilot Project

Edward H. Rau

James Carscadden

Division of Environmental Protection
Office of Research Facilities Development and Operations
National Institutes of Health

U.S. Department of Health and Human Services

Office of Research Facilities

This is an updated version of the original presentation made at the U.S. Department of Health and Human Services Environmental Symposium Workshop held in May 2004 .

Workshop location:

Lister Hill Center Auditorium of the National Library of Medicine on the campus of the National Institutes of Health in Bethesda, Maryland.

Last Updated January 2010

Purpose of Presentation

- NIH's proposed protocol for improving the laboratory decommissioning process was presented at the first DHHS Environmental Workshop in 2002.
- Here we will summarize the results of the first full implementation of that protocol conducted as a pilot project at NIH Building 3 and the lessons learned from this project.
- Emphasis will be on mercury, a ubiquitous contaminant in older biomedical facilities.

Background

A Major NIH Initiative: Improving the Facility Decommissioning Process

- Multiple, large lab facility renovation projects at NIH dictate the need for a more systematic and streamlined decommissioning process.
- Revitalization of Building 10 is needed and will probably be one of the largest, most complex decommissioning projects in history.
  - The total area involved is greater than that of the Pentagon.
  - It is largely comprised of laboratories and clinics. A variety of hazardous materials were used in their operations.
  - Asbestos, lead, polychlorinated biphenyls were widely used in construction of the original building.

<u>Building 10</u>

Warren G. Grant Clinical Center

Phases of the Decommissioning Protocol

I - Initial Facility Assessment

Determine potential contaminants by reviewing historical records, interviews and observations.

II - **Facility Characterization Assessment**

Perform if indicated by results of the initial assessment. Conduct sampling and analysis to determine if potential contaminants are present and to estimate the extent of contamination for development of remediation plans, contract specifications and cost estimates.

III - **Decontamination and Remediation**

IV - **Final Status Survey**

Process Enhancements Evaluated in the Pilot Project:

- Use of a systematic, phased protocol.
- Detailed checklist for assessing hazardous substances likely to occur in biomedical facilities.
- Technical guidance for assessment, decontamination of remediation of mercury and other specific contaminants.
- Procedures for minimization and disposal of hazardous debris.

Checklist for Hazardous Substances in Decommissioning

- Developed by NIH to assist in conducting initial facility assessments for hazardous substances:
  - Lists areas and equipment in facilities that may contain hazardous substances
  - Includes dates of applicable bans for various substances to limit scope of assessment by age of building
  - Characterizes hazardous substances as intrinsic or contaminant per the EPA Debris Rule
- A work in progress. The checklist is updated whenever new contaminants are found during subsequent decommissioning projects.

Example of a Section from the Decommissioning Checklist

Updated: May 2008

DEP Decommissioning Guidance - Attachment 1

CHECKLIST FOR HAZARDOUS SUBSTANCES THAT MAY BE ENCOUNTERED IN DECOMMISSIONING I

ITEM OR AREA DESCRIPTION	CHEMICAL HAZARDS	Antifreeze compounds	Arsenic compounds	Azides-reactive	Cadmium or its compounds	Chromium compounds	Diethylhexylphthalate (DEHP)	Dioctylphthalate	Fuels - flammable or combustible liquids	Lead metal	Lead compounds	Lead-sulfuric acid battery	Mercury compounds	Mercury metal	Nickel-cadmium (Ni-Cd) batteries	Oils	Ozone depleting substances (CFCs, HFCs, HCFCs)	Perchlorates - reactive	Picrates - reactive	Phosphoric acid	Polychlorinated biphenyls (PCBs)	Selenium compounds	Silver metal and its compoun	Te
Accelerators and cyclotron areas																								
Autoclaves																								
Barometers and manometers														■										
Batteries																								
Alarms and smoke detectors														■										
Emergency lighting												■												
Exit signs					■							■			■									
Cage washers																				□				
Casework														□										
Ceiling tiles																								
Compressors																■	■							
Dental clinics														□										
Shielding										■														
Electrical systems																								
Cables and wiring										■														
Cables, shielded										■														
Cables, oil-filled										■						■					■S			
Capacitors							■			■						■					■S			
DC Watt hour meters														■										
Fuse bases																								
Relays														■							■S			
Switches - tilt, silent, float, industrial														■										
Thermostats														■										
Transformers																					■□S			■
Transformer vaults																					□			
Voltage regulators																					■S			
Electron microscopy areas											□			■□										
Elevators																								
Brakes and clutch facings																								
Pits																□								
Exit signs, self-powered																								

(Full Copies are Available on Request)

Pilot Project Location

- Building constructed in 1938
- Historical significance:
  - Home to 5 Nobel Laureates
  - Documentary film available
- Size
  - Four stories and two basements
  - Total area 47,000 $Feet^2$
- Primary functions
  - Early uses: animal care and breeding; some labs
  - Recent years: NHLBI and NIAMD laboratories

NIH Building 3

General Decommissioning Plan

- Before decommissioning – hazardous substances (chemical, radioactive and biohazardous) in containers and equipment were to be removed by occupants.
- Conduct surveys in radiation areas for surface contamination.
- Decontaminate and remove all hoods, casework and plumbing for recycling or disposal.
- Assess and decontaminate hazardous substances in the remaining infrastructure.
- Conduct final status survey to confirm decontamination and release building for architectural demolition and new use as an office.

Why is Mercury a Major Concern In Laboratory Decommissioning?

- Probably present as a contaminant in almost all types of labs and biomedical facilities above levels regulated as hazardous waste or that may cause wastewater discharge limits to be exceeded.
- Potential for serious personnel exposures and releases during demolition activities.
- Adverse health effects may result from chronic exposure to very low levels.
- Easily spilled and reportable quantities are very low.
- Wastewater discharge limits are becoming much more strict.
- High potential long term environmental liability associated with contamination and improper disposal of hazardous debris.
- Pollution prevention mandates are focused on persistent, bioaccumulative and toxic chemicals (PBTs) such as mercury.

Treatment and Disposal of Mercury Debris is Problematic and Costly.

- Most limiting constituent affecting disposal - regulations require debris to be managed as hazardous waste if leachate contains greater than 0.2ppm (mg/l) of extractable mercury.
- On-site treatment may be required to reduce volume and toxicity – this raises permitting issues.
- Few disposal options and facilities
- Extremely high unit cost of disposal relative to other construction and demolition (C&D) waste streams

Assessment Phase

Assessment Objectives

- Locate and characterize hazardous substances in plumbing and infrastructure:
  - Asbestos, lead paint and PCBs – already assessed in previous surveys
  - Mercury
  - Lead metal in other infrastructure
  - Other hazardous chemical substances
  - Radioactive materials

Assessment Objectives
(continued)

- Collect information for selecting decontamination approaches
- Characterize and estimate quantities of
  - Recyclable materials
  - Hazardous wastes
  - Radioactive wastes
  - Multihazardous wastes (includes mixed waste)
- Evaluate mercury vapor meter as a method of surveying sink traps for contamination

Assessment of Wastewater System Plumbing

- Sink traps were assumed to be worst case – highest risk of significant mercury and lead contamination
- Traps studied were selected from:
  - All types of materials: brass, PVC, iron, composites
  - All floors: 1-4, basement, subbasement
  - All types of labs and other occupancies.
- Pipes downstream of sink traps extending to building perimeter were also tested.

Reactivity Concerns - Laboratory Plumbing Removal

- Past laboratory uses and discharges of picric acid and sodium azide solutions may have formed reactive, potentially explosive residues in contact with metals used in plumbing.
- Chemical inactivation of residues was deemed infeasible:
  - Different and incompatible inactivation chemicals would be required for azides and picrates.
  - Inactivation chemicals cannot be discharged to the sewer, present additional safety hazards and require disposal as RCRA Hazardous Waste.
  - Potential to change composition of residues in pipes and interfere with analyses that were part of the pilot study.

Precautions for Potential Reactivity

- All drain lines were kept wet.
- Pipes were cut above joints – no couplings were unscrewed (to avoid friction).
- Work was performed by an experienced explosives technician.
- Technician wore heavy gloves, face shield and body armor during trap removal operations.

Sink Trap Removal

Sink Trap Removal – Visually Checking Contents for Mercury Metal

- Precautions for containment of spills need to be taken when removing traps.

- Note the large droplet of mercury in the bottom left corner of the tray.

Additional Reactivity Concerns - Chemical Fume Hood and Ductwork Removal

- Perchlorate contamination in fume hoods and exhaust ductwork presents another potential explosion hazard during demolition.
- Information on historical uses of perchlorate in each laboratory was unavailable or unreliable.
- All hoods were tested for perchlorate contamination and evaluated by an explosives technician before removal.
- Hoods with evidence of perchlorate contamination were washed thoroughly with water before removal.
- All hoods and ductwork were kept wet during removal operations to further minimize reactivity hazards.

Results - Field Observations

- No reactivity was observed during removal operations.
- Elemental mercury was found in about 10% of traps.
- Gold foil-type mercury meter deemed not effective for trap surveys – readings were at background at sinks with mercury contaminated traps.
- Some cup sinks upstream from traps were made of lead metal. A total of 62 lead cup sinks were found.

Summary of Chemical Analysis Results on Plumbing Residue Samples

- Contamination with mercury and lead above the estimated TCLP thresholds was evident throughout the wastewater system.
- Other toxic metals were present in localized areas:
  - Arsenic, chromium, selenium, silver
- Contamination was largely associated with sediments, not the trap components.
- No association evident between trap materials and contamination levels.
- Meter readings do not identify traps with mercury above levels regulated as hazardous waste.
- Radioassays of surface swipes and solids did not indicate presence of radioactive residues – *Debris will not be a mixed waste!*

Air Surveys to Assess Areas for Spills and Contamination

Air Survey Objectives

- Collect air readings throughout building in breathing zones and in proximity to surfaces.
- Establish background air levels in building before demolition.
- Locate spills, contaminated equipment and areas to be cleaned up.
- Mark contaminated items/areas with paint and indicate same on building drawings.
- Estimate decontamination work for bid documents.

Air Survey Instrumentation

- This is a portable AA spectrophotometer with Zeeman background correction.
- Use of gold foil amalgam type meters was discontinued.
- This unit was used during all remediation activities

Lumex Model Ra-915+

Copyright © 2001 - 2006 OhioLumex Co.

Reasons for Selection

- Not susceptible to interferences from other common chemicals.
- Allows real-time assaying with a response time of 1 second.
- Can be modified to detect organometallic mercury compounds
- With appropriate attachments can be used to analyze liquids and solids on-site - 15 samples per hour:
  - Water (cold vapor) - Solids (pyrolyser)
- Has the high selectivity and ultra low detection limits needed for final clearance surveys
  - 2 ng/m^3 (air)
  - 0.5 ng/l (water)

Office of Research Facilities

Project Air Action Levels

Reference Air Concentration	Normalized (Nanograms/Cubic Meter)
Air Survey Action Level (ASAL) If exceeded the area sampled was assumed to be potentially contaminated and further investigation and decontamination was to be performed.	250
Post Decontamination Material Clearance Level If the level at the surface of an object was less than this limit it was released and no further decontamination was required before release as non-hazardous debris.	1000*
Final Clearance Level for Release of Areas This clearance level is 10 times lower than the ACGIH TLV for occupational exposure.	2500

* This level was lowered to 250 in subsequent projects.

Office of Research Facilities

Project Air Action Levels:
Relationship to other Regulatory Standards and Guidelines

Reference Air Concentration (Mercury Vapor)	Normalized Units (Nanograms/Cubic Meter)
NIOSH Immediately Dangerous to Life or Health (IDLH)	10,000,000
OSHA 8 Hour TWA Permissible Exposure Level (PEL) Note: Incorrectly listed in 29CFR1910.100 Z-2 as Ceiling Limit	100,000
ACGIH Threshold Limit Value (TLV) 8 Hour (Occupational exposure)	25,000
EPA Reference Concentration (RfC) (Chronic exposure/general population)	300
ATSDR Minimal Risk Level (MRL) (Non-occupationally exposed individuals)	200

Project Air Action Levels for Mercury: Rationale

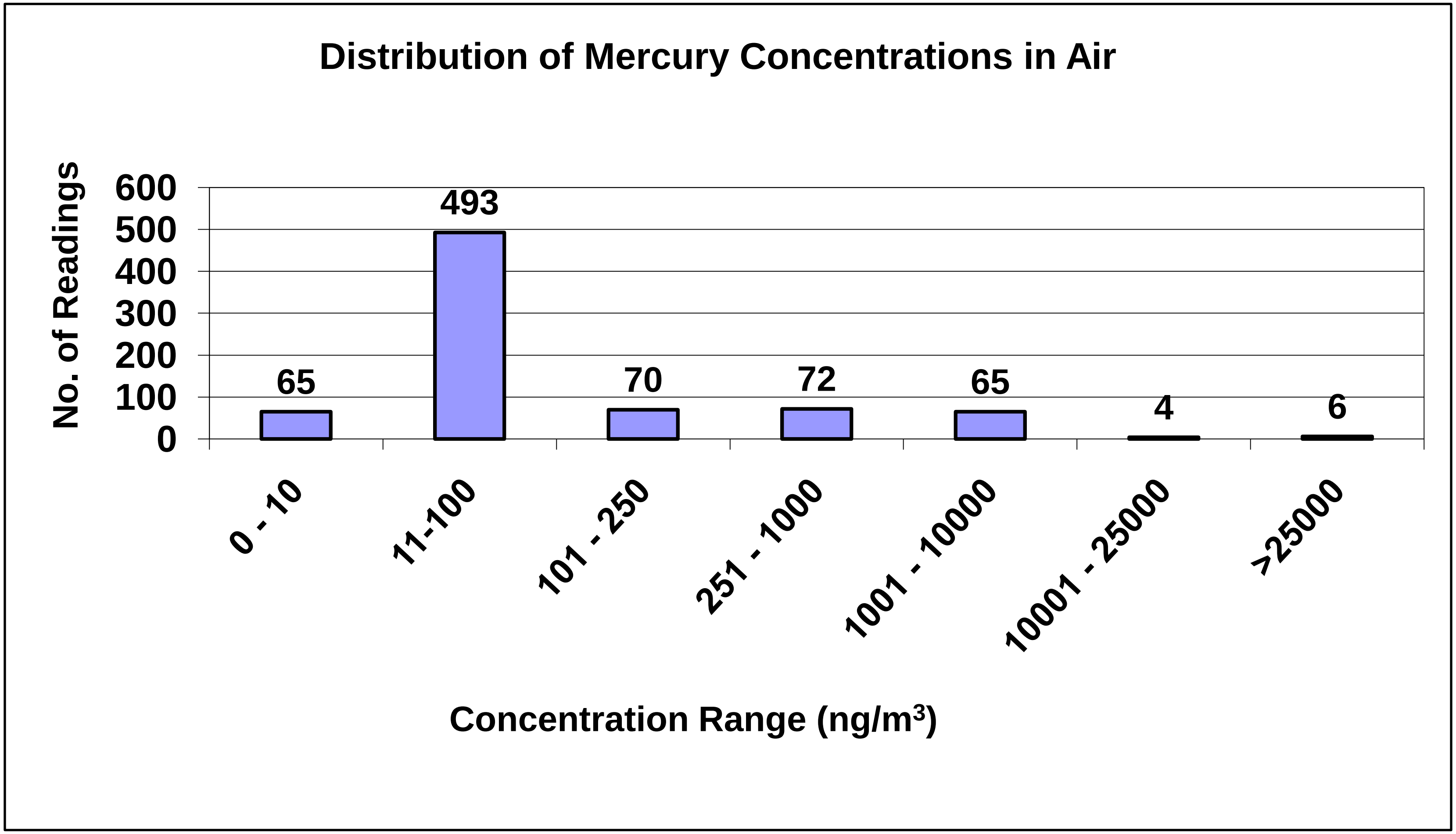
We are frequently asked why the Air Survey Action Level (ASAL) used was higher than the clearance levels for materials and areas.

- The ASAL is significantly above the expected indoor background level and is used as an indicator of a spill or contaminated object in the area requiring further investigation, not to access health risk. Many factors such as temperature, air circulation patterns, chemical form etc. can reduce the effectiveness of air monitoring for detection of contaminated areas so this very conservative trigger level was used.
- The release levels used in this project for materials and areas were well below the regulatory limit (OSHA PEL of 100,000ng/m^3) and the ACGIH TLV (25,000ng/$m^{3)}$ but higher than those currently used for releases of materials. This higher level was necessary to discriminate from the high background levels encountered in areas undergoing demolition.
- In subsequent projects we reduced the release limit for materials to 250ng/m^3 at the surface of the object.

Project Air Action Levels: Rationale
(Continued)

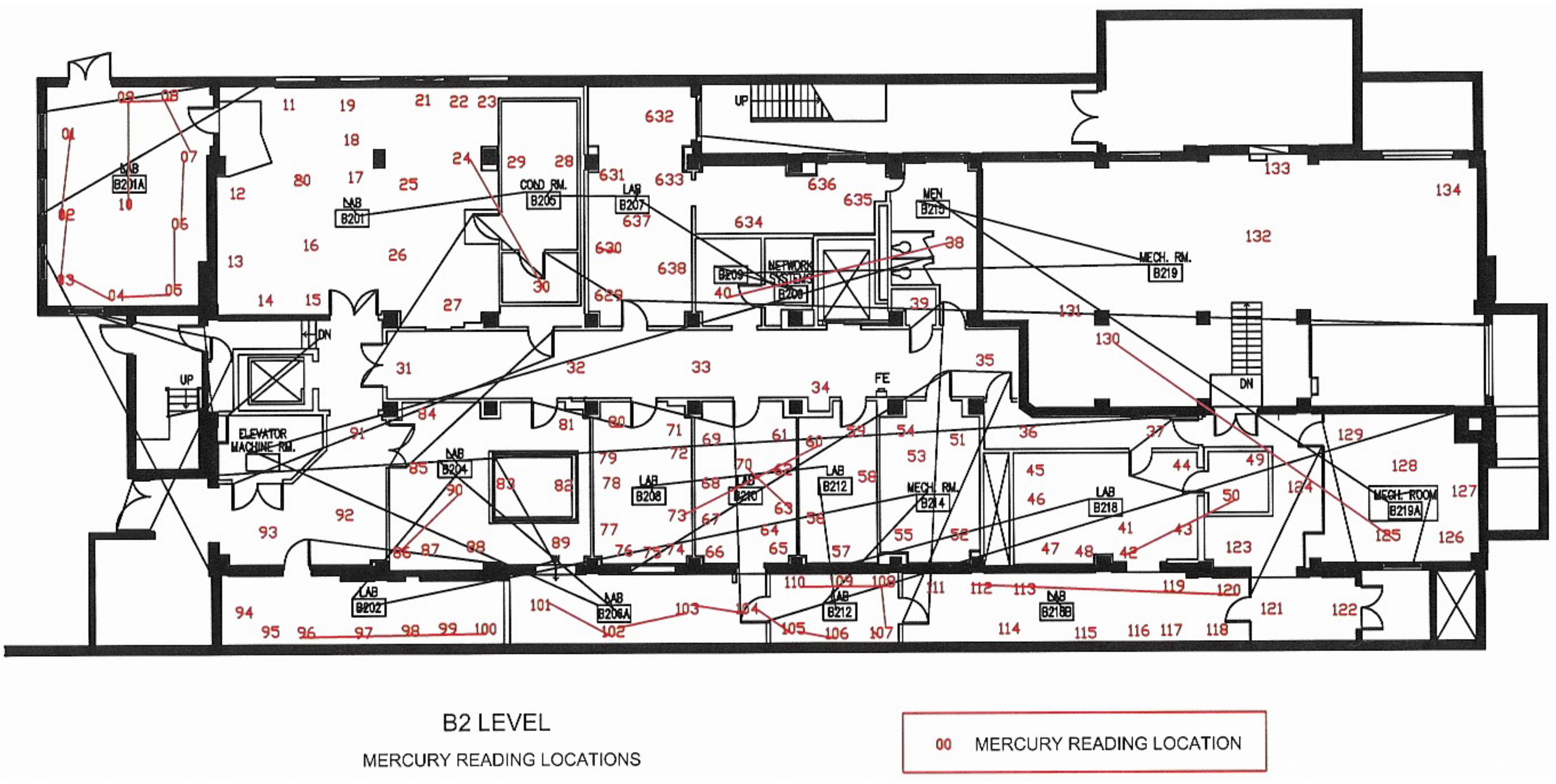
- The Post Decontamination Clearance Level (PDCL) is set at the beginning of the project and should ensure that levels of contaminants present after decontamination present an acceptable level of risk to the most sensitive future next occupants of the cleared area.
- For airborne mercury vapors in the breathing zone:
  - The PDCL used in this project (2500ng/m^3) was conservative for occupational exposures – ten times lower than the NIOSH TLV (25,000ng/m^3).
  - For non-occupationally exposed populations the PDCL should be below the lowest levels associated with heath effects in chronically exposed members of the general population.
  - For the general population these levels are about 100 times lower than the TLV for occupational exposures. Refer to the EPA Reference Concentration (300ng/m^3) and the ATSDR Minimal Risk Level (200ng/m^3)
  - PDCLs below the EPA(RfC) and ATSDR MRL for the general population may be required to protect sensitive individuals and research activities.

Air Survey Results – Pilot Project



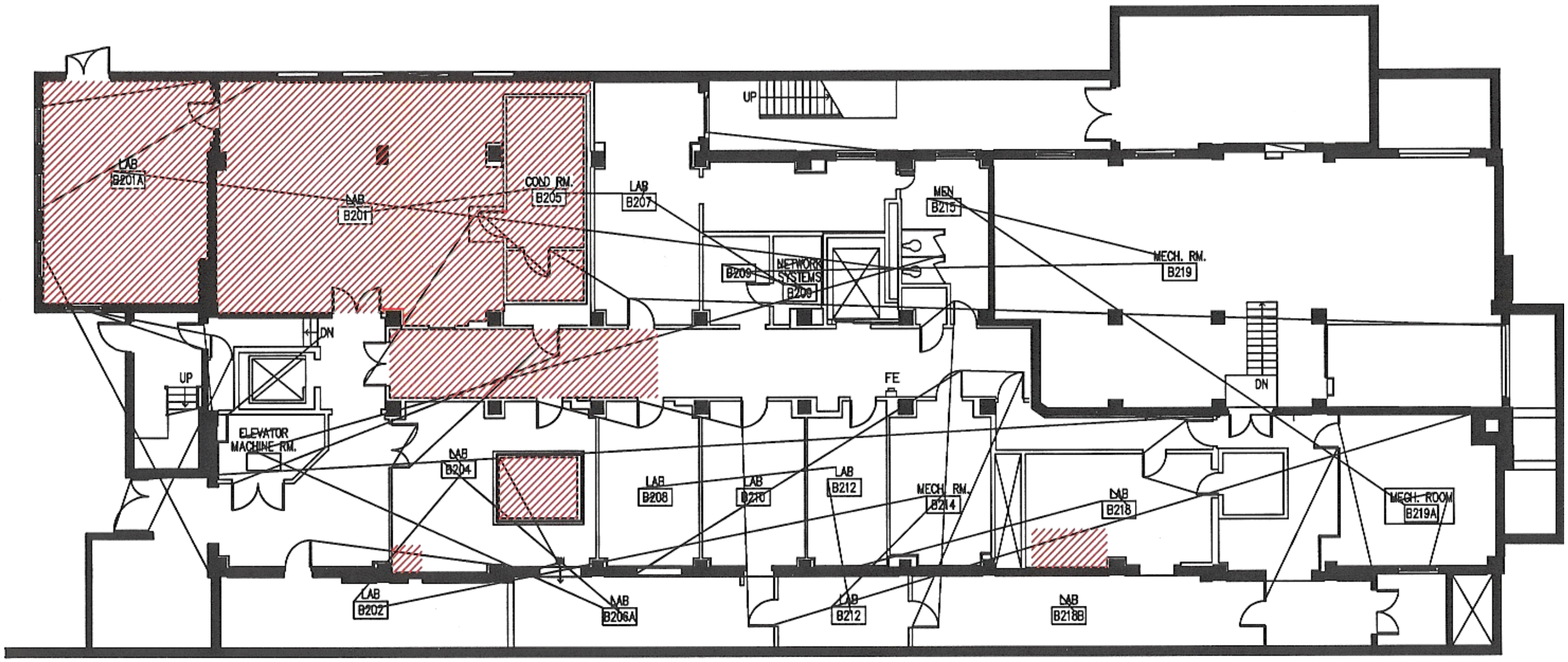
Air Survey Results

Example of Drawing Showing Readings and Locations



Air Survey Results

Example of Drawing Showing Areas Above Action Level



B2 LEVEL

ELEVATED MERCURY LOCATIONS

ELEVATED MERCURY LOCATION

Air Survey Results

- The background level in the vicinity of the building was less than 10 ng/m^3
- A total of 917 inside air readings were taken in 77 labs and corridors:
- 28/77 (36%) of labs had mercury levels greater than 250 ng/m^3:
  - 19/28 (68 %) general area contamination
  - 9/28 (32%) labs with only hot spots
- Contamination was found in other areas – cold rooms, restrooms corridors and offices, probably as a result of trackage from contaminated laboratories.
- No levels were found above the OSHA TLV in the breathing zone.

Assessment for Items Containing Intrinsic Mercury

Assessment Steps

1. Developed checklist of mercury containing items
2. Conducted visual survey to locate items on the checklist
3. Prepared inventory of items found and their locations
4. Removed items before selective demolition

Items Found

- Flow meters
- Fluorescent light tubes
- HID light bulbs
- Manometers
- Refrigerators and freezers
- Switches (many types)
- Thermostats
- Thermometers

Remediation Phase

Planning Considerations

Environmental Health and Safety

- Need to protect employees against multiple hazardous substances and structural hazards.
- Avoid reportable releases of mercury and other hazardous substances to the environment
- The Reportable Quantity for mercury releases is small - only 1 pound:
  - Mercury Metal = 33.6 ml
  - Mercury Characteristic Wastewater = ~ 454 ml
- Comply with RCRA hazardous waste accumulation, storage and labeling requirements.

Planning Considerations:
Waste Minimization

- Ensure strict segregation of waste streams, particularly high mercury retort treatability group wastes (extreme disposal cost).
- Segregate pipes from horizontal runs (most likely to be contaminated) from risers and vents.
- Decontaminate and recycle casework and other nonporous wastes to minimize generation of hazardous debris.
- Minimize use of water in decontamination activities to reduce generation of wastewater requiring management as hazardous waste.

Wastewater System Plumbing Removal

Removal Options Considered

- Decontaminate plumbing in-situ.
- Remove, decontaminate plumbing and recycle as nonhazardous scrap.
- Remove and dispose of contaminated plumbing as hazardous waste without on-site treatment:
  - Retort liquid mercury and intrinsic materials (non-debris).
  - Macroencapsulate and landfill mercury contaminated debris off-site.

Option Selected:

Remove Plumbing and Dispose Without Treatment

Justifications:

- Project plan was for all plumbing was to be removed during demolition – none left in place.
- Reduced testing and analysis requirements.
- Less handling and potential for spills and exposures.
- Very limited space was available for on-site handling and treatment of bulky wastes.
- Uncertainty that pipe treated by on-site treatment methods would consistently pass TCLP for multiple metals.

Office of Research Facilities

Justifications
(Continued)

- Potential for generation of large volume secondary waste streams from treatment activities that would requiring additional treatment and/or off-site disposal.
- RCRA permitting may have been required for on-site treatment.
- Macroencapsulation/landfill profile allows a wide variety of types of debris materials, asbestos, multiple RCRA metal contaminants and mercury > 260 ppm.
- Confidence that minimization requirements could be applied to reduce generation of high cost waste streams.

Plumbing Removal Methods - Cutting Pipe

Office of Research Facilities

Plumbing Removal – Draining Contained Liquids and Pipe Sludge

Office of Research Facilities

Plumbing Removal – Sealing Cut Ends to Prevent Spills

Plumbing Removal – Moving Debris Out of Building

Plumbing Removal – Temporary Debris Storage and Shipping Container

- Outdoor storage in a containment area
- 20 cubic yard dumpster with:
  - Absorbent
  - Tarp cover
  - Hazardous waste signage
- Dumpster selected was a DOT approved for use as a shipping container.

Plumbing Removal – Accumulation Container for Retort Wastes

- For high mercury wastes to be treated at a retort facility
- Traps were assumed to contain greater than 260 mg/kg mercury.
- Drained traps could have been shipped for macroencapsulation to reduce disposal cost.
- Retorting is required for wastes containing liquid mercury and mercury wastes that are not classified as debris.

Office of Research Facilities

Assessment and Removal of Subsurface Sanitary Sewer Lines

Assessment

- Findings:
  - Monitoring air at pipe openings entering foundation showed elevated mercury levels.
  - A video camera survey of subsurface pipes was conducted to investigate this.
  - Survey revealed what appeared to be mercury accumulations in several areas and other areas with obstructions and collapsed pipes.
- Presumptions: Mercury contamination was present in the subsurface plumbing.

Suspected Mercury Accumulation on Bottom of Subsurface Pipe as Seen in Building Sewer Video

Remediation of Subsurface Wastewater Plumbing

<u>Steps:</u>

1. Mapped wastewater system for project planning.
2. Selected remediation option:
   - Pressure washing and collection of wastewater was considered; rejected as infeasible due to collapsed pipes and obstructions.
   - Removal option selected.
3. Conducted engineering evaluation to determine impacts of pipe removal on structural integrity of building.
4. Removed contaminated pipes.
5. Tested surrounding soils for contamination – none found.
6. Filled excavations with gravel and poured new concrete floor

Mapping: Excavations Revealed Multiple Inactive and Active Systems

(Photo from 10/29/03)

Plumbing in Proximity to Building Support Footers

Area Decontamination

Office of Research Facilities

Decontamination Steps – Room Areas

(If Air Concentration is Greater Than Action Level)

- Clean-up visible spills with a mercury vacuum cleaner.
- Vacuum cleaner had charcoal and HEPA filters to prevent air emissions.
- Remove and dispose of contaminated porous materials (wood etc.) as hazardous waste.
- Remove all casework from room, decontaminate it and recycle as scrap metal.
- Remove and dispose of floor tiles as hazardous, asbestos containing material.

Decontamination Steps
(Continued)

- Clean and decontaminate floors and walls.
- Apply suppressant if needed during or after cleaning
- Conduct follow-up air testing
- Repeat decontamination if surface readings are greater than the release level (1,000 ng/m^3)*
- Perform final clearance survey after all demolition activities are complete.

***The release level used in current decommissioning projects is 250 ng/M^3**

Area Decontamination – Preparing Mercury Vacuum Cleaner for Use

Area Decontamination – Removal of Visible Mercury Droplets From a Floor with a Mercury Vacuum Cleaner

Area Decontamination – Removal of Casework

Area Decontamination –

Installation of Spill Containment System in Area Used for Decontamination and Clearance of Casework

Area Decontamination –
Cleaning Items Before Release

Area Decontamination –
Floor Clean Up Before Tile Removal

Final Clearance Survey

- Purpose was to ensure that the building was safe for unrestricted use.
- Conducted after all decontamination and architectural demolition was complete.
- Procedures:
  1. Seal connections, penetrations between floors.
  2. Discontinue ventilation.
  3. Raise air temperature to 80-85^{o}F for minimum of 8 hours.
  4. Survey air near surface at random points.
  5. Collect time-weighted sample from breathing zones (one per open floor area or contiguous air space).

Final Clearance Survey
(Continued)

6. Clear areas if mercury level is $\leq$ 2,500 ng/m^3
7. Repeat decontamination procedures in areas with mercury > 2,500 ng/m^3 until clearance level is reached.
8. Release for unrestricted use when all areas and floors of the building are $\leq$ 2,500 ng/m^3
9. Submit final report and documentation of results to safety officer.

Final Clearance Survey Results

ng/m^3 [Temp. ^{o}F]

Level	Floor Surface Random Points (Mean)	Breathing Zone (8 Hour TWA)
4	144 [83]	243 [98]
3	255 [83]	299 [90]
2	266 [87]	159 [94]
1	225 [88]	117 [90]
B1	125 [81]	151 [87]

Final Clearance Survey Results

(August 2003 – Temperature 87-98^{o}F)

- All areas and all floors passed – including surfaces and breathing zone samples.
- **All results were below the EPA Reference Concentration (RfC) of 300ng/m^3**
- **This was approximately 10 times lower than the maximum release level originally set for the Project.**

Waste Generation and Costs

Estimated Quantities of Hazardous Wastes Generated

Fluorescent light tubes Recycling	5,700 Linear Feet 550 Kilograms
High Mercury Wastes Retort – Mercury Recovery	1,125 Kilograms
Hazardous Debris Macroencapsulation and landfill	85 Cubic Yards 21 Metric Tons
Wastewater Hg > 0.2 mg/l Treatment	1,100 Liters ~ 5 X 55 gallon drums

Office of Research Facilities

Estimated Project Costs

Plumbing Assessment Study (One-time study)	**$100,000**
Area Contamination Survey (Air monitoring and mapping)	**$ 17,000**
Area Decontamination (excludes asbestos)	**$350,000**
Above-slab Plumbing Removal	**$100,000**
Sub-slab Plumbing Removal	**$73,000**
Hazardous Waste Disposal	**$ 100,000**
Slab Restoration	**$ 26,000**
Asbestos removal and disposal	**$250,000**
Final Clearance Survey	**$12,000**
Total Project	**$1,028,000**

Estimated Decontamination Costs

Per Square Foot of Building Area

Contamination Assessment (Excludes non-routine plumbing study cost)	**$ 0.36**
Decontamination and Removal Operations (Included area decontamination and all plumbing removal; excludes asbestos)	**$11.13**
Hazardous Waste Disposal (Excludes associated general solid waste disposal, scrap metal recycling, asbestos disposal)	**$ 2.13**
Site Restoration (floor slab)	**$0.55**
Final Clearance Survey	**$0.26**
Asbestos Removal and Disposal	**$5.32**
Total for Decontamination, Assessment and Abatement	**$19.75**

Conclusions

- The decommissioning protocol was successfully implemented.
- The assessment and decontamination techniques used here worked well and provided invaluable information for application to future decommissioning projects.
- Full decommissioning was completed without excessive personnel exposures, environmental releases or significant project delays.

Conclusions
(Continued)

- Mercury and lead were the most common contaminants.
- Labor associated with mercury decontamination was the largest component of total decommissioning cost.
- Adherence to simple minimization techniques significantly reduced mercury waste generation and disposal costs.

LESSONS LEARNED

(Addendum)

Lesson # 1

Air surveys with meters are useful for planning purposes but may fail to detect significant mercury spills and contamination.

- Vapors from spills and contamination in casework, under floor tiles, in plumbing etc. may not be released into areas assessable to surveyors.
- Mercury may be present as non-volatile compounds, bound to solid materials or covered by oxide films that prevent or greatly reduce vapor generation necessary for detection.
- Organometallic mercury compounds may not be detectable.

Lesson # 2

Multiple mercury air monitoring instruments may be required during decontamination activities.

- Meters may be needed in each active work area for continuous monitoring of personnel exposures.
- Equipment set-up for air monitoring can also be used for on-site analyses of liquid and solid waste samples. However, this may not be practical because of the time required for change out of equipment and recalibration.
- Instrumentation suitable for one phase of work such as initial surveys may not be suitable for other phases such as final clearance surveys that require greater sensitivity and precision.

Lesson # 3

Demolition activities may raise ambient mercury concentrations in air by a factor of 1000 or more.

- Complete air monitoring needed for preliminary surveys and to determine perimeters of spills and contaminated areas before demolition starts.
- Air action levels used to trigger further investigation and clean-up may have to be raised during active demolition.
- To protect personnel monitor air concentrations continuously during active demolition and spill cleanup activities regardless of preliminary survey data collected prior to onset of these activities.

Lesson # 4

Containment systems for abatement of asbestos and other contaminants may cause a build-up of mercury vapors in the work area.

– Health and Safety plans for abatement activities must consider impacts of containment systems on mercury air concentrations.

– The sequence of abatement actions for multiple contaminants is very important.

– Monitor mercury air concentrations during abatement activities for other contaminants such as asbestos.

Lesson # 5

Segregation of horizontal and vertical plumbing greatly reduces generation of mercury debris.

- Air concentrations of mercury at openings of horizontal sanitary lines were all greater than 1000 ng/m^3. These pipes were disposed as hazardous mercury debris.
- Concentrations of mercury in the air in open ends of risers and dry sanitary vent pipes were all less than 1000 ng/m^3. These were recycled as scrap metal.

Office of Research Facilities

Lesson # 6

Decontamination of whole laboratories may be more efficient than attempting to delineate and treat specific surfaces that have low level mercury contamination.

- Determination of areas with low level contamination is difficult, particularly when ambient air concentrations are raised by demolition activities.

- Solutions effective in treating (removing and stabilizing) low level mercury surface contamination (trisodium phosphate/bleach) are economical to use and may be easily applied over large surfaces.

Lesson # 7

With the availability of macroencapsulation for debris containing mercury greater than 260 mg/kg the amount of waste processed by high cost retorting can be greatly reduced.

- Retorting is required only for wastes containing free mercury metal and materials that do not meet the definition of debris.

- Wastes such as drained sink traps that were previously placed in the “High Mercury” retort processing group could have been treated by macroencapsulation at much lower cost.

Lesson # 8

Include provisions for area heating in decontamination plans.

- Vaporization of mercury is greatly reduced by low temperatures.
- Monitoring of air concentrations for decontamination clearance should only be done at or above normal ambient temperatures.
- Include plans for heating areas and/or affected surfaces if work will be performed in winter.
- Remember: utilities may not be available during demolition.

Lesson # 9

Waste profiles for debris should be written to cover as many types of construction materials as possible.

– Myriad types of construction materials and all of the RCRA metals may be found in debris from laboratory decommissioning.

– Modifications to approved waste profiles to add new materials e.g., wood that are found after demolition begins may require considerable approval time delaying disposal and project completion.

– The presence of materials and contaminants with hazardous waste identification numbers that are not in the approved profile may result in rejections of shipments.

Lesson # 10

Ensure that there is adequate time between completion of decontamination and start up of architectural demolition activities.

- Allows air conditions to stabilize for final clearance surveys.
- Demolition activities may disrupt heating, ventilation and other utilities that may be needed to for final clearance sampling or additional remediation efforts.

The Most Important Lesson of All…

An ounce of mercury prevention saves a ton of debris and lots of:

$ $ $