



# Laboratory Decommissioning

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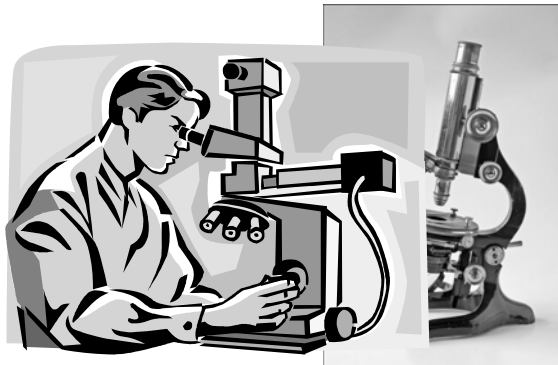
# Laboratory Decommissioning

## Learning Objectives

- ▶ Understand the issues related to close-out/decommissioning of a laboratory
- ▶ Familiar with ANSI Laboratory Decommissioning Standards (ANSI/AIHA Z9.11-2008)
- ▶ Identify risk assessment concepts for laboratory decommissioning
- ▶ Develop a decommissioning plan

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Nothing lasts forever. Out with the old  
so the new can move in, it's simple!



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## Or Is It?

Laboratory decommissioning is not just a matter of removing equipment, distributing supplies, and wiping down the bench tops. When lab space is repurposed, federal regulations may apply, best practices are recommended, and voluntary guidelines are available.

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Laboratory space can be a unique property with varied parameters. Clinical and research laboratories have different physical requirements and changing needs. As facilities age they may be replaced or remodeled. In addition, labs may be moved or repurposed.

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## Unique Issues Involved

- ▶ Hazardous chemicals
- ▶ Biohazardous materials
- ▶ Research samples and clinical specimens
- ▶ Specialized equipment



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## Terminology

- **Close-out** – Process to deal with materials and equipment when a project is discontinued
- **Clearance** – Visual verification by an in-house independent party that all hazards, equipment, and materials have been removed
- **Decommissioning** – Official process conducted after a lab clearance. This is a technical inspection done by trained individuals. This is usually reserved for demolition or major remodeling projects. It involves testing all areas for specific hazards, such as mercury and asbestos. Various testing equipment is used. Drains, countertops, floors, etc. are examined to ensure that the workers and surrounding community are safe.

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## Federal Demolition Standard

### **29CFR 1926.850(e)**

It shall also be determined if any type of hazardous chemicals, gases, explosives, flammable materials, or similarly dangerous substances have been used in any pipes, tanks, or other equipment on the property. When the presence of any such substances is apparent or suspected, testing and purging shall be performed and the hazard eliminated before demolition is started.

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## Decommissioning Standard ANSI/AIHA Z9.11–2008

- Multiple steps in the sequence
- Several phases
- Documentation required – level depends upon the scope of the project
- Plan → review plans → adjust plans → review plans
- Group effort required – laboratory, facility, administration, safety, housekeeping, regulatory agencies

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## Multiple criteria for Assessment and Scope

Example	Level 1	Level 2	Level 3	Level 4	Level 5
Future use	Higher hazard use	Laboratory, or similar use	Office space, commercial	Child care, school, public use	Child care, school, public use
Remediation resources	Internal resources, routine operations	Internal resources, extra operations with some external resources	External resources and professionals required	External resources and professionals required for extended durations	Specialized resources and professionals required for extended durations
Assessment summary	Low risk, low impact	Low to moderate risk, moderate impact	Moderate to high risk, moderate impact	High risk, high impact	Government agency intervention or oversight

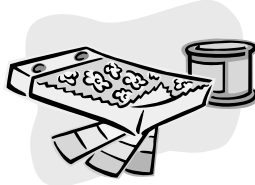
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	Level 1	Level 2	Level 3*
<b>Assessment Summary</b>	Low risk low impact	Low to moderate risk, moderate impact	Moderate to high risk, moderate impact
<b>Records availability</b>	Complete records on all activities	Adequate records for most important activities which may involve hazardous materials	Incomplete records for hazardous materials activities
<b>On-site assessment</b>	Visual 'on-site' might be sufficient, some localized, surface detect-read instruments	Surface and sub-surface and direct read instruments for suspect materials	Extensive samples for a wide range of materials targeted proximate areas
<b>Intended future use</b>	Non-sensitive operations, restricted/ unused or for hazards greater current	Low sensitivity operations; laboratory, waste, restricted/ unused.	Moderately sensitive operations; office commercial space
<b>Persistence of hazardous materials</b>	Readily removed or non-existent	Requires moderate removal efforts	Requires moderate removal efforts or some isolation
<b>Detection, monitoring of hazardous materials</b>	Easily detected and monitored	Moderate detection and or monitoring efforts	Moderate to advanced detection and or monitoring efforts
<b>Scope of remediation</b>	Surface clean up with standard cleaning practices	Surface and sub-surface clean up localized and contained areas	Subsurface cleanup widespread areas within boundaries of interest.
<b>Remediation resources</b>	Internal resources: routine operations	Internal resources, extra operations with some external resources	External resources and professionals required
<b>Regulatory impact</b>	Regulatory agency notification may be required for specific materials or areas	Regulatory agency sign-off required for specific materials or areas	Regulatory agency approval or sign-off may be required for portions of decommissioning

\*Default level assumes moderate to high risk until assessed otherwise

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## Criteria for Assessment and Scope Levels 1 – 5



### ► On-site assessment

- Visual 'on-site' might be sufficient, some localized, surface detect-read instruments
- Extensive samples for a wide range of materials, targeted proximate areas, constant monitoring



### ► Records availability

- Complete records on all activities
- Incomplete or inaccurate records for entire site and adjacencies

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## Criteria for Assessment and Scope Levels 1 – 5

- ▶ **Persistence of hazardous materials**
  - Level 1 – Readily removed or non-existent
  - Level 5 – Substantial removal efforts or isolation
- ▶ **Detection, monitoring of hazardous materials**
  - Level 1 – Easily detected and monitored
  - Level 5 – Advanced detection and monitoring efforts post-decommissioning
- ▶ **Scope of remediation**
  - Level 1 – Surface clean up with standard cleaning practices
  - Level 5 – Infrastructure cleanup beyond boundary of area of interest, and scope may not be fully known

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## Criteria for Assessment and Scope Levels 1 – 5

- ▶ **Regulatory impact**
  - Level 1 – Regulatory agency notification may be required for specific materials or areas (asbestos)
  - Level 3 – Regulatory agency approval or sign-off may be required for portions of decommissioning
  - Level 5 – Regulatory agency approval and sign-off required pre-, during, and post- decommissioning (NRC)

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## ANSI Decommissioning Sequence

1. Scope
2. Historical Review
3. Potential Contaminants
4. Vacate and Clean (Close-out)
5. Plan for Sampling and Analysis
6. Site Survey and Initial Sampling
7. Review Status and Evaluate Needs
8. Document Final Status

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## Decommissioning Initiation

- ▶ Decommissioning decision made
- ▶ Notify all pertinent personnel prior to departure or relocation
- ▶ Current inventory of equipment and hazardous material
- ▶ Close-out plan required – Plan reviewed by
  - Chemical Hygiene Officer
  - Biosafety Officer
  - Radiation Safety Officer

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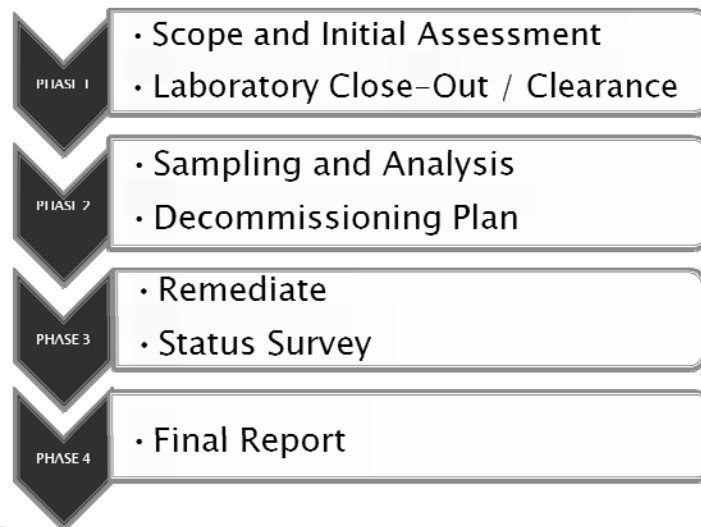
## Close-Out Plan

► Plan includes

- Defined duties
- Description of laboratory space, equipment, and material
- Methods for disposal/transport of chemicals, radiological products and biological material
- Identification of potential contaminant sites
- Process for cleaning and disinfection

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## Decommissioning



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	<b>RISK LEVEL 1</b>	<b>RISK LEVEL 2</b>	<b>RISK LEVEL 3 or above</b>
<b>Phase I</b> (Scope, Assessment, Close-out, Clearance)	Required	Required	Required
<b>Phase II</b> (Sampling, Analysis, Decommissioning Plan)	NA	Required	Required
<b>Phase III</b> (Remediate, Status Survey)	NA	NA	Required
<b>Phase IV</b> (Final Report)	Required*	Required	Required

\* The final status report for a level 1 (and some level 2) decommissioning may be a simple record to file or log in a book.

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## Phase I – Scope and Initial Assessment

- **Age of building** – Built before OSHA and EPA requirements? Asbestos used?
- **Prior use** – Review past documents such as chemical inventories, Notice of Violation (NOV), interviews
- **Historical documents**
  - All replacement fume hoods (installed Location A, 1999; Location B 2000), have asbestos-free bench tops
  - Original building fixed furniture have stone or resin bench tops and cove moldings. Sink drain boards may be Transite (asbestos cement). Vertical support columns on cabinet consoles may be Transite.

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## Chemical Contaminants of Concern

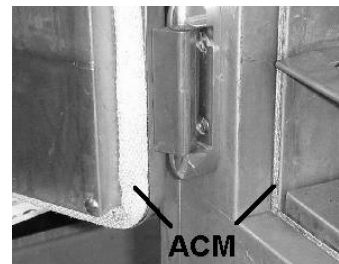
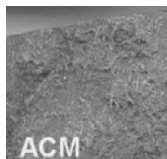
- Mercury
- Lead
- Asbestos
- Perchloric Acid
- Heavy Metal Azides
- Picric Acid



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## Asbestos Containing Material (ACM)

Lab bench tops may be made of Transite, stone, plywood or wood press-board. Modern lab benches are often made of chemical resistant plastic.



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## Potential Biohazards

- Human, animal and plant pathogens:
  - Bacteria, including those with drug resistance, plasmids, fungi, viruses, parasites, prions
- All human blood, blood products, tissues and certain body fluids (OPIM)
- Cultured cells and potentially infectious agents these cells may contain
- Allergens
- Toxins (bacterial, fungal, plant, etc.)
- Certain recombinant products
- Clinical specimens

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## Decontamination of Biological Safety Cabinets (BSCs)

- Formaldehyde – sporicidal and penetrates all areas however, leaves a residue, and is carcinogen
- Chlorine Dioxide Gas (Approved in Annex G of NSF/ANSI 49) – sporicidal and penetrates all areas
- Vaporized Hydrogen Peroxide – sporicidal and penetrates all areas, EPA approved, under consideration by NSF

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## Decontamination of Biological Safety Cabinets (BSCs)

No	Aspect	Formalin Vapor	Chlorine Dioxide	Hydrogen Peroxide
1	Is it carcinogenic ?	Yes	No	No
2	Is it a genotoxin ?	Yes	No	No
3	Permissible Exposure Level (PEL)	0.75 ppm	0.1 ppm	1 ppm
4	Immediately Damaging to Life & Health (IDLH)	2 ppm	5 ppm	75 ppm
5	Sealing of the biosafety cabinet	Must be airtight	Must be airtight	Some small gaps are OK
6	Must people leave lab during the process ?	Yes, due to leakage danger	Yes, due to leakage danger	No, people can still work in lab
7	Is room humidity control required ?	Yes, above 60%	Yes, between 60 to 80 %	No
8	Residue	Substantial, needs extensive cleaning	Minimal, in the form of NaCl	No residue. Needs no cleaning at all.
9	Decontamination time per cabinet	11-17 hours	3-4 hours	3-10 hours
10	Equipment cost	USD \$100	USD \$1,500 + Cl gas canister	USD \$18,000 to \$52,000

<http://www.escoglobal.com/resource.php?id=12>

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## Phase I – Laboratory Close-Out

- Determine a deadline for all lab work to cease
- A Move Manager or Project Coordinator is recommended for major moves
- Equipment may need to be moved by a manufacturer technician
- Hazardous material close-out/sign-out should be part of any termination procedure

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## Phase I – Laboratory Close-Out

- **Provide Guidelines for lab management and staff**
  - Do not move more than you need to move
  - Do not move waste materials
  - Pack safely
  - Clean and decontaminate
  - Obtain clearances and certifications

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## Phase I – Laboratory Close-Out

- **Define duties**
  - Empty and clean BSCs and if appropriate arrange for gas decontamination
  - Pack and move biological materials properly
  - Empty and defrost refrigerators, drain water jacketed incubators, remove thermometers, and drain oil from vacuum pumps
  - Contact supplier for return of gas cylinders
  - Properly label chemicals and group by compatibility
  - Transfer chemicals or non-contaminated equipment
  - Arrange for removal of radioactive material, complete radiation survey and decontaminate as required

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## Phase I – Laboratory Close-Out

### ► Define duties

- Laboratory personnel are responsible for preparing freezers for the move, ensuring that all loose vials and containers are properly packaged using unbreakable containers (plastic, metal, or cardboard)
- Arrange for Clearance Inspection with the Safety Office and the Radiation Safety Officer

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## Phase I Laboratory Close-Out

**Equipment must be  
certified as free  
from hazards**

DECONTAMINATION CERTIFICATE	
Print certificate and attach to equipment or instrument after decontamination is complete.	
Item	
Make/Model	
Serial Number	
Identification No.	
Equipment is :	
<input type="checkbox"/> Being relocated to another room on campus	
<input type="checkbox"/> Awaiting onsite service	
<input type="checkbox"/> Being shipped offsite for service	
<input type="checkbox"/> Being sent to surplus	
<input type="checkbox"/> Being discarded	
<input type="checkbox"/> Other	
This equipment has been exposed to: <input type="checkbox"/> Hazardous Chemicals <input type="checkbox"/> Biohazardous Materials: <input type="checkbox"/> Radioactive Materials: Post-decontamination wipe tests were performed to verify that the instrument is free of radioactive materials. Records of the wipe tests are on file.	
Decontamination Method Used:	
<input type="checkbox"/> I certify that this equipment has been appropriately decontaminated and does not pose a radioactive, biological, or chemical hazard.	
Name:	Date:
Signature:	Phone:

## Laboratory Manager/PI Checklist

### Laboratory Information

Laboratory to be vacated: Building \_\_\_\_\_ Room(s): \_\_\_\_\_  
 Principal Investigator: \_\_\_\_\_ Department: \_\_\_\_\_  
 Date laboratory will be vacated: \_\_\_\_\_

*The purpose of this checklist is to assist Principal Investigators in safely removing hazardous materials from a laboratory and confirming that the area is free from contamination.*

CHEMICALS	Yes	No	N/A
Refrigerators, area under sinks, fume hoods, cabinets and shelves, and bench tops have been checked for storage of hazardous materials (include shared spaces).			
COMPRESSED GAS CYLINDERS			
Arrangements have been made for returning empty cylinders to vendors.			
BIOLOGICAL MATERIALS			
All work surfaces and storage areas, including walk-in coolers, freezers, refrigerators and incubators have been decontaminated.			

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## Laboratory Manager/PI Checklist

RADIOACTIVE MATERIALS	Yes	No	N/A
CONTROLLED SUBSTANCES			
COMPRESSED GAS CYLINDERS			
EQUIPMENT			
RECORDS			

**I have, to the best of my knowledge, complied with the requirements of the Laboratory Decommissioning Checklist and am not aware of any other items or special circumstances that are not listed on this form.**

Principal Investigator: \_\_\_\_\_ Date: \_\_\_\_\_  
 Lab Director: \_\_\_\_\_ Date: \_\_\_\_\_

### Clearance Inspection Sign-Off

Laboratory Safety Officer: \_\_\_\_\_ Date: \_\_\_\_\_  
 Biological Safety Officer: \_\_\_\_\_ Date: \_\_\_\_\_  
 Radiation Safety Officer: \_\_\_\_\_ Date: \_\_\_\_\_

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## Phase I – Laboratory Close-Out

Medical Pathological Waste (MPW) boxes must not be used for storing or moving chemicals, equipment or personal property. Movers will not transport MPW boxes.

Because MPW boxes are treated as medical waste, valuable equipment or irreplaceable records may be lost if they are packed in an MPW box.

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## Phase I – Laboratory Clearance

- ▶ **Clearance inspection**
  - Open all drawers
  - Check for residue
  - Sharps (especially razor blades)
  - Tops of cabinets and shelves

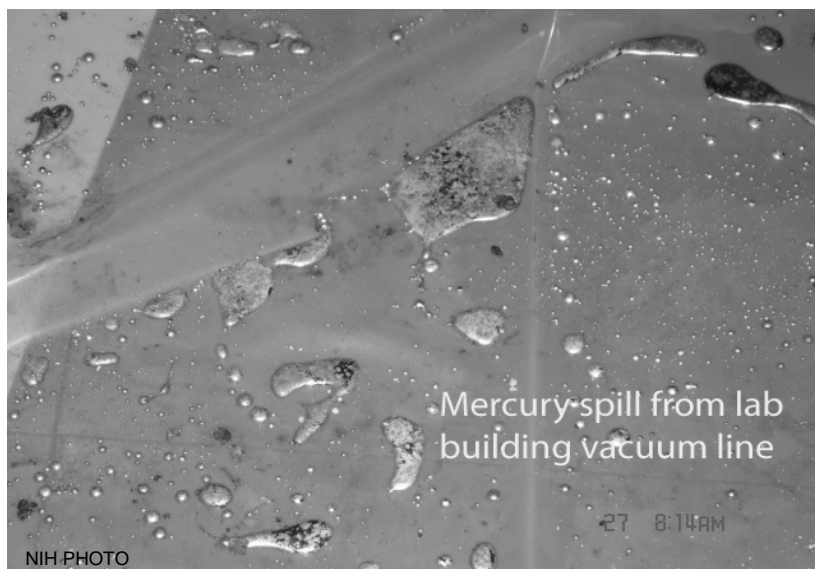


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## Phase II – Sampling and Analysis

- Post clearance inspection
  - Remove signage
  - Restrict access
- Evaluation and initial sampling
  - Visual inspection
  - Capabilities

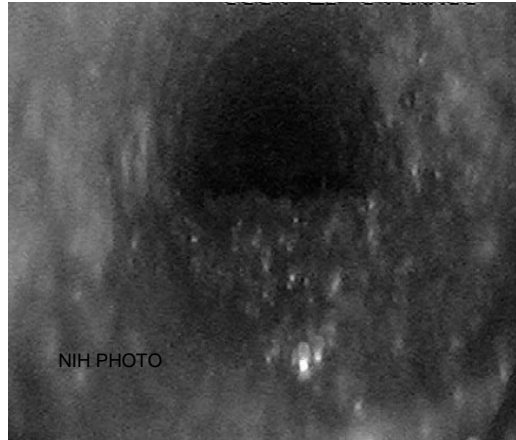
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## Mercury

This photo shows what appears to be droplets of mercury in a pipe. It was taken with a video camera placed deep into the wastewater plumbing system under the basement floor of a laboratory building.



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## Phase II – Decommissioning Plan

- Remediation decisions
  - Degree of remediation required
  - In-house or contract
  - Sampling requirements – what, where, how many
  - Decommissioning Plan

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## Phase II – Decommissioning Plan

### ▸ Sampling Analysis Plan (SAP)

- Possible scope of work if outside expertise is required
- Field Sampling Plan (FSP)
- Health and Safety Plan (HASP)
- Quality Assurance Project Plan (QAPP)

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## Phase II – Decommissioning Plan

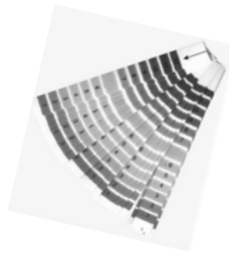
### ▸ Field Sampling Plan (FSP)

- Sampling rationales and objectives, sample locations, collection procedures, and details related to analytical procedures and data reporting
- Risk criteria and cleanup levels for all contaminants included in the SAP
- Sampling methods

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## Phase II – Sampling Methods

- **Direct reading instruments** – Geiger-Mueller meters, X-Ray fluorescence meters, Jerome mercury vapor analyzer
- **Colorimetric tests** – Methylene blue to detect perchlorates
- **Test strips** – pH, nitrates



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## Phase II – Sampling Methods

- **Bulk sampling** – building materials for asbestos
- **Wipe samples** – radioactive materials or trace metals
- **Media sampling** – water samples from a drain trap, wash water samples

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## Sample Sites

Building Area	Potential Area of Be Contamination
Floor	Corner of room where dust accumulates Traffic area traversed by lab workers Area under an object not routinely cleaned
Ceiling Tile	Area adjacent to supply and exhaust ventilation system registers Area above chemical processing area
Process Equipment	Motionless air areas that accumulate dust Hidden surfaces not routinely cleaned
Internal Areas	Area behind book shelf Area under cabinet drawer
HVAC System	Motionless air areas where dust accumulates Area at the top of air ducts Access flanges Gaps between walls and floors Mechanical areas associated with motors and blowers Damper Filters Control Valves Interior of Ducts
Miscellaneous	Horizontal Surfaces Door jambs Area at the top of light fixtures Elevated window sills Area at the top of beams and other structural elements

## Phase III – Remediation

### ► Remediate

- Define boundaries
- How clean is clean??
- Removal required??
- Dust level consideration
- Deferred remediation
- Disposal



MERCURY VACUUM



**Mercury in expansion anchors found under vinyl  
asbestos tile**

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## **Phase III – Remediation Plan**

- Timeline and Budget
- Risks involved
- Usage – prior and future
- Contractor qualifications
- Remediate – immediate and deferred
- Acceptable sampling methods
- Parameters for “clean”

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## Phase III – Status Survey

- ▶ Visual inspection
- ▶ Document review and evaluation of assumptions
- ▶ Confirmatory sampling
- ▶ Comparison to scope, standards and acceptance criteria
- ▶ Resolution of deviations

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## Phase IV – Final Report

- ▶ Decommissioning plan
- ▶ Steps for implementation decommissioning plan
- ▶ Sampling reports and interpretation of data
- ▶ Ancillary documents

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## Phase IV – Final Report Ancillary Documents

- Site maps
- Photographs
- MSDS
- Hazardous materials inventory
- Hazardous waste manifests
- Contractor qualifications
- Contractor SOPs
- Remediation worker training and PPE
- Equipment disposal inventories
- Risk Assessment criteria

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## Phase IV – Final Report

A written statement of “**acceptable level of risk**” for re-occupancy or demolition shall be made by a **qualified individual**, such as a certified industrial hygienist, who has the training and experience to review risk assessment and sampling data and make a determination that based on decommissioning activities, conditions within the decommissioned facility pose no significant health risk to occupants.

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