Laboratory Decommissioning: Lessons Learned in the Field

by Jennifer Bossleman, M.S.

EH&E manages the environmental health & safety (EH&S) programs encompassing approximately 2 million square feet of research laboratory space. As part of this responsibility, we have decommissioned 10% of this research laboratory space, which includes research requiring biosafety level (BL) 1, BL2, and BL2+ practices and procedures.

This article reviews the American Industrial Hygiene Association (AIHA) standard for laboratory decommissioning and the lessons we have learned from our decommissioning experience.

Decommissioning Standard


The document provides a strategy to ensure the safe decommissioning of a laboratory and to provide a safe work environment for the next tenant of the laboratory. It identifies the minimum acceptable criteria for completing the decommissioning process, and the documentation of necessary information for regulatory and historical purposes. Some of the highlights from this document are as follows:

- Provides a flowchart outlining the process for a decommissioning project.
- Outlines the roles and responsibilities associated with this process.
- Supplies a checklist of hazardous chemicals associated with pieces of equipment found in a laboratory setting and the recommended laboratory analyses to confirm decontamination based on the laboratory operations.

Lastly, the standard recommends the following documentation to support your laboratory decommissioning:

- Decommissioning Plan
- Site Decommissioning Report
- Statement of “Acceptable Level of Risk” for Reoccupancy

EH&E’s Experience

Prior to the AIHA standard, EH&E used a similar process to ensure the proper methods for decontamination were used during the decommissioning process. Below are some lessons we learned from managing the decommissioning of approximately 200,000 square feet of research space.

Initial Meeting
It is important to have an initial meeting to ensure everyone is informed on their role during the decommissioning process and to determine the appropriate steps to ensure a safe environment for the next occupant. Listed below are some of the more general questions to ask. Your questions can often be more pointed based on your knowledge of the space.

- Who will be responsible for cleaning the laboratory? The researchers? A subcontractor?
- What procedures were performed in the laboratory space?
- What hazardous chemicals, biological materials, and radioactive materials were used in the laboratory space?
- What equipment was used in the space?
- Were hazardous chemicals, biological materials, and/or radioactive materials used inside the equipment?
- Are hazardous chemicals, biological materials, and/or radioactive materials inside the equipment?
- Who will be responsible for cleaning, disinfecting, or decontaminating the equipment?
- Is the equipment being disposed of, relocated, repaired, or sent to storage?
- Were there any spills associated with hazardous, biological, and/or radioactive materials within the laboratory?
- What are the laboratory cleaning procedures?
- Who will be conducting the testing (if applicable) to ensure that the laboratory was cleaned properly?
- Who will be responsible for signing off that the laboratory and the associated equipment have been cleaned, disinfected, or decontaminated properly?
- Who will conduct the final walkthrough to determine whether or not the laboratory was cleaned properly?

**Proper Cleaning, Disinfecting, and Decontamination Methods**

We've found that many people within the research laboratory community are under the impression that one disinfectant or cleaning method works for every situation. This is not the case, and this information should be distributed. An example is 70% ethanol, which is often used to disinfect biological materials. Ethanol is not an approved method for disinfection if a research laboratory was using Marburg virus, which requires 1% sodium hypochlorite, 2% glutaraldehyde, or formaldehyde for disinfection.

If a laboratory indicates that they worked with perchloric acid (HClO4) (a strong mineral acid), then there is a concern that the vapors may contaminate ventilation equipment (e.g., a chemical fume hood). Perchlorate residues can form highly unstable compounds such as metallic perchlorates. If the chemical fume hood was not designed for perchloric acid use, then a special procedure for cleaning the chemical fume hood is required. For radioactive materials, you may use a Geiger counter or collect wipe samples depending on the radioactive material and the quantity being used in the research laboratory.

**Proper Detection Methods**

The proper detection method used to ensure proper decontamination is an important factor to plan early in the decommissioning process. The detection method(s) used will depend on the chemicals previously used in the space, and this includes not only chemicals used in experiments but also those used for processes such as disinfection. Mercury is often used in the process of chemical manufacturing and bleach is one of these chemicals. If your laboratory used mercury-
containing bleach for disinfecting purposes, you may need to collect wipe samples from your laboratory bench tops or wastewater samples from the sink traps. These “secondary” chemicals are often overlooked in the decommissioning planning process.

The following figures illustrate how sampling revealed the presence of mercury contamination in flooring in a former laboratory space, and then documented the successful clean-up effort. The first figure shows the spatial distribution of elevated levels of mercury vapor in air in a former laboratory as indicated by red and yellow shaded areas. The second figure was generated from testing performed after the completion of remediation activities directed by EH&E and illustrates that the mercury levels have been reduced below health-based benchmarks.

**Figure 1:** Illustration of mercury levels in laboratory space. Areas in red and yellow indicate elevated levels of mercury.
Detection methods for other chemicals make screening easier. Ethidium bromide is an intercalating agent commonly used as a nucleic acid stain in molecular biology laboratories for techniques such as agarose gel electrophoresis. When exposed to ultraviolet (UV) light, it will fluoresce with an orange color. As a result, you can use an UV light to check the area to ensure ethidium bromide has been removed from the work areas where it was used as part of the research. The key is to take the time to carefully map out the areas being decommissioned and to walk through on paper the chemicals used and areas impacted. This will help to ensure that you don’t overlook potential contaminants from your screening list.

Documentation

It is critical to document your efforts from the initial meetings with laboratory personnel, through the selection of detection methods, to confirmatory testing that ensures the laboratory was cleaned properly, and even the final laboratory walkthrough. This documentation will be used as a reference document throughout the process, and it should be reviewed periodically and updated if necessary. It is your final proof of due diligence when the project is complete.

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