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Sustainable High Efficiency Deconstruction

(SHED)

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Introduction

- Today great emphasis is placed on sustainable design and construction of new buildings yet there is very little emphasis on sustainable deconstruction.
- This is despite a large inventory of decaying, obsolete federal buildings and infrastructure.
- Many of these buildings simply cannot meet new mission and sustainability requirements without major alterations or total replacement - demolition.
- Impacts from these deconstruction activities can be significant but minimized with the improved practices described here.

Some Definitions
(As Used Here)

Deconstruction – activities that result in partial alteration or complete removal of an existing structure.

Decommissioning – a process to ensure that a facility and its associated infrastructure meet environmental, health and safety requirements for its next use (AIHA/ANSI definition).

Sustainable High Efficiency Deconstruction (SHED) – A combined decommissioning and deconstruction process that maximizes reutilization of materials and minimizes waste generation, energy and water use, project completion time and costs.

Barriers to Sustainable Deconstruction

- Older buildings were not designed to facilitate deconstruction.
- Planning for more sustainable renovations and deconstruction is still not considered in most new building designs and doesn't receive design credits.
- Federal facilities include many atypical buildings such as laboratories that require frequent renovations to meet rapidly changing missions.
- Labs may be particularly problematic to deconstruct because they often contain a greater variety of potentially hazardous substances in the infrastructure and as contaminants.

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Drivers for Improving Decommissioning Practices

Regulatory Compliance and Risk Avoidance

"THE PRIME DIRECTIVES"

- Occupant and Worker Protection – OSHA
- Transportation of Construction Waste – DOT
- Waste Management – EPA, NRC and States
  - Prevention of hazardous releases to the environment
  - Waste characterization and identification
  - On-site waste management - handling, labeling, storage
  - Off-site waste management - treatment, storage, recycling, disposal using appropriate technologies

Violations may result in severe regulatory penalties and present potentially extreme personal and institutional liabilities.

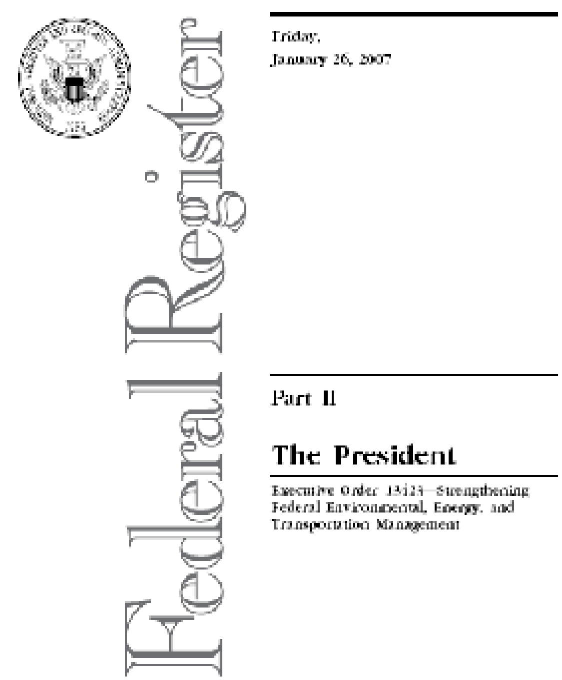
New Drivers for Sustainable Deconstruction

Executive Order 13423

--General mandates to:

- Reduce disposal of toxic and hazardous materials.
- Establish cost effective waste prevention and recycling programs.
- Comply with *Guiding Principles* for sustainable design and operation of facilities.

--Obtain credits for sustainability certifications LEED®, Green Globes® etc.


Federal Register

Friday,
January 26, 2007

Part II

The President

Executive Order 13423—Strengthening Federal Environmental, Energy, and Transportation Management

History of Laboratory Decommissioning Protocol Development at NIH

Year	Action
1999	Convened workshop on decommissioning at National Leadership Conference on Biomedical Research and the Environment.
2000	Workshop findings published in *Environmental Health Perspectives*.
2001	Draft NIH decommissioning protocol developed
2003	Full pilot test (NIH Building 3)
2006	Lessons learned applied to major lab demolition project – NIH Building 36 case study (reported here).
2008	AIHA/ANSI issues American National Standard based largely on the NIH protocol.

NIH Protocol Objectives

- Protect occupants, owners and the environment by:
  - Defining acceptable long and short term risk during and after deconstruction → clean-up levels.
  - Assessment for presence of materials presenting excessive risk.
  - Decontamination, removal and proper management of hazardous materials and wastes.
  - Ensuring that the site presents acceptable level of risk for its next intended use after deconstruction.
- Control costs by:
  - Streamlining contaminant assessment procedures.
  - Avoiding surprises, downtime.
  - Devising rapid methods for screening and sorting of debris items

Decommissioning Protocol Overview

Phases (Flexible)	**Action**
I	INITIAL FACILITY ASSESSMENT Collect historical records, conduct interviews, make site observations to determine potential risks.
II	FULL FACILITY ASSESSMENT If indicated by results of initial assessment, set risk reduction targets, conduct more through assessment, sampling and analysis and develop remediation plans.
III	DECONTAMINATION AND REMEDIATION Demolition may be during or after this phase.
IV	FINAL STATUS SURVEY AND DOCUMENTATION Confirm hazard reduction, document status and release the building or site for new occupancy.

Sustainability and Efficiency Objectives

Greening the Protocol

- Modify decommissioning processes to maximize reutilization of existing buildings and components by:
  - Selective demolition
  - Decontamination in situ
  - Encapsulation rather than destructive removal
  - Reuse of materials in the project

- Maximize local recycling of debris.
  - Reduces energy used and greenhouse gas generation from shipping and production of replacement materials.
  - Required to meet Executive Order and achieve LEED® credits.

Sustainability and Efficiency Objectives

- Minimize waste generation especially hazardous and radioactive debris and wastewater (a regulatory requirement)
  - High disposal costs.
  - Shipping to distant sites often required.
  - Few licensed/permitted facilities.
  - Limitations of landfill capacity and willingness to accept debris
- Avoid generation of mixed waste (radioactive and chemically hazardous debris)
  - Assess for both radioactive materials and hazardous chemicals before planning remediation.
  - Isolate contaminated areas.
  - Strict segregation of radioactive, hazardous and mixed streams.

Some Lessons Learned

Mercury is the most common and problematic contaminant encountered in laboratory decommissioning:

- Extremely low allowed discharge levels in wastewater. Compliance may require total replacement of plumbing systems.
- Potential impacts on health at very low levels of exposure.
- Contamination may favor growth of multiply antibiotic resistant bacteria and suppress immune response.
- High debris management costs and few disposal outlets. Requires macroencapsultation and disposal in chemical waste landfill.

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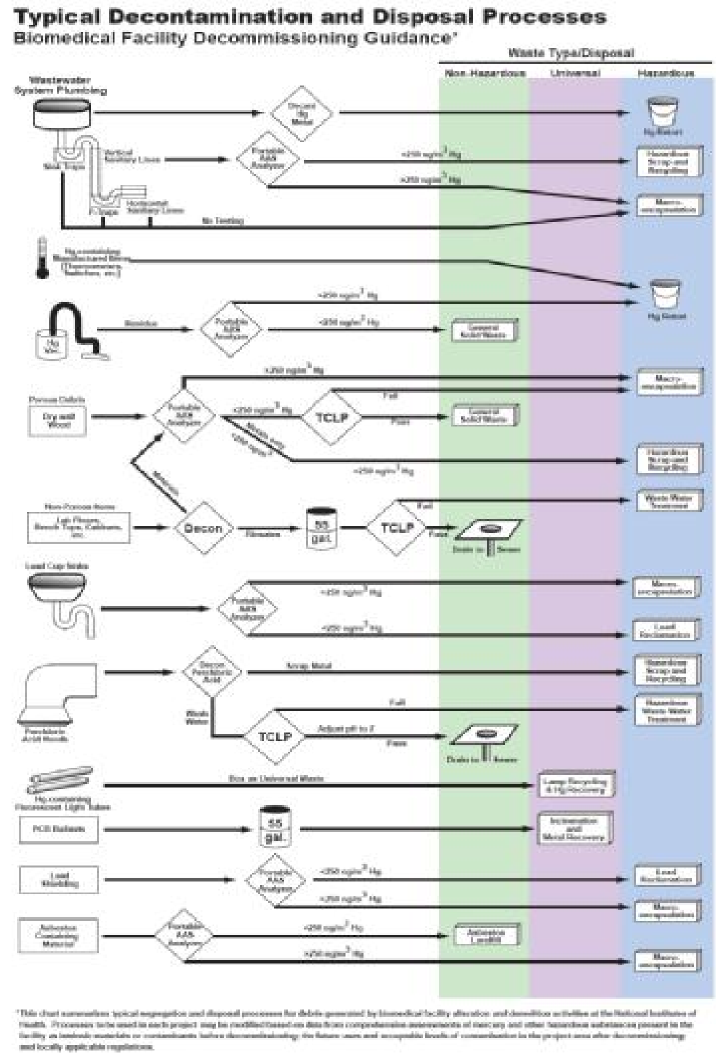
Lessons - Continued

- Reduce time and control costs using data from previous projects in similar buildings:
  - Streamlining assessment procedures and reducing sampling and analysis.
  - Reusing, adapting and sharing of assessment protocols, remediation plans, contract specifications.
- Have qualified contractors in place for:
  - Routine assessment and remediation services
  - Construction waste recycling
  - Response in the event unexpected hazards are found during deconstruction

Lessons - Continued

- Develop “worker friendly” guidance such as pictorial flowcharts for rapid clearance, sorting and disposal of debris items.

- This is the flowchart used at NIH facilities for assessment, sorting and determining the final disposition of debris items. It is based largely on mercury levels.



Example of Decommissioning Assessment Checklist for Biomedical Facilities

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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 compound…	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										■						■					■5			
Capacitors							■			■						■					■5			
DC Watt hour meters														■										
Fuse bases																								
Relays														■							■5			
Switches - tilt, silent, float, industrial														■										
Thermostats														■										
Transformers																					■□5			■
Transformer vaults																					□			
Voltage regulators																					■5			
Electron microscopy areas											□			■□										
Elevators																								
Brakes and clutch facings																								
Pits																□								
Exit signs, self-powered																								

(Full Copies Available on Request)

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National Partnership for Environmental Priorities

A Case Study

Decommissioning of a Large Biomedical Research Laboratory

Building 36
National Institutes of Health Campus
Bethesda, Maryland

GOING,

Decommissioning completed, building decontaminated leaving a clean shell. Demolition beginning.

GOING, GOING…

Building demolished. Rubble piles cleared and ready for recycling.

GONE!

~100% Recycled. Clean site.

Ready for unrestricted reuse.

Project Outcomes
Impacts of Materials Reduced

- Enhanced decontamination and materials clearance procedures allowed virtually 100% of the entire structure to be recycled.
- More than 5,800 tons of debris, primarily concrete and scrap metal were recycled locally as non-hazardous material.
- Recycling and reuse of this material saved significant landfill space.

Project Outcomes

Energy Savings

EPA estimated that by recycling these materials locally energy savings equivalent to removing nearly 3,300 cars from the roadways for one year were attained.

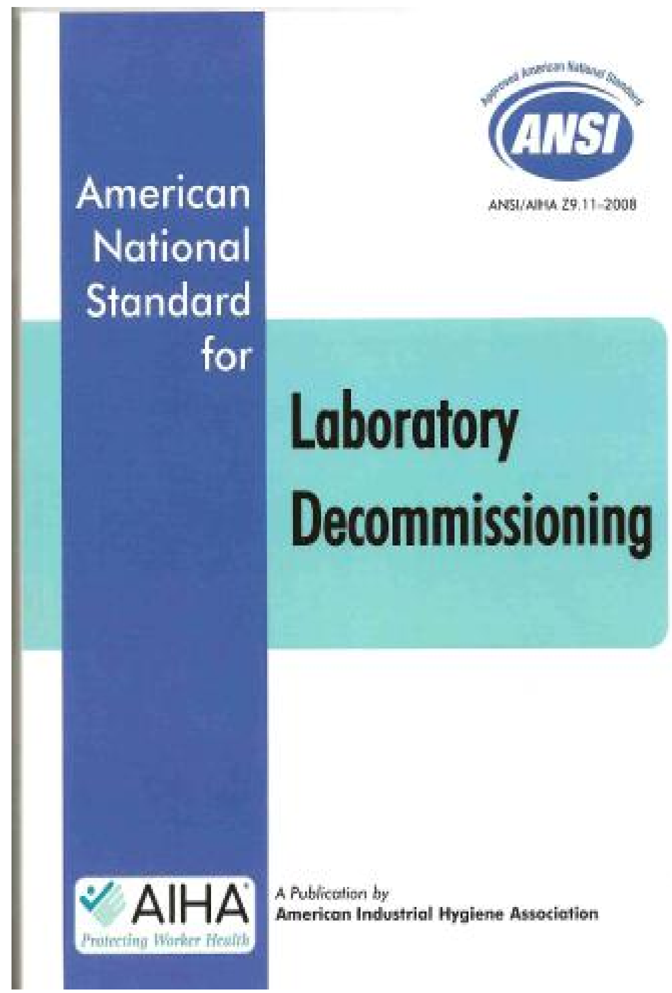
Project Outcomes

Sustainability Rating Credits

- Phase II of the new Porter Neuroscience Research Center will be constructed on the clean site.
- Credits from the decommissioning activity may be applied to the design and construction of the new facility.
- It is expected to achieve at least a LEED® Gold or Green Globes® – Two Globe rating.

Outcomes
Applications Beyond NIH

- Protocol elements are now used by EPA, other agencies and many universities.
- It was a primary basis for the new *American National Standard for Laboratory Decommissioning* released in 2008.
- Methods can be adapted to other building types.



Taking Science to the SHED

Research Needs

- Develop protocol to determine acceptable contaminant levels for restricted or unrestricted release of decommissioned building spaces.
  - Levels are currently very difficult to define and there are few existing standards (except for land contamination and radioactive materials).
  - Setting too low increases remediation costs, may unnecessarily restrict or prevent reuse of decommissioned assets.
  - Too high may present hazards to occupants and research assets.
- Preference for protocol to define release levels based on scientific assessment of acceptable risk for the next occupancy rather than inflexible regulatory standards.

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Research Needs - Continued

- Traditional sampling and analysis methods for assessment of contaminants in labs have major limitations:
  - Vast variety of potential contaminants precludes testing for most individual substances.
  - Validated analytical methods may not be available.
  - Time required and costs are very high.
  - Contaminant levels may vary significantly over small areas reducing effectiveness of composite sampling methods.
  - Interpretation of analytical results and toxicological significance unclear – no benchmarks or standards for most chemicals.
  - Our ability to access effects of interactions and risks posed by multiple contaminants is very limited.

Research Needs - Continued

- More effective and feasible sampling and analysis methods are needed:
  - Rapid
  - Can be completed on-site or nearby
  - Lower cost
  - Should report indicators of overall biological risk posed by the area sampled e.g., acute toxicity, carcinogenicity, endocrine disruption potential, rather than levels of specific chemicals.
- New rapid bioassay methods for determining toxicity - “lab on a chip” etc. are available and may be adaptable for these purposes.

Building More and Greener SHEDs

Other Actions Needed

- Secure regulatory acceptance of rapid debris screening methods.
- Develop uniform federal standards for release of debris materials to recycling outlets.
- Establish interagency clearinghouse for sharing assessment tools, remediation plans by building type; deconstruction contracts and specs.
- Work with sustainability rating organizations USGBC and Green Building Initiative to ensure credits can be awarded for SHED of previous building areas.
- Prevention - develop and incorporate features for SHED in new building designs.

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Thank You!

National Partnership for Environmental Priorities

CLOSING THE CIRCLE

Sustainable Buildings Industry Council
Beyond Green AWARD

2009 White House Closing the Circle Award
"Planting the Seeds of Change"

Go Green HHS

2009 Green Champion Award

EPA WASTE WISE