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Document 14.9 Safe Handling of Asbestos-Containing Material During Construction Work

Recommended for approval by the ES&H Working Group

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14.9

Safe Handling of Asbestos-Containing Material During Construction Work***Contents**

1.0	Introduction	4
1.1	General.....	4
1.2	LLNL Asbestos Control Program	4
1.3	Applicability	5
1.4	Subcontractors	6
2.0	Hazards	6
3.0	Control of Asbestos Work.....	6
3.1	Classification of Asbestos Work	7
3.1.1	OSHA Categories.....	7
3.1.2	LLNL Administrative Categories	8
3.2	General Control Requirements	8
3.3	Controls for Class I Asbestos Work.....	10
3.3.1	Regulated Area.....	10
3.3.2	Competent Person/Accredited Supervisor.....	10
3.3.3	Critical Barriers.....	10
3.3.4	Ventilation.....	11
3.3.5	Contamination Control	12
3.3.6	Decontamination Areas.....	12
3.3.7	Alternatives to a Decontamination Area	13
3.3.8	Dust Control Systems for Class I Asbestos Work	14
3.3.9	Alternative Controls for Class I Asbestos Work.....	18
3.4	Controls for Class II Asbestos Work	18
3.4.1	Asbestos Work Permits and Operating Procedures	18
3.4.2	Regulated Area.....	19
3.4.3	Competent Person.....	19
3.4.4	Critical Barriers.....	19
3.4.5	Contamination Control	19
3.4.6	Decontamination Areas.....	19
3.4.7	Removal of PACM/ACM.....	19
3.4.8	Alternative Controls for Class II Asbestos Work	22
3.5	Controls for Class III Asbestos Work.....	23
3.5.1	Asbestos Work Permits and Operating Procedures	23
3.5.2	General Controls	23
3.5.3	Regulated Area.....	23
3.5.4	Competent Person.....	24

* Editorial Revision

3.6	Controls for Class IV Asbestos Work.....	24
3.6.1	Asbestos Work Permits and Operating Procedures	24
3.6.2	Regulated Area.....	24
3.6.3	Decontamination.....	24
3.7	Nonconstruction Asbestos Work.....	24
3.7.1	Exposure Monitoring.....	24
3.7.2	Regulated Areas	25
3.7.3	Training	25
3.8	Alternative Methods of Compliance for Installation, Removal, Repair, and Maintenance of Certain Roofing and Pipeline Coating Materials.....	25
3.9	Administrative Controls	25
3.9.1	Airborne Exposure Limits	25
3.9.2	Incidental Exposure	26
3.9.3	Air Monitoring Program.....	26
3.9.4	Medical Surveillance	31
3.9.5	Waste Disposal	32
3.9.6	Posting and Labeling.....	32
3.9.7	Plant Engineering Asbestos Operations and Maintenance Program	32
3.9.8	Process for Review of Planned Work.....	33
3.9.9	Asbestos Work Permit.....	33
3.9.10	Subcontracted Asbestos Work	34
3.9.11	Training	35
3.9.12	Personal Protective Equipment.....	36
4.0	Responsibilities.....	38
4.1	Workers	38
4.2	Plant Engineering Department	39
4.2.1	Plant Engineering Training Manager.....	39
4.2.2	Supervisors.....	39
4.2.3	Construction Project Managers and Designers	40
4.3	Hazards Control Department.....	40
4.4	Health Services Department.....	42
4.5	Environmental Protection Department	43
4.6	Facility Points of Contact	43
5.0	Work Smart Standards	44
6.0	Resources for More Information.....	45
6.1	Contacts	45
6.2	Other Sources.....	45
6.3	Lessons Learned.....	45

Appendices

Appendix A	Acronyms, Terms, and Definitions	47
Appendix B	Common ACBM.....	52
Appendix C	Compliance Guide for the OSHA Construction Industry Asbestos Standard	53
Appendix D	Process for Limited-Scale Asbestos Work	56
Appendix E	Asbestos Work Permit.....	58
Appendix F	Signs and Labels.....	59

Tables

Table 1.	Training requirements for asbestos-related work.....	35
Table 2.	Selection criteria for respirators.....	37

14.9

Safe Handling of Asbestos-Containing Material During Construction Work

1.0 Introduction

1.1 General

The term "asbestos" refers to a group of six fibrous minerals used in construction materials and other products. Asbestos is present in a variety of products in many LLNL buildings. Further use of asbestos-containing material (ACM) in LLNL buildings or equipment is prohibited unless specifically approved, through the Integration Work Sheet (IWS) process, by a facility point of contact (FPOC), the Plant Engineering Asbestos Project Manager, and industrial hygiene staff. For further details, see the Controlled Items/Services List, which can be found at the following Internet address:

<http://www-r.llnl.gov/pm/html/trrinfo.html>

This document contains federal, state, and LLNL requirements governing asbestos-related work, as well as detailed procedures for carrying out such work. Laboratory employees and subcontract workers who perform work that involves, or may incidentally disturb, asbestos shall comply with all requirements in this document. Appendix A of this document contains acronyms, terms, and definitions; the other appendices specify requirements and provide guidance and supporting material.

1.2 LLNL Asbestos Control Program

LLNL has established an Asbestos Control Program to address issues related to asbestos work. The goals of the program are to:

- Prevent or minimize exposure of workers and visitors to airborne asbestos dust.
- Comply with applicable laws, regulations, Department of Energy (DOE) orders, and internal LLNL requirements pertaining to asbestos.
- Identify, label, and periodically inspect asbestos-containing building material (ACBM). See Appendix B for a list of common ACBM.
- Provide LLNL employees and subcontract workers who handle or disturb asbestos with appropriate training, equipment, and personal protective equipment (PPE).

- Provide proper industrial hygiene monitoring and referral for medical surveillance, if necessary.
- Prevent the installation of new asbestos-containing items whenever possible.
- Handle untested building materials that could contain asbestos [i.e., presumed asbestos-containing materials (PACM)] as if the materials contain asbestos until proven otherwise.
- Ensure that subcontracted asbestos work is properly planned, reviewed, and conducted.

1.3 Applicability

The requirements in this document apply to all Laboratory personnel and subcontractors who perform work involving ACM or PACM. The operations covered by this document include the following:

- Activities including, but not limited to
 - Incidental contact with asbestos when performing other work, e.g., telephone cable installation.
 - Demolition or salvage of structures in which asbestos is present.
 - Removal, enclosure, or encapsulation of materials containing asbestos.
 - Construction, alteration, repair, maintenance, or renovation of structures, substrates, or parts thereof that contain asbestos.
 - Installation of products containing asbestos.
 - Asbestos spills and emergency cleanup.
 - Transportation, disposal, storage, and containment of asbestos or products containing asbestos at sites where construction activities are performed.
 - Housekeeping activities involving asbestos or products containing asbestos.
- Sampling of construction or building material to determine the presence of asbestos.
- Working with ACM in a nonconstruction, nonlaboratory setting, e.g., automotive brake and clutch work.
- Inspection of ACBM, as defined in 40 CFR 763, Subpart E, Appendix C (Building Inspection).
- Planning of ACBM removal, as defined in 40 CFR 763, Subpart E, Appendix C (Project Design).
- Management of ACM removal.

The provisions of this document shall become applicable 60 days after approval. Furthermore, the requirements in this document do not apply to asbestos used in research activities. Such uses of asbestos are subject to Document 14.2, "LLNL Chemical Hygiene Plan for Laboratories," in the *ES&H Manual*.

1.4 Subcontractors

When a subcontractor performs services involving asbestos work, the subcontractor's procedures are reviewed by the appropriate ES&H Team, the construction project manager, and the FPOC to assure that the subcontractor's procedures comply with the requirements of this document. In addition, the requirements of Document 2.4, "Construction Subcontractor Environment, Safety, and Health Program," and Document 2.5, "Procured Services Subcontractor Environment, Safety, and Health Program," in the *ES&H Manual* and Plant Engineering Contracting Specifications 01310, 13280, 13282, and 13284 shall also be followed.

2.0 Hazards

Intact ACM is not hazardous unless the material is disturbed or deteriorates, causing loose fibers to become airborne and respirable. Inhalation of asbestos fibers may increase the risk of developing lung cancer or mesothelioma, a cancer of the lining of the lungs and abdominal area. Inhalation of ACM may also cause asbestosis, a scarring of the lungs. Concurrent exposure to asbestos and cigarette smoke may greatly increase the risk of lung cancer because the two substances act synergistically.

3.0 Control of Asbestos Work

An IWS is a work authorization document that is required to be prepared, reviewed, and approved before any LLNL employee or subcontract worker performs work that involves, or may incidentally disturb, asbestos. An IWS shall be revised and reapproved if changes in operations increase the level of hazard or introduce additional hazards.

Two of the Work Smart Standards identified as applicable to the handling of asbestos at LLNL are:

- 29 CFR 1926.1101.
- 29 CFR 1910.1001.

In addition, LLNL shall meet the applicable training requirements under the Environmental Protection Agency's (EPA's) Asbestos Hazard Emergency Response Act

(AHERA) of 1986 (i.e., 40 CFR 763 Subpart E, Appendix C), as amended by the Asbestos School Hazard Amendments and Reauthorization Act of 1990, and other selected parts of 40 CFR 763 Subpart E.

LLNL is subject to asbestos-handling regulations promulgated by the EPA, the Bay Area Air Quality Management District, and (at Site 300) the San Joaquin Valley Unified Air Pollution Control District. The State of California's asbestos waste-handling requirements are also applicable to asbestos work performed at the Laboratory.

Further information on air quality requirements, environmental protection requirements, and waste handling can be found in Volume III of the *ES&H Manual*. A list of applicable Work Smart Standards also can be found in Section 5.0 of this document.

Engineering controls are the primary means of reducing exposure to asbestos and are implemented to the extent feasible or necessary. Administrative and personal protective controls supplement engineering controls.

3.1 Classification of Asbestos Work

Federal [i.e., Occupational Safety and Health Administration (OSHA)] regulation divides asbestos-related construction work into four categories (see Section 3.1.1), with certain general controls for all categories and specific engineering, administrative, and personal protective controls for each category. LLNL also requires two administrative categories for asbestos-related construction work (see Section 3.1.2).

3.1.1 OSHA Categories

Class I asbestos work refers to activities involving the removal of thermal system insulation (TSI) and surfacing ACM, other than removal required for maintenance activities. Surfacing ACM is material that is applied to building surfaces in a wet state and allowed to dry in place. This category includes paints and texturing and joint compounds.

Class II asbestos work refers to activities involving the removal of ACM that is not TSI or surfacing material. This includes, but is not limited to, the removal of asbestos containing wallboard, floor tile, sheeting, roofing and siding shingles, and construction mastics.

Class III asbestos work refers to repair and maintenance operations in which ACM, including TSI and surfacing material, is likely to be disturbed.

Class IV asbestos work involves maintenance and custodial activities in which workers come in contact with ACM, as well as activities to clean up waste and debris having ACM.

A summary of the required controls for each category of asbestos work is given in Appendix C.

3.1.2 LLNL Administrative Categories

In addition to an IWS, a completed Asbestos Work Permit (see Section 3.9.9) is required for limited- and large-scale asbestos work performed by LLNL employees and subcontract workers. Limited-scale asbestos work conducted pursuant to a negative exposure assessment (NEA) (see Section 3.9.3) does not require an Asbestos Work Permit.

LLNL has established two categories of asbestos work for administrative purposes:

1. Limited-scale asbestos work, which includes
 - Class I asbestos work involving the removal of less than 25 lineal feet or 10 ft² of PACM/ACM.
 - Class II asbestos work involving less than 500 ft² of PACM/ACM.
 - All asbestos work involving the removal of vinyl asbestos tiles, regardless of quantity.
 - All Class III and Class IV asbestos work.

Appendix D outlines the process for carrying out limited-scale asbestos work.

2. Large-scale asbestos work, which is defined as
 - All Class I asbestos work involving more than 25 lineal feet or 10 ft² of PACM/ACM.
 - Class II asbestos work involving more than 500 ft² of PACM/ACM, except the removal of vinyl asbestos tile.

3.2 General Control Requirements

Except as noted, the engineering controls, devices, and work practices that follow apply to all classes of asbestos work, regardless of the level of exposure. See Section 3.9 for administrative controls.

Vacuum Cleaners. Vacuum cleaners for asbestos control and cleanup shall be equipped with high-efficiency particulate air (HEPA) filters and shall be used whenever possible to collect all PACM/ACM debris and dust.

Wet Methods. Wet methods (or wetting agents) shall be used to control worker exposure when handling, mixing, removing, cutting, applying, and cleaning up asbestos—except when the use of such methods is not feasible, such as when electrical hazards, equipment malfunction, or (in roofing work) slipping hazards could result.

Housekeeping. Wastes and debris contaminated with asbestos shall be cleaned up and disposed of promptly in air-tight containers. PACM/ACM shall be placed in sealed containers as the material is removed.

Prohibited Activities. The following engineering controls and work practices are prohibited for asbestos-related work or for work that disturbs PACM/ACM, regardless of the levels of asbestos exposure or the results of initial exposure assessments:

- Using high-speed abrasive disc saws that are not equipped with a point-of-cut ventilator or an enclosure with HEPA-filtered exhaust air.
- Using compressed air to remove asbestos or PACM/ACM, unless the compressed air is used with an enclosed ventilation system equipped with HEPA filters and designed to capture the dust cloud created by the compressed air.
- Dry sweeping, shoveling, or other dry cleanup of dust and debris from PACM/ACM.
- Rotating workers to reduce worker exposure to asbestos.
- Specifying asbestos or ACM for any building or building maintenance application.

Other Requirements. All work involving the disturbance of PACM/ACM shall be conducted in a manner that minimizes breakage or damage of PACM/ACM; removes PACM/ACM in the largest segments feasible; and complies with any governing Asbestos Work Permit, site-specific safety plan, or contract document, as applicable. (Appendix E is an example of an Asbestos Work Permit.)

Fabrics or plastic films used to create enclosures that are intended for occupancy, or that are capable of being occupied, shall be certified and shall conform to the requirements for large-scale tests in National Fire Protection Agency Standard 701, *Standard Methods of Fire Tests for Flame-Resistant Textiles and Films*.

3.3 Controls for Class I Asbestos Work

This section specifies the controls for Class I asbestos work.

3.3.1 Regulated Area

A regulated area shall be established for Class I asbestos work. A regulated area:

- Isolates the source of asbestos aerosol generation.
- Keeps unprotected personnel away from the asbestos work being performed.
- Demarcates the specific site where asbestos work is conducted, including any adjoining areas where debris and waste from asbestos work accumulate and work areas within which airborne concentrations of asbestos exceed, or may exceed, the OSHA permissible exposure limits (PELs).

Signs, such as the one shown in Fig. F-4 in Appendix F, shall be used to demarcate regulated areas.

3.3.2 Competent Person/Accredited Supervisor

All Class I asbestos work, including the installation and operation of dust control systems, shall be supervised by a competent person designated by the organization performing the work. A competent person is one who has the qualification, training, and authority to ensure worker safety and health, as defined in 29 CFR 1926.1101(b). Training shall be obtained in a comprehensive course for supervisors (e.g., a course conducted by a certified, EPA- or state-approved training provider). See Section 3.9.11 for further details.

3.3.3 Critical Barriers

To prevent fiber migration, critical barriers are required for any of the following:

- Class I asbestos work involving the removal of more than 25 linear feet or 10 ft² of TSI or surfacing material.
- Activities in which the employer (either LLNL or a subcontractor) cannot produce an NEA, as specified in Section 3.9.3.
- Situations in which unprotected workers are to perform work in an area adjacent to a regulated area.

Usually, critical barriers are physical barriers (e.g., plastic sheeting) that prevent dust migration by separating regulated areas from unregulated areas and keeping the asbestos work area at a negative pressure relative to adjacent areas. Critical barriers

often need to cover electrical outlets and other places where the negative pressure inside the critical barrier would otherwise be compromised by uncontrolled infiltration of outside air.

Negative pressurization of the space inside a critical barrier shall be sufficient to maintain a water pressure differential of -0.02 column inches (water gauge) or more.

Existing heating, ventilation, and air-conditioning (HVAC) systems shall be isolated in regulated areas by sealing with a double layer of 6-mil-thick plastic or equivalent material.

Alternatively, another barrier or isolation method that prevents migration of asbestos from the regulated area may be used (e.g., making the regulated area so large that airborne dust does not migrate to the perimeter).

If a barrier method other than a physical barrier is used, a certified industrial hygienist or licensed professional engineer who is qualified as a project designer shall evaluate the work area, projected work practices, and engineering controls. Furthermore, he or she shall certify, in writing, that the planned control method is adequate to prevent:

- Direct and indirect worker exposure from exceeding the PELs under worst-case conditions of use.
- Asbestos contamination from occurring outside the regulated area.

An IWS is used to document implementation of OSHA control requirements.

Asbestos work conducted using a specified control procedure in outdoor situations in which no unprotected persons are in the vicinity of the work does not need critical barriers, visual surveillance, or perimeter monitoring unless such measures are specified by the ES&H Team industrial hygienist.

3.3.4 Ventilation

For all Class I asbestos jobs that do not have an NEA or in which exposure monitoring shows that a PEL has been exceeded, ventilation shall be used in the regulated area to move contaminated air away from the breathing zone of workers and toward a HEPA filtration system or other dust-collection device. Whenever feasible, local exhaust ventilation shall be used. Instead of, or in addition to, local exhaust ventilation, a HEPA-filtered, negative-air-pressure, air filtration exhaust unit (e.g., a general exhaust system) may be used to ventilate the area inside of a critical barrier.

3.3.5 Contamination Control

All objects within a regulated area shall be covered with an impermeable drop cloth or plastic sheeting and secured with duct tape or equivalent material. In addition, walls and other surfaces adjacent to a regulated area may be covered with an impermeable drop cloth to aid in site cleanup.

3.3.6 Decontamination Areas

A three-chambered decontamination area adjacent and connected to the regulated area shall be established for all large-scale Class I asbestos work and shall consist of the following:

- An equipment room supplied with labeled, impermeable bags and containers for containment and disposal of contaminated protective equipment.
- A clean change room equipped with a locker or appropriate storage container for each worker.
- Shower facilities that comply with the requirements in 29 CFR 1910.141(d)(3), unless such facilities are not feasible. Showers shall be adjacent to both the equipment room and clean room, if feasible. The water for the shower should have a temperature of at least 32°C and a flow rate of at least 10 L/min.

Workers enter and exit a regulated area through the decontamination area. Therefore, the equipment room and clean room each shall be at least 1 m² in surface area and 2 m high, if feasible. If locating the shower between the equipment room and the clean room is demonstrated to be unfeasible, or if the work is performed outdoors, then workers shall do either of the following:

- Remove asbestos contamination from their worksuits in the equipment room using a HEPA vacuum before proceeding to a shower that is not adjacent to the work area.
- Remove their contaminated worksuits in the equipment room, then don clean worksuits and proceed to a shower that is not adjacent to the work area.

Below are the steps for entering and leaving a decontamination area.

Entry into a Decontamination Area

1. Enter the decontamination area through the clean room.
2. Remove and deposit street clothing in the locker provided.

3. Don protective clothing and respiratory protection before leaving the clean room.
4. Go through the shower and equipment rooms to enter the regulated area.

Exit from a Decontamination Area

1. Remove all gross contamination and debris from protective clothing before leaving the regulated area.
2. Without removing the respirator, remove protective clothing in the equipment room. Deposit the clothing in labeled, impermeable bags or containers.
3. Shower with the respirator on before entering the clean room.
4. Take off the respirator and change into street clothes in the clean room.

The respirator shall not be reused, but instead shall be returned to Respirator Services (in the Hazards Control Department).

3.3.7 Alternatives to a Decontamination Area

Alternate decontamination procedures may be used for limited-scale Class I asbestos work. For example, an equipment room (or area) can be set up adjacent to the regulated area, or mini-enclosures may be used for the decontamination of workers and equipment. The design and work practices for an equipment room and mini-enclosure are as follows.

Equipment Rooms and Equipment Areas

Design

- The room shall be of sufficient size to accommodate cleaning of the equipment and removal of PPE without spreading contamination beyond the area. This goal can be achieved by covering the floor or other horizontal working surface with an impermeable drop cloth.

Work practices

- Work clothing shall be cleaned with a HEPA vacuum prior to removal.
- All equipment and surfaces of containers filled with PACM/ACM shall be cleaned prior to removal from the equipment room (or area).
- The employer shall ensure that workers enter and exit the regulated area through the equipment room (or area).

Mini-Enclosures

A small, walk-in enclosure (i.e., a mini-enclosure) that can accommodate no more than two persons may be used for limited-scale work if the material disturbed or removed can be completely contained by the mini-enclosure. The design and work practices for such mini-enclosures are as follows:

Design

- Fabricated or job-made enclosures shall be constructed of 6-mil-thick plastic or equivalent.
- An enclosure shall be placed under a negative pressure [at least -0.02 column inches (water gauge) are recommended] by means of a HEPA-filtered vacuum or an equivalent ventilation unit.

Work practices

- Before use, an enclosure shall be inspected by a competent person for leaks and smoke tested for breaches. Any breaches shall be sealed. For subcontracted work, the project inspector shall perform such inspections.
- Before use, the interior of a mini-enclosure shall be completely washed with amended water and cleaned with a HEPA vacuum.
- Air movement within an enclosure shall be directed away from workers' breathing zone.

3.3.8 Dust Control Systems for Class I Asbestos Work

There are five OSHA-approved dust-control systems for Class I asbestos work:

1. Negative-pressure enclosures (NPEs).
2. Glove bags.
3. Negative-pressure glove bags.
4. Negative-pressure glove boxes.
5. Water spray systems. Such systems shall not be used unless described in detail in a safety plan, operating procedure, or contract submittal and reviewed by the ES&H Team industrial hygienist.

The above controls are used in addition to the general controls (e.g., critical barriers or equivalent) required for all asbestos work.

Negative-Pressure Enclosures

Design

- NPEs may be of any configuration.
- At least four air changes (six are recommended) per hour shall be maintained in NPEs.
- A water pressure differential of at least -0.02 column inches (water gauge), relative to outside pressure, shall be maintained within NPEs as evidenced by continuous manometric measurements.
- NPEs shall be kept under negative pressure throughout the period of use and until acceptable clearance sample results are obtained.
- Air movement shall be directed away from workers performing asbestos work within the enclosure and toward a HEPA filtration system.
- Backup air filter units and an emergency generator should be staged onsite for all large-scale Class I and II asbestos work performed in NPEs. Backup units shall be of a size that is sufficient to maintain a negative pressure differential of at least -0.01 column inches (water gauge) during failure of the primary system. In addition, backup units shall be tested before work begins and staged to be capable of coming online within 15 minutes of a power or fan failure. An emergency power system that automatically triggers the generator in the event of a power failure should be considered if there is a significant possibility of contamination of occupied adjacent areas resulting from a power failure.

Work Practices

- NPEs shall be inspected by a competent person for breaches before beginning work. Smoke testing for breaches may be necessary if a water pressure differential of -0.02 column inches (water gauge) cannot be maintained. For subcontracted work, the project inspector or a consulting industrial hygienist shall perform such inspections.
- Electrical circuits in the enclosure shall be deactivated unless equipped with ground-fault circuit interrupters.

Glove Bags

Design

- Glove bags shall be made of 6-mil-thick plastic (or equivalent approved by the ES&H Team industrial hygienist) and shall be seamless at the bottom.

Work Practices

- Glove bags may be used to remove ACM from piping. A glove bag shall be installed to completely cover the circumference of a pipe or other structure on which work is performed.
- Glove bags shall be smoke tested internally for leaks, including sealed leaks, before use.
- Glove bags may be used only once and, after being used, may not be moved to another location for further use.
- Glove bags shall not be used on surfaces whose temperature exceeds 150°F.
- Prior to disposal, glove bags shall be collapsed by removing the air inside with a HEPA vacuum.
- Before beginning work, loose and friable material adjacent to a glove bag (or glove box) shall be wrapped and sealed in two layers of 6-mil-thick plastic or otherwise rendered intact. (Friable material is any material that can be reduced to a powder by applying hand pressure.)
- Waste bags attached to glove bags shall be connected to a collection bag using a hose or other material that can withstand the pressure of the PACM/ACM waste and water without losing integrity. A sliding valve or other device shall separate the waste bag from the hose to ensure that no asbestos exposure occurs when the waste bag is disconnected.
- At least two persons shall perform Class I glove bag removal operations.
- The length of a glove bag shall not exceed 60 inches.
- The ES&H Team industrial hygienist may prohibit the use of multiple glove bags either in series or in an area where the glove bags' removal may disturb more than 10 lineal feet of asbestos-containing pipe insulation.

Negative-Pressure Glove Bag Systems

Negative-pressure glove bag systems may be used to remove PACM/ACM piping and fittings.

Design

- In addition to the specifications for glove bags, negative-pressure glove bag systems shall include a HEPA vacuum (or other device) to generate a constant negative pressure of at least -0.02 column inches (water gauge).
- A means shall be provided to prevent the bag from collapsing during removal.

Work Practices

- The HEPA vacuum (or other device) shall run continuously during the operation.
- When a collection bag is used along with a separate waste bag that is discarded after one use, the collection bag may be reused if first rinsed clean with amended water.

Negative-Pressure Glove Boxes

This type of glove box may be used to remove PACM/ACM from pipe runs.

Design

- Glove boxes shall have rigid sides and shall be made of metal or other material that can withstand the weight of PACM/ACM and water used during removal of the material.
- A HEPA-filtered vacuum or other negative-pressure generator shall be used to create a negative pressure differential of at least -0.02 column inches (water gauge) in the system.
- An air filtration unit shall be attached to any air inlet on a glove box.
- A glove box shall be fitted with gloved apertures.
- An aperture at the base of a box shall serve as a bagging outlet for PACM/ACM waste and water.
- A backup generator shall be present onsite and be of a size that is sufficient to operate the negative-pressure system within five minutes of a power failure.
- Waste bags shall consist of at least 6-mil-thick plastic and shall be double-bagged before waste is placed inside.

Work Practices

- At least two persons shall conduct work in a negative-pressure glove box.
- Glove boxes shall be smoke tested before each use.
- Before work begins, loose or damaged PACM/ACM adjacent to the glove box shall be wrapped and sealed in two layers of 6-mil-thick plastic or otherwise rendered intact.

3.3.9 Alternative Controls for Class I Asbestos Work

Class I asbestos work may be performed using controls other than those specified in this document if all of the following provisions are met:

- The alternative control method encloses, contains, or isolates the processes or source of airborne asbestos dust or otherwise captures or redirects such dust before it enters the breathing zone of workers.
- An industrial hygienist or professional engineer qualified, as a project designer, to evaluate the work area, the projected work practices, and the engineering controls certifies, in writing, that the alternative method is sufficient to prevent
 - Direct and indirect worker exposure from exceeding the PELs under worst-case conditions of use.
 - Asbestos contamination from exceeding the clearance level outside the regulated area.

An ES&H Team industrial hygienist shall conduct an evaluation of work performed by LLNL employees. Subcontractors who use an alternative procedure shall retain a certified industrial hygienist or project designer to perform such evaluations and shall submit the results to the ES&H Team industrial hygienist for review and approval.

The evaluation of TSI (25 linear feet or 10 ft² or less) or surfacing material (10 ft²) to be removed may be performed or reviewed by a competent person. Perimeter or clearance monitoring otherwise required may be omitted in such cases.

3.4 Controls for Class II Asbestos Work

Class II asbestos work may be performed using one of the control systems (see Section 3.3) allowed for Class I asbestos work. Only glove bags and glove boxes that fully enclose the material to be removed are allowed. The requirements below, as well as the general requirements in Section 3.2, are applicable to Class II asbestos work.

3.4.1 Asbestos Work Permits and Operating Procedures

The current version of National Institute of Building Sciences (NIBS) specifications may be used as a starting point for developing Asbestos Work Permits (see Section 3.9.9) and operating procedures.

3.4.2 Regulated Area

A regulated area shall be established for Class II asbestos work unless the work is covered by an NEA and is not generally accessible to unprotected people. The guidelines for establishing and demarcating a regulated area for Class II asbestos work are the same as those described in Section 3.3.1 for Class I asbestos work.

3.4.3 Competent Person

All Class II asbestos work shall be supervised by a competent person, as described in Section 3.3.2.

3.4.4 Critical Barriers

Critical barriers (see Section 3.3.3) and ventilation (see Section 3.3.4) are required for all indoor Class II asbestos work if one of the following applies:

- There is no NEA.
- Conditions change during the job, and there is an indication that asbestos exposure may exceed the PELs.
- PACM/ACM is likely to become friable during the removal process.

3.4.5 Contamination Control

An impermeable drop cloth shall be placed on all surfaces that may become contaminated during removal activities involving Class II asbestos.

3.4.6 Decontamination Areas

Any Class II asbestos work that is known to result in exposure exceeding the PELs shall be provided with a three-chambered decontamination system, if feasible. Class II asbestos work for which there is no NEA should be provided with either a three-chambered decontamination system or an equipment room, as determined by the ES&H Team industrial hygienist. The design and work practices for an equipment room for Class II asbestos work, including procedures for entering and leaving the decontamination area, are the same as those described in Section 3.3.6 for Class I asbestos work.

3.4.7 Removal of PACM/ACM

Specified below are procedures for removal of various types of PACM/ACM.

Floor Tiles

Workers shall comply with the work practices below when removing vinyl and asphalt flooring materials that contain PACM/ACM.

- Flooring or its backing shall not be sanded.
- Vacuums equipped with HEPA filters, disposable dust bags, and metal floor tools (without a brush) shall be used to clean floors.
- Linoleum sheeting shall be removed by cutting, wetting of the snip point, and wetting during delamination. Do not rip up resilient sheeting or flooring material.
- All scraping of residual adhesive or backing shall be performed using wet methods or devices equipped with a HEPA-filtered local exhaust system.
- Dry sweeping is prohibited. Instead, dry HEPA vacuuming shall be used.
- Mechanical chipping is prohibited unless performed in an NPE. Any procedure that requires breaking tile, thereby creating visible or measurable asbestos-containing dust in air, is considered mechanical chipping.
- Tiles shall be removed intact whenever possible. Wetting may be omitted when tiles are heated and can be removed intact.
- Resilient flooring material, including associated mastic and backing, shall be assumed to contain asbestos unless an industrial hygienist or qualified building inspector determines, by means of polarized light microscopy, that the material is free of asbestos.

Roofing

Workers shall comply with the work practices described below when removing roofing material with PACM/ACM.

- Roofing material shall be removed intact to the extent feasible.
- Wet methods should be used when feasible. The use of wet methods is not required for roof removal if the PACM/ACM is removed intact, if exposure does not exceed the PELs, and if wetting would create a substantial slipping hazard. When cutting machines are used, and the material is not removed intact, wet methods are required to the extent that the procedure does not create a slipping hazard.
- All loose dust from sawing operations shall be HEPA vacuumed immediately. When built-up, smooth (i.e., non-graveled) roofing is removed using a power cutter, dust may be wet swept rather than HEPA vacuumed.

- Wet methods and HEPA vacuuming are not required to remove or repair less than 25 ft² of roofing material if the material remains intact and does not generate visible dust.
- Cutting machines shall be continuously misted during use unless a competent person determines that misting substantially decreases worker safety.
- ACM that has been removed from a roof shall not be dropped or thrown to the ground. Instead, such material shall be carried or passed to the ground by hand or lowered to the ground with a covered, dust-tight chute, crane, or hoist.
 - Nonintact ACM shall be lowered to the ground as soon as practicable, but in any event no later than the end of the work shift. While on the roof, the material shall either be kept wet, placed in a impermeable waste bag, or wrapped in plastic sheeting.
 - Intact ACM shall be lowered to the ground as soon as practicable, but in any event no later than the end of the work shift.
- Roof-level heating and ventilation air-intake sources shall be isolated, or the ventilation system shall be shut down.

Asbestos Cement Panels

The work practices described below are applicable when removing cementitious asbestos-containing siding, shingles, or Transite panels.

- Cutting, abrading, or breaking of siding, shingles, or Transite panels are prohibited unless the employer can demonstrate that other methods less likely to result in asbestos fiber release cannot be used.
- Each panel or shingle shall be sprayed with amended water prior to removal.
- Unwrapped or unbagged panels or shingles shall be lowered to the ground immediately via a covered, dust-tight chute, crane, or hoist. Alternatively, panels or shingles may be placed in an impervious waste bag or wrapped in plastic sheeting and lowered to the ground no later than the end of the work shift.
- Nails shall be cut with flat, sharp tools.

Gaskets

The following work practices apply when removing gaskets containing PACM/ACM.

- A gasket that is visibly deteriorated and cannot be removed intact shall be removed within a glove bag or glove box equipped with a HEPA-filtered local exhaust system.
- A gasket shall be wet thoroughly with amended water prior to removal and immediately placed in a disposal container.
- Any scraping to remove PACM/ACM residue shall be performed using wet methods.

Miscellaneous Materials Containing PACM/ACM

The work practices below apply to miscellaneous materials containing PACM/ACM.

- Material shall be thoroughly wetted with amended water prior to and during removal.
- Material shall be removed in an intact state unless the employer demonstrates that intact removal is not possible.
- Cutting, abrading, or breaking the material are prohibited unless the employer can demonstrate that methods less likely to result in asbestos fiber release are not feasible.
- Material that is removed shall be immediately bagged, wrapped, or kept wet until transferred to a closed receptacle no later than the end of the work shift.

3.4.8 Alternative Controls for Class II Asbestos Work

Controls different from those described in this document, as well as modified engineering and work practice controls, may be used if all of the following provisions are met:

- The organization planning the work demonstrates, by data representing worker exposure (e.g., NEA), that during the use of such method, worker exposure will not exceed the PELs under any anticipated circumstances.
- A competent person evaluates the work area, the projected work practices, and the engineering controls and certifies, in writing, that the alternate method is sufficient to prevent
 - Direct and indirect worker exposure from exceeding the PELs under worst-case conditions of use.

- Asbestos contamination from exceeding the clearance level outside the regulated area.

A competent person shall perform the evaluation for work done by LLNL employees or subcontract workers. Subcontractors who use an alternative procedure shall retain a competent person to perform the evaluation and submit the results to the ES&H Team industrial hygienist for review and approval.

3.5 Controls for Class III Asbestos Work

The requirements below, as well as the general requirements in Section 3.2, are applicable to Class III asbestos work.

3.5.1 Asbestos Work Permits and Operating Procedures

The current version of NIBS specifications may be used as a starting point for developing Asbestos Work Permits and operating procedures.

3.5.2 General Controls

If there is no NEA for a job, or if monitoring results for the NEA show that a PEL has been exceeded, workers shall contain the area using an impermeable drop cloth and plastic sheeting (i.e., critical barriers) or equivalent. A glove bag, glove box, mini-enclosure, or NPE may also be used. In addition, the employer shall establish an equipment room (or area) adjacent to the regulated area for the decontamination of workers and equipment.

The design and work practices for equipment rooms for Class III asbestos work are the same as those described in Section 3.3.7 for Class I asbestos work.

Class III asbestos work shall be performed using wet methods and, to the extent feasible, local exhaust ventilation.

When work involves drilling, cutting, abrading, sanding, chipping, breaking, or sawing of TSI or surface material, the employer shall use impermeable drop cloths and shall isolate the operation using mini-enclosures, glove bags, or another isolation method.

3.5.3 Regulated Area

A regulated area shall be established for Class III asbestos work unless there is an NEA and the work is to be performed in areas to which untrained personnel do not have any access. The guidelines for establishing and demarcating a regulated area for Class III asbestos work are the same as those described in Section 3.3.1 for Class I asbestos work.

3.5.4 Competent Person

All Class III asbestos work shall be supervised by a competent person. The training for a competent person in such cases can be a 16-hour operations and maintenance course that meets the requirements of 40 CFR 763, Subpart E, Appendix C.

3.6 Controls for Class IV Asbestos Work

The requirements below, as well as those in Section 3.2, are applicable to Class IV asbestos work.

3.6.1 Asbestos Work Permits and Operating Procedures

The current version of NIBS specifications may be used as a starting point for developing Asbestos Work Permits and operating procedures.

3.6.2 Regulated Area

Class IV asbestos work shall be conducted in a regulated area if exposure that exceeds a PEL is anticipated.

3.6.3 Decontamination

When Class IV asbestos work involves the cleanup of PACM/ACM debris, the employer shall establish an equipment room (or area) adjacent to the regulated area for the decontamination of workers and equipment. The design and work practices for equipment rooms for Class IV asbestos work are the same as those described in Section 3.3.7 for Class I asbestos work.

3.7 Nonconstruction Asbestos Work

This section describes the controls that apply to nonconstruction asbestos work.

3.7.1 Exposure Monitoring

Initial personal air monitoring shall be performed for all tasks in which exposure could possibly exceed the PEL. If the results of personal air monitoring indicate that airborne asbestos levels exceed one-half of the PEL, then air monitoring shall be repeated at an interval no greater than six months.

3.7.2 Regulated Areas

A regulated area shall be established where airborne asbestos levels exceed the PEL. The same controls applicable to Class 1 construction-related asbestos work (specified in Section 3.3) shall apply to a regulated area established for nonconstruction asbestos work.

3.7.3 Training

The following training is required for workers who perform nonconstruction asbestos work:

- Course HS4420 ("Asbestos Safety Awareness").
- Job-specific training provided by the ES&H Team industrial hygienist at a safety meeting.

3.8 Alternative Methods of Compliance for Installation, Removal, Repair, and Maintenance of Certain Roofing and Pipeline Coating Materials

Before work begins and as needed during the job, a competent person shall inspect the worksite and determine that the roofing material is intact and will likely remain intact. All workers performing this type of work shall meet the OSHA training requirements.

Material shall be removed by manual methods and shall not be sanded, abraded, or ground. Wet methods shall be used for all removal and disturbance of pipeline asphaltic wrapping.

3.9 Administrative Controls

This section specifies the administrative controls for asbestos-handling work.

3.9.1 Airborne Exposure Limits

This section covers two types of exposure limits:

- PELs (for workers conducting asbestos work).
- Clearance limits (for areas outside a regulated area).

Personal Exposure Limits

The PEL used as the asbestos exposure levels not to be exceeded by personnel involved in asbestos-related work shall be one of the following:

- An 8-hour, time-weighted average (TWA) airborne asbestos concentration of 0.1 fibers per cubic centimeter of air (f/cc), as determined by phase contrast microscopy (PCM) and in accordance with the OSHA reference method.
- The excursion limit, which is 1.0 f/cc averaged over any half-hour period, as determined by PCM.

All persons assigned to conduct Class I asbestos work shall be assumed to be potentially overexposed to airborne asbestos until specific monitoring demonstrates otherwise. Therefore, all requirements for air monitoring, PPE, medical surveillance, and training shall be met before performing Class I asbestos work. All exposure-monitoring data for LLNL workers is provided to the Health Services Department.

Clearance Limits

Transmission electron microscopy (TEM) analysis is the preferred method for clearance sampling because of this technique's lower detection limit and ability to positively identify asbestos fibers. The acceptable asbestos clearance level for all samples in an area analyzed using PCM shall be less than or equal to 0.01 f/cc. Such analysis shall be done in accordance with the National Institute for Occupational Safety and Health (NIOSH) 7400 method or the most recent OSHA analytical method. (For more information about these and other analytical methods specified in this document, consult the sources listed in Section 6.2.)

For TEM analysis, the acceptable clearance level for samples shall be less than or equal to 70 structures per square millimeter. Such analysis shall be done in accordance with the AHERA method or Yamate level 2 method. All asbestos structures greater than 0.5 μm shall be counted.

3.9.2 Incidental Exposure

Incidental exposure to asbestos (such as background levels in work areas and exposure levels of individuals not directly involved with asbestos work) should not exceed the clearance criteria described above. If air sampling indicates excessive exposure, the industrial hygienist should notify management, identify the source of the asbestos, and recommend appropriate action.

3.9.3 Air Monitoring Program

Personal and clearance air monitoring are important parts of providing feedback and improvement to all affected parties following asbestos abatement work. All air monitoring reports shall be sent to the FPOC, the Health Services Department, the supervisor and workers involved in the project, and any others specified by the Hazards Control Department. If airborne asbestos levels exceed the PEL or clearance

level, specific actions and recommendations to lower airborne asbestos levels during similar future work shall be made.

Exposure to airborne asbestos by individuals performing asbestos-handling work shall be determined by personal air sampling results analyzed in accordance with the OSHA analytical method or an equivalent PCM procedure. The Hazards Control Department characterizes asbestos exposure of LLNL employees or subcontract workers who perform limited-scale work. For all subcontracted and large-scale asbestos work (i.e., Class I asbestos work that disturbs 25 lineal feet or 10 ft² of PACM/ACM or Class II asbestos work, other than floor tile, exceeding 500 ft²), the organization performing the work shall retain an industrial hygienist to characterize worker exposure to asbestos as required by Plant Engineering Department specifications. The ES&H Team industrial hygienist may provide such services, if negotiated with the team leader, for Plant Engineering personnel who perform large-scale work.

Initial Exposure Monitoring

Either an ES&H Team industrial hygienist, a contractor retained as a certified industrial hygienist, or a competent person shall conduct initial sampling to assess accurately the 8-hour TWA and 30-minute excursion exposures, as appropriate.

Periodic Monitoring

Unless an NEA, as specified in Section 3.9.3, for the entire operation has been developed and approved by the Hazards Control Department, daily monitoring that is representative of the 8-hour TWA or 30-minute excursion limit shall be conducted for workers who perform Class I or Class II asbestos work or who are assigned to work within a regulated area. Periodic monitoring shall be conducted for all operations (except Class I and II asbestos work) at intervals sufficient to document the validity of the exposure prediction if exposures are expected to exceed the PELs.

An exemption from daily personnel sampling is provided if the individuals performing the work wear continuous-flow or type C pressure-demand, supplied-air respirators.

The ES&H Team industrial hygienist shall provide written notification to the supervisors of monitored LLNL workers and subcontract workers as soon as possible after receiving the air sampling results. If the TWA or excursion limit has been exceeded, notification shall include requirements for medical surveillance and the steps necessary to reduce airborne asbestos levels. A copy of the notification shall be provided to the Health Services Department. A contractor shall submit the results of air sampling work conducted by its subcontractors to the University, as required by Plant Engineering Department specifications. All results shall be reported regardless of the protection afforded the affected workers by the respirators in use.

Perimeter Sampling

Perimeter sampling shall be conducted around each regulated area that is not in an NPE. The limits for airborne asbestos at the perimeter of an asbestos work area are the same as the clearance sample limits. The frequency of sampling, as well as the sampling and analysis procedures, shall be determined by the ES&H Team industrial hygienist and indicated on the Asbestos Work Permit (see Appendix E), operating procedures, or the contract specifications for subcontracted work. The Hazards Control Department conducts perimeter sampling for LLNL employees or subcontract workers who perform limited-scale work.

However, an organization conducting large-scale work is responsible for obtaining a competent person to conduct perimeter sampling. If time permits, the ES&H Team industrial hygienist may provide such services, if negotiated with the team leader, for Plant Engineering personnel who perform large-scale work.

A copy of the results (with an interpretation) of perimeter samples taken for each occupied or reoccupied area should be provided to the FPOC within 15 days of receipt. The FPOC shall communicate the results to individuals who occupy the affected area of the building in question.

Clearance Sampling

When Required

Clearance samples are used to document the adequacy of decontamination and cleanup after asbestos work. Clearance samples shall be collected (if technically feasible) in the following situations:

- After all indoor, large-scale, and limited-scale asbestos work in NPEs.
- For activities for which sampling is deemed appropriate and feasible by the industrial hygienist.

Clearance sampling is not usually required for Class III, Class IV, or outdoor asbestos work. In some cases, however, the ES&H Team industrial hygienist may determine that sampling may be appropriate after Class III or outdoor asbestos work. Clearance sampling may not be appropriate or feasible after glove bag or glove box work in low-occupancy areas, such as machine rooms.

The Hazards Control Department should conduct sampling for LLNL employees and subcontract workers who conduct limited-scale work. However, an LLNL organization performing or subcontracting large-scale asbestos work should have the services of a certified industrial hygienist to conduct clearance sampling. The ES&H Team industrial

hygienist may provide such services, if negotiated with the team leader, for Plant Engineering personnel who perform large-scale work.

Aggressive Techniques

Clearance sampling shall be conducted using aggressive techniques, if technically appropriate, in accordance with the procedure described in 40 CFR 763, Subpart E, Appendix C. Clearance samples shall only be collected after an area has passed a rigorous visual inspection and if removal of all potentially asbestos-containing dust and debris has been verified. Critical barriers and negative pressure shall be maintained until clearance samples yield acceptable results.

The ES&H Team industrial hygienist shall determine the number of clearance samples to be collected. As a minimum, at least one sample shall be collected for each discrete work area. The required number of samples and analysis procedures shall be specified in subcontracting specifications.

Other Sampling

Personal, area, or other types of samples may, at the discretion of the industrial hygienist, be collected in occupied areas believed to be contaminated with airborne asbestos. The sampling and analytical methods used in such cases shall be determined by the industrial hygienist. A copy of the results (with an interpretation) of hazard assessment samples obtained for each occupied area shall be provided to the FPOC within 15 days of receipt. The FPOC shall communicate the results to individuals who occupy affected areas of the building in question.

Analytical Methods for Clearance Samples

Clearance samples collected may be analyzed using either the PCM or TEM method. In general, TEM analysis is used. TEM analysis equivalent to the OSHA analytical method or Yamate level 2 method is used for the following:

- Class I asbestos work that disturbs more than 25 lineal feet or 10 ft² of PACM/ACM.
- Class II asbestos work, excluding floor tile-related work, involving more than 500 ft² of PACM/ACM.
- Class II asbestos work involving more than 150 ft² of floor tile.

Selective Fiber Counting

All fibers meeting the OSHA size criteria (i.e., greater than 5 μm in length, with a 3:1 aspect ratio) shall be counted whenever analysis is performed by PCM, unless the industrial hygienist determines that selective fiber counting is warranted and a laboratory with the necessary skills is available to perform the analysis. The use of optical microscopy for selective fiber counting is not permitted for samples collected by consultants or contractors unless approved by the ES&H Team industrial hygienist.

Negative Exposure Assessments

For any asbestos job to be performed by workers who have been trained in compliance with this document, it may be possible to demonstrate that worker exposure will not exceed the PELs. For such a determination of negative exposure (i.e., an NEA) to be made, objective data need to show that the asbestos-containing product or material in question, or the activity involving such products or materials, cannot release airborne fibers in concentrations exceeding the TWA or the excursion limit under work conditions having the greatest potential for releasing asbestos. If prior asbestos jobs have been monitored for the TWA limit and excursion limit within 12 months of the current or projected job, the employer, whether LLNL or a subcontractor, shall show that:

- Monitoring and analysis were performed in compliance with the asbestos standard in effect.
- Data were obtained under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations.
- The operations were conducted by workers whose training and experience are no more extensive than those of individuals performing the current job.
- There is a high degree of certainty that worker exposures will not exceed the TWA or excursion limit under conditions prevailing in the workplace.
- Initial air sampling including monitoring that was performed during worst-case conditions, i.e., the portion of the entire asbestos job that was most likely to result in exposure exceeding the 8-hour TWA exposure or 30-minute excursion limit.

Only ES&H Team industrial hygienists are permitted to accept an NEA. In general, NEAs for workers are developed by the Hazards Control Department. Subcontractors shall submit complete documentation of any NEA to the ES&H Team industrial hygienist for review. Inadequate NEAs shall not be used for work performed at LLNL.

3.9.4 Medical Surveillance

Medical surveillance is intended to:

- Facilitate early detection of asbestos-related conditions by identifying and evaluating workers who are at higher risk with regard to asbestos work.
- Assess workers' ability to wear a respirator.

The Health Services Department consults with Hazards Control Department professionals to make medical surveillance determinations. Medical surveillance shall be provided to all workers who:

- Engage in, for a combined total of 30 days or more in a single year, Class I, II, or III asbestos work or Class IV work in which airborne asbestos levels are equal to or greater than the PEL. (Work lasting less than one hour per day is not to be included in the 30-day period if the material in question is removed or disturbed intact.)
- Wear negative-pressure respirators for protection against asbestos for more than 30 days in a single year.
- Perform nonconstruction activities and are exposed, for one or more days in a single year, to airborne asbestos levels equal to or greater than the PEL.
- Have a significant asbestos occupational work history, as determined by a Health Services Department clinician.

Prior to the examination, the Health Services Department (and, in the case of subcontract workers, the external examining physician) shall receive the following:

- The hazard assessment (from the Hazards Control Department).
- A description of the worker's duties related to asbestos exposure and a description of any personal protective and respiratory equipment to be used (from the worker's supervisor).

Exams shall be performed by, or under the supervision of, a licensed physician at no cost to workers. The content of such exams shall comply with the requirements in 29 CFR 1910.1001(l) and 29 CFR 1926.1101(m).

Baseline exams shall be provided to workers:

- Prior to assignment in areas where the use of negative-pressure respirators is required for more than 30 days in a single year.
- Following exposure to asbestos levels exceeding the PEL within the first thirty working days of the year.

Personnel shall continue to be offered annual examinations for the duration of their employment. The Health Services Department shall provide LLNL employees and their supervisors with a written opinion concerning the results within 30 days of the exam. Employers of subcontract workers are responsible for assuring that all requirements are met.

3.9.5 Waste Disposal

All friable PACM/ACM shall be disposed of as hazardous waste. Nonfriable PACM/ACM (e.g., Transite and floor tile) shall be disposed of as nonfriable asbestos-containing waste. Contact a Hazardous Waste Management (HWM) Division technician to determine the friability of a specific waste, as well as specific packaging requirements. Friable asbestos waste shall be placed in 6-mil-thick plastic bags that have been HEPA vacuumed (to remove excess air), then sealed and placed in outer plastic bags that are also 6 mil thick. Outer containers shall be conspicuously labeled with the DANGER sign shown in Appendix F (Fig. F-1) and with the LLNL Hazardous Waste label, which is shown in Document 36.3, "Management of Satellite and Waste Accumulation Areas," in the *ES&H Manual*.

Waste generated by LLNL employees or subcontract workers is disposed of by the HWM Division. Disposal of all hazardous asbestos waste generated by outside subcontractors shall be the responsibility of those subcontractors. Written authorization is required from the HWM Division before waste can be shipped offsite for disposal.

3.9.6 Posting and Labeling

The DANGER sign shown in Appendix F (Fig. F-1) shall be conspicuously posted on, or as close as possible to, ACM. ACM shall be labeled directly. If direct labeling is not feasible, a comprehensible sign such as that shown in Fig. F-2a or Fig. F-2b shall be posted in a convenient location on a wall or by a light switch. A sign (Fig. F-3) shall be posted near the principal doorways of buildings that contain ACBM. Regulated areas shall be demarcated with signs that contain the wording specified in Fig. F-4.

Signs posted at the perimeter of a regulated area need not include a warning regarding respirators or coveralls if such gear is not necessary within the regulated area.

3.9.7 Plant Engineering Asbestos Operations and Maintenance Program

As a minimum, the Plant Engineering Department shall institute an Asbestos Operations and Maintenance Plan [the current form of this plan is the *Plant Engineering Maintenance Operations Manual*, Maintenance Operations Procedure (MOP) 2001], which is to be the basis for the Plant Engineering Asbestos Operations and Maintenance Program. The plan shall include procedures for:

- Surveying structures to locate ACBM and evaluate its condition.
- Labeling ACBM with the appropriate signs, as described in Section 3.9.6.
- Monitoring identified ACBM for deterioration.
- Repairing or removing damaged ACBM.
- Promptly cleaning up or isolating ACBM spills.
- Properly training Plant Engineering personnel who handle asbestos.
- Keeping accurate records of asbestos removal and repair work.
- Apprising FPOCs of the location and extent of asbestos in their areas of responsibility.
- Notifying facility managers, FPOCs, and the Hazards Control Department annually of the findings of inspections or of changes that have occurred (e.g., removal, replacement, or repair of ACBM). ACBM should be resurveyed every three years by the Plant Engineering Department, and the condition of previously identified accessible asbestos shall be checked by facility managers during annual self-assessments.

3.9.8 Process for Review of Planned Work

In accordance with the requirements in Document 42.1, "Design and Construction," in the *ES&H Manual*, the Hazards Control Department shall review all plans for facility demolition, renovation, remodeling, or construction that may disrupt PACM/ACM. This requirement applies to any such activities conducted by LLNL employees or subcontract workers.

Written documentation of control measures for the handling of asbestos shall be developed and submitted to the ES&H Team for review, depending on the size of the job.

3.9.9 Asbestos Work Permit

Asbestos Work Permits are used to document limited- and large-scale asbestos work and are only applicable to work performed by LLNL employees or subcontract workers. A work supervisor is responsible for developing and submitting an Asbestos Work Permit to the ES&H Team industrial hygienist 48 hours before the scheduled work, if possible.

Completing an Asbestos Work Permit is a joint effort in which the Responsible Individual, industrial hygienist, asbestos abatement workers, and supervisor define the scope of work, estimate the potential asbestos hazard and any additional hazards, and

develop and implement controls for each hazard. The scope of work and hazard controls are documented on the Asbestos Work Permit.

Limited-scale work conducted pursuant to an NEA does not require an Asbestos Work Permit.

3.9.10 Subcontracted Asbestos Work

Subcontractors performing asbestos-related work shall comply with the requirements of all of the following:

- Plant Engineering Department specifications (as applicable).
- This document.
- Document 2.1, "Laboratory and ES&H Policies, General Worker Responsibilities, and Integrated Safety Management," in the *ES&H Manual*.
- Document 2.4.
- Document 2.5.

Plant Engineering personnel who produce subcontracting documents for asbestos work shall either be accredited as project designers (see Section 3.9.11 for criteria) or have work plans and contract documents reviewed by an LLNL employee who is accredited as a project designer. All work plans and contract documents shall be reviewed by the ES&H Team.

Subcontractors performing large-scale asbestos work shall submit a site-specific safety plan that defines the scope of work, analyzes the hazards, develops controls for each hazard, and describes methods of evaluating the work and improving work practices.

An organization contracting large-scale asbestos work should retain a certified industrial hygienist or competent person to perform applicable air monitoring and site surveillance.

Many subcontracts involve incidental asbestos work. For example, installing a new trailer may involve splicing into an asbestos cement water pipe. Such work should be identified by the Responsible Individual before the contract is sent out for bid and should be addressed in the specifications. Alternatively, arrangements can be made for the work to be done by in-house personnel. As part of the design review process, such aspects of the project shall be detailed in the submittal provided to the ES&H Team.

3.9.11 Training

The training requirements for each group below are specified in Table 1.

- Supervisors (i.e., competent persons)—Individuals who plan and manage asbestos work.
- Asbestos workers—Workers who conduct asbestos work.
- Asbestos project designers—Individuals who prepare site-specific safety plans for large-scale work or contract specifications for subcontracted asbestos work of any type.
- Building inspectors—Individuals who survey buildings to identify ACBM. Individual samples for specific issues are not considered survey samples, and an accredited building inspector is not required.
- Other personnel who may have incidental contact with PACM/ACM.

Table 1. Training requirements for asbestos-related work.^a

Course title/length	Content	Who should attend	Annual refresher
Asbestos Safety Awareness (HS4420)/1–2 hr	General asbestos awareness, health effects, and LLNL requirements	Anyone who may incidentally come in contact with asbestos, any interested worker, and Hazards Control Department health and safety technicians	No
Worker (Class I and II asbestos work)/32 hr	Handling asbestos in buildings and on equipment, up to large-scale work	Plant Engineering and other personnel	Yes 8 hr
Class III asbestos work/16 hr	Handling asbestos in maintenance and operations	Plant Engineering personnel	Yes 8 hr
Class IV asbestos work/2–4 hr	Cleaning minor asbestos contamination	Plant Engineering and other personnel	Yes 2 hr
Supervisor—Class I and II asbestos work/40 hr	Supervision of Class I and II asbestos work	Supervisors of personnel who perform this work, Plant Engineering Asbestos Project Manager, industrial hygienist (at least one), and construction inspectors assigned to worksites where large-scale asbestos is removed	Yes 8 hr
Supervisor—Class III asbestos work/16 hr	Supervision of workers performing this work	(Same as above)	Yes 8 hr

Project designer (certified designer) ^{b/} 24 hr	Procedures to plan, contract for, and conduct full-scale asbestos work	Project managers, construction managers, and construction estimators involved in large-scale asbestos work; Plant Engineering Asbestos Project Manager, and industrial hygienist (at least one)	Yes 8 hr
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Table 1. Training requirements for asbestos-related work (cont'd).

Course title/length	Content	Who should attend	Annual refresher
Building inspector (certified inspector) ^{b/} 24 hr	Procedures to survey buildings to identify ACBM	Personnel who survey buildings to identify ACBM, Plant Engineering Asbestos Project Manager, and industrial hygienist (at least one)	Yes 8 hr
Job-specific training/time varies	Tailored to non-building or unusual work	Anyone involved in asbestos work that does not fit other categories	No

^a Only course HS4420 is offered by the Laboratory. The other courses are required by the State of California, and arrangements must be made to take these courses from certified vendors.

^b Training content to meet requirements of 40 CFR 763.

All training, except course HS4420 ("Asbestos Safety Awareness"), shall be provided by a training center accredited by the State of California in accordance with 40 CFR 763, Subpart E, Appendix C. Contact your training coordinator for information on the availability of training facilities and classes.

3.9.12 Personal Protective Equipment

The primary types of PPE used against asbestos exposure include respirators and protective clothing.

Respiratory Protection

Respirators shall be used during emergencies, regardless of exposure, and for the following:

- All Class I asbestos work.
- All Class II asbestos work in which the PACM/ACM is not removed in a substantially intact state.
- All Class II and III asbestos work performed without an NEA.

- All Class IV asbestos work performed within a regulated area where workers performing other work in the area are required to wear respirators.
- All work specified in this section in which workers are exposed at levels exceeding the TWA or excursion limit.

Table 2 gives the criteria for selecting the appropriate respirator.

Table 2. Selection criteria for respirators.

Airborne concentration of asbestos	Required respirator or conditions of use
Not to exceed 1 f/cc (10×PEL), or otherwise as required independent of exposure pursuant to 29 CFR 1926.1101(h)(2)(iv)	Half-mask, air-purifying respirator (other than a disposable respirator) equipped with high-efficiency filters.
Not to exceed 5 f/cc (50×PEL)	Full-facepiece, air-purifying respirator equipped with high-efficiency filters.
Not to exceed 10 f/cc (100×PEL)	Any powered, air-purifying respirator (PAPR) equipped with high-efficiency filters or any supplied-air respirator operated in continuous-flow mode.
Not to exceed 100 f/cc (1000×PEL)	Full-facepiece, supplied-air respirator operated in pressure-demand mode.
Greater than 100 f/cc (1000×PEL) or unknown concentration	Full-facepiece, supplied-air respirator operated in pressure-demand mode and equipped with an auxiliary, positive-pressure self-contained breathing apparatus (SCBA).

All workers who perform Class I asbestos work without an NEA in regulated areas where exposures may exceed 1.0 f/cc shall be provided a full-facepiece, supplied-air respirator that operates in the pressure-demand mode. The respirator shall be equipped with an auxiliary, positive-pressure self-contained breathing apparatus (SCBA) or a HEPA-filtered backup filtration system. If monitoring data are available for the required job and indicate that exposures do not exceed 1.0 f/cc, then tight-fitting, powered, air-purifying respirators (PAPRs) may be used.

Negative-pressure respirators used for protection against asbestos shall be fit-tested every 12 months. Employers shall provide a tight-fitting PAPR in lieu of a negative-pressure respirator whenever (1) a worker chooses to use the former type of respirator or (2) the former type of respirator would provide adequate protection to a worker.

Protective Clothing

Workers shall use protective clothing (including coveralls or similar whole-body clothing), head coverings, gloves, and foot coverings when performing large-scale

Class I asbestos work in which exposure to airborne concentrations of asbestos exceeding the TWA or excursion limit is possible or when no NEA is available.

Disposable protective clothing is preferred, although in some instances reusable clothing may be used but shall never be worn outside the immediate work area.

Clean protective clothing shall be provided at the start of each work session and when reusing protective clothing is not permitted or is impractical because of heavy contamination. If reusable clothing is used, the employer shall inform launderers of contaminated clothing of the requirement to prevent release of airborne asbestos.

In general, personal clothing should not be worn under coveralls. However, form-fitting underwear or bathing suits may be worn if reviewed by the ES&H Team industrial hygienist.

Contaminated clothing shall be transported in sealed, impermeable bags or other closed, impermeable containers, which shall be properly labeled.

4.0 Responsibilities

All workers and organizations responsible for the safe handling of asbestos-containing materials shall refer to Document 2.1 for a list of general responsibilities. This section describes specific responsibilities of LLNL organizations and workers who perform asbestos-related work. Specific responsibilities are also provided for organizations within LLNL that have key asbestos safety roles.

4.1 Workers

Workers shall:

- Follow all safety rules and other applicable procedures.
- Discuss all safety questions with their supervisors.
- Attend and satisfactorily complete all assigned training courses.
- Participate in required medical surveillance.
- Follow controls as detailed in the Asbestos Work Permit or other operational procedures.

4.2 Plant Engineering Department

The Plant Engineering Department shall:

- Appoint a Plant Engineering Asbestos Project Manager. This manager shall implement and oversee the Plant Engineering Asbestos Operations and Maintenance Program and receive training as an AHERA-certified supervisor, certified building inspector, and certified project designer.
- Perform initial labeling and posting of ACBM.
- Maintain and update a site-wide ACBM database that includes changes and modifications.
- Provide FPOCs with an updated list of ACBM within their facilities.
- Resurvey ACBM every three years.

4.2.1 Plant Engineering Training Manager

The Plant Engineering training manager shall maintain training records in the Livermore Training Records and Information Network (LTRAIN) for each Plant Engineering worker trained to perform any type of asbestos-related work. This manager shall also ensure that the asbestos training provided to workers by outside vendors meets applicable requirements of both OSHA and the EPA.

4.2.2 Supervisors

Supervisors of workers who perform asbestos-related work shall:

- Provide appropriately trained workers (see Table 1 in Section 3.9.11 for criteria).
- Ensure that an IWS and an Asbestos Work Permit are prepared and that the documents are reviewed by an ES&H Team industrial hygienist before starting asbestos-related work.
- Ensure that work practices comply with all applicable documents, including site-specific documents, such as the Asbestos Work Permit.
- Ensure that engineering controls (e.g., ventilation equipment, HEPA vacuum cleaners, and water sprayers assigned to specific locations) work properly and are tested when appropriate.
- Provide the Health Services Department (or, in the case of subcontract workers, the external examining physician) with a description of a worker's duties related to exposure, as well as a description of any personal protective and respiratory equipment to be used.

- Ensure that personnel receive medical evaluations, as specified in this document.
- Ensure that friable PACM/ACM and contaminated items meeting asbestos waste criteria are disposed of as hazardous waste by the HWM Division.
- Implement changes to improve the asbestos removal process. Such changes may include purchasing new types of tools and equipment.

4.2.3 Construction Project Managers and Designers

Construction project managers and designers shall:

- Participate in the subcontracting process for asbestos-related work and ensure that subcontractors are qualified in accordance with the requirements in this document and Plant Engineering specifications.
- Ensure that subcontracting documents meet Integrated Safety Management (ISM) requirements and are prepared or reviewed by a project team member who is a certified project designer (see Table 1 in Section 3.9.11 for criteria).
- Maintain training as a project designer or have a Plant Engineering representative who is a certified project designer as part of the construction team.
- Ensure that plans for subcontracted asbestos-related work are reviewed by the ES&H Team.
- Verify that subcontractors have appropriately notified the Bay Area Air Quality Management District or the San Joaquin Valley Unified Air Pollution Control District.
- Arrange to have worksites inspected to ensure that contractors perform work in accordance with contract specifications.
- Retain a certified industrial hygienist, or make special arrangements with the ES&H Team, to perform asbestos safety and health oversight and perimeter and clearance monitoring for large-scale, subcontracted asbestos abatement worksites.

4.3 Hazards Control Department

The Hazards Control Department shall:

- Provide one or more staff members who are trained in accordance with the requirements in 40 CFR 763, Subpart E, Appendix C, and accredited as a

certified supervisor, building inspector, and project manager (see Table 1 in Section 3.9.11 for criteria).

- Monitor asbestos exposure of LLNL employees and subcontract workers who work on limited-scale work.
- Monitor asbestos exposure involving large-scale work if such monitoring has been negotiated with the team leader.
- Conduct initial and periodic monitoring as required.
- Notify supervisors of air sampling results for affected workers.
- Monitor (as required) the perimeter of areas where limited-scale asbestos work is conducted by LLNL employees or subcontract workers.
- Maintain records of monitoring indefinitely.
- Review operations to ensure compliance with applicable regulations.
- Provide
 - Services to identify ACM through optical microscopy. (Records of such analyses shall be maintained.)
 - Exposure assessment consultation for historically reported potential exposures.
 - Hazard assessment results for all monitored workers, including subcontract workers [to be provided to the worker, supervisor, Health Services Department, FPOCs, and (in the case of subcontract workers) the employer].
- Test LLNL-owned vacuum cleaners, HEPA filters, exhaust hoods, and other engineering controls to ensure that each functions in accordance with regulations, standards of good industrial practice, and the manufacturer's specifications.
- Review plans, specifications, and procedures for asbestos-related work for compliance with regulations, LLNL requirements, and best management practice.
- Review submittals for large-scale asbestos work.
- Provide respirators and guidance (i.e., hazard assessment) for the selection of respirators and other PPE to LLNL employees and subcontract workers.
- Fit-test respirators in accordance with applicable OSHA requirements.
- Complete and sign Asbestos Work Permits and operating procedures started by Plant Engineering.

- Conduct pre-work inspections of Plant Engineering asbestos jobs, as appropriate.
- Review triennial ACM surveys by the Plant Engineering Department.
- Notify FPOCs when Hazards Control Department personnel find new ACM.
- Provide training to workers who may incidentally encounter asbestos. (See Table 1 in Section 3.9.11 for details.)
- Conduct post-work inspections and collect clearance air samples
 - As needed after limited-scale asbestos work (by LLNL employees or subcontract workers).
 - As negotiated with the team leader for large-scale asbestos work.
- Approve the removal of engineering controls based on the results of clearance samples and visual inspections.
- Identify ways to improve controls and work practices and provide such recommendations for improvement to the various parties involved in asbestos abatement.
- Develop NEAs for repetitive operations, when appropriate.
- Review work performed by consultants on asbestos worksites.

4.4 Health Services Department

The Health Services Department shall:

- Consult with Hazards Control Department professionals and supervisors in making medical surveillance determinations for individuals and groups.
- Ensure that clinicians are available to answer medical questions or other health concerns workers may have.
- Provide workers with medical surveillance, as required by 29 CFR 1926.1101 and 29 CFR 1910.1001.
- Maintain LLNL employees' medical records indefinitely.
- Review and provide consultation on reports of historical exposure.
- Provide medical approval for respirators.
- Inform LLNL employees of the results of examinations and communicate any restrictions to LLNL employees and their LLNL supervisors.

4.5 Environmental Protection Department

When required, the Environmental Protection Department shall:

- Notify the Bay Area Air Quality Management District or (in the case of Site 300) the San Joaquin Valley Unified Air Pollution Control District of pending asbestos-related renovation and maintenance work and planned asbestos-related demolition work, regardless of the asbestos content of the structure in question.
- Ensure that friable and nonfriable asbestos waste is properly packaged, handled, and disposed of at the appropriate waste facility.
- Determine if a particular asbestos-containing waste should be deemed hazardous for purposes of disposal.

4.6 Facility Points of Contact

FPOCs shall:

- Be aware of locations identified by the Plant Engineering and Hazards Control Departments as having ACM.
- Promptly report to the Plant Engineering and Hazards Control Departments areas where PACM/ACM is damaged or deteriorating.
- Maintain copies of inspection records, survey reports, and assessment findings related to asbestos in their facilities.
- Coordinate and assist in the completion of asbestos-related inspections and work.
- Maintain oversight of identified PACM/ACM.
- Respond to incidents involving asbestos release.
- Assist the Plant Engineering and Hazards Control Departments in surveying buildings for PACM/ACM.
- Limit access to potentially hazardous, asbestos-containing areas, including asbestos work areas.
- Promptly arrange for the repair or replacement of deteriorated or damaged PACM/ACM.
- Call the area health and safety technician for assistance upon learning of a potential or actual asbestos problem.

- Call the area ES&H Team to collect a sample for analysis in the event of a spill involving an unknown material.
- Assist the Plant Engineering and Hazards Control Departments in providing safe working conditions for building occupants.
- Assist Plant Engineering personnel and subcontract workers during asbestos work.
- Replace asbestos warning signs that have been removed or defaced.
- Ensure that maintenance or renovation activities that disturb PACM/ACM are properly reviewed.
- Concur with or reject proposals for the installation of any asbestos-containing item within their areas of cognizance.

5.0 Work Smart Standards

Bay Area Air Quality Management District, Regulation 11, Rule 2, *Asbestos*.

DOE Order 440.1A, "Worker Protection Management for DOE Federal and Contractor Employees," Attachment 2, "Contractor Requirement Document," Sections 1–11, 13–18 (delete item 18.a), 19 (delete item 19.d.3), and 22.

National Fire Codes (NFC), November 2003 Edition, with the exception of NFPA 5000 and NFPA 900.

San Joaquin Valley Unified Air Pollution Control District, Rules 3050 (*Asbestos Removal Fees*) and 4002 (*National Emission Standards for Hazardous Air Pollutants*).

29 CFR 1910, Subpart J, *General Environmental Controls* (contains 29 CFR 1910.141, *Sanitation*).

29 CFR 1910, Subpart Z, *Toxic and Hazardous Substances* (contains 1910.1001, *Asbestos*).

29 CFR 1926, Subpart C, *General Safety & Health Provisions*.

29 CFR 1926, Subpart Z, *Toxic & Hazardous Substances* (contains 29 CFR 1926.1101, *Asbestos*).

40 CFR 61, *National Emission Standards for Hazardous Air Pollutants*.

40 CFR 763 Subpart E, Appendix C, *Asbestos Model Accreditation Plan*.

6.0 Resources for More Information

6.1 Contacts

For additional information and guidance regarding this document, contact the following as necessary (see the ES&H contact list for telephone numbers):

- Plant Engineering Asbestos Project Manager—Results of asbestos surveys.
- Area ES&H Team—Asbestos identification and hazard evaluation.
- Plant Engineering Department—Whiz tags (i.e., work orders) for repair or removal of ACM.
- Environmental analyst or HWM technician—Status of waste material.
- Hazards Control Department, Safety, Education, and Training Section—Course HS4420.
- ES&H Team—General information.
- Plant Engineering Training Office—Training for Plant Engineering personnel.
- Health Services Department—Appointment scheduling.

6.2 Other Sources

The National Institute of Building Sciences, *Guidance Manual: Asbestos Operations and Maintenance Work Practices*, NIBS, Washington D.C. (1992).

National Institute of Occupational Safety and Health, *Manual of Analytical Methods*, "7400 method," NIOSH publication number 84-100 (latest edition).

Occupational Safety and Health Administration, *Analytical Method*, OSHA ID 160, Salt Lake City, UT (latest edition).

Yamate, G., et al., *Methodology for the measurement of airborne asbestos by electron microscopy*, Contract Number 68-02-3266, Washington, D.C. (July 1984).

Plant Engineering Asbestos Contracting Specifications 01310–01319 (latest editions).

6.3 Lessons Learned

For lessons learned applicable to the handling of asbestos-containing materials, refer to the following Internet address:

http://www-r.llnl.gov/es_and_h/lessons/lessons.shtml

Appendix A

Acronyms, Terms, and Definitions

ACBM	Asbestos-containing building material.
ACM	Asbestos-containing material.
AHERA	Asbestos Hazard Emergency Response Act of 1986. Amended in 1990.
Amended water	A solution of soap or other wetting agent and water that is used to wet ACM prior to cutting or manipulation and that suppresses the formation of airborne asbestos fibers.
Asbestos	Six fibrous magnesium silicate minerals: chrysotile, crocidolite, amosite, and the fibrous forms of actinolite, tremolite, and anthophyllite.
Asbestos-containing building material (ACBM)	Construction materials containing more than 1.0% asbestos and installed inside buildings or other structures or in attached, covered walkways.
Asbestos-containing material (ACM)	Any material, naturally occurring or manufactured, that contains more than 1% asbestos by weight.
Asbestos Operations and Maintenance Plan	A plan [<i>Plant Engineering Maintenance Operations Manual, Maintenance Operations Procedure (MOP) 2001</i>] designed to minimize the exposure of occupants within a building or area to asbestos fibers resulting from damaged or deteriorating ACBM.
Asbestos-related work	Any work that involves an ACM and that may result in the release of any quantity of asbestos fibers into the air.
Asbestos Work Permit	A form (see Appendix E) used to plan and coordinate asbestos-related work. This form describes the manner in which work is to be conducted, is initiated by a supervisor (or competent person), and is completed and signed by an industrial hygienist.
Certified industrial hygienist	An industrial hygienist certified by the American Board of Industrial Hygiene in the practice of industrial hygiene.

Class I asbestos work	Any activity involving the removal of TSI, surfacing ACM, or PACM.
Class II asbestos work	Any activity involving the removal of ACM that is not TSI or surfacing material. Such work includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics.
Class III asbestos work	Repair and maintenance operations in which ACM, including TSI and surfacing material, is likely to be disturbed.
Class IV asbestos work	Maintenance and custodial activities during which workers contact, but do not disturb, ACM or PACM and activities to clean up waste and debris containing ACM.
Clearance sample	An air sample collected in an area after the end of asbestos work but before the area is reoccupied by workers. Such samples are collected to verify that concentrations of airborne asbestos are acceptable.
Competent person	One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous, including asbestos hazards in the workplace, and capable of selecting the appropriate control strategy for asbestos exposure, and who has the authority to take prompt corrective measures to eliminate them. In addition, for Class I and Class II work, one who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan for supervisor, or its equivalent and, for Class III and Class IV work, who is trained in a manner consistent with EPA requirements for training of local education agency maintenance and custodial staff.
Critical barriers	A positive means to prevent fiber migration from a work area to an adjacent area.
Demolition	Wrecking or removing any load-bearing element in a structure and any related razing, removing, or stripping of asbestos products.
DOE	Department of Energy.

EPA	Environmental Protection Agency.
FPOC	Facility point of contact.
Friable	Capable of being reduced to a powder by applying hand pressure.
Glove bag	An impermeable plastic sack, no more than 60 × 60 inches, that is designed to enclose disturbed asbestos and that allows personnel access through built-in gloves.
HEPA	High-efficiency particulate air (filter).
High-efficiency particulate air (HEPA) filter	A filter capable of removing at least 99.97% of a monodisperse aerosol having a mean diameter of 0.3 μm.
HWM Division	Hazardous Waste Management Division.
HVAC	Heating, ventilation, and air-conditioning.
ISM	Integrated Safety Management.
IWS	Integration Work Sheet.
Large-scale asbestos work	Class I asbestos work involving more than 25 lineal feet or 10 ft ² of ACM and Class II asbestos work involving more than 500 ft ² of ACM.
Limited-scale asbestos work	Class I asbestos work involving the removal of less than 25 lineal feet or 10 ft ² of ACM; Class II asbestos work involving less than 500 ft ² of ACM; all removal of vinyl asbestos tile; and all Class III and IV asbestos work.
LTRAIN	Livermore Training Records and Information Network.
Medical surveillance	An evaluation of a worker's ability and suitability to perform asbestos-related work and wear a respirator. This evaluation typically includes an examination; a review of medical and work history; tests deemed necessary by the examining physician; a review of information from previous medical exams and exposure-monitoring results, if available; and a written opinion concerning the results. Surveillance begins before initial assignment and is followed up at least annually thereafter.

Mini-enclosures	A small walk-in enclosure that accommodates no more than two persons. A mini-enclosure may be used if the material being disturbed or removed can be completely contained by the enclosure.
NEA	Negative exposure assessment.
Negative exposure assessment (NEA)	A demonstration, based on representative monitoring data from prior operations, that workers' asbestos exposures are expected to be consistently less than the 8-hour and 30-minute permissible limits.
Negative-pressure enclosure (NPE)	An enclosure of any configuration that maintains at least four air changes per hour (six air changes are recommended) and has a water pressure differential of at least -0.02 column inches (water gauge) (-0.05 column inches are recommended), relative to outside pressure, as evidenced by continuous manometric measurements.
NIBS	National Institute of Building Sciences.
NIOSH	National Institute for Occupational Safety and Health.
NPE	Negative-pressure enclosure.
OSHA	Occupational Safety and Health Administration.
PACM	Presumed asbestos-containing material.
PAPR	Powered, air-purifying respirator.
PCM	Phase contrast microscopy.
PEL	Permissible exposure limit.
PPE	Personal protective equipment.
Presumed asbestos-containing material (PACM)	Building materials, including, but not limited to, thermal system insulation and surfacing material, that may contain asbestos but have not yet been tested.
Project designer	A person who has successfully completed the training requirements for an abatement project designer established by 40 CFR 763.90(g).

Regulated area	An area established by the employer to demarcate areas where Class I, II, or III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work areas accumulate; and a work area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility that they may exceed, the permissible exposure limit.
Remediation	Any asbestos-related job carried out specifically to correct an asbestos hazard.
Renovation	Work, other than demolition, in which PACM/ ACM is moved or stripped from any part of a structure.
SCBA	Self-contained breathing apparatus.
Spill (PACM/ACM)	An accidental release of asbestos from PACM/ACM.
Structure	An object shown by transmission electron microscope imaging to contain one or more asbestos fibers, either free or in the matrix of another material.
Surfacing ACM	Construction ACM applied to the surface of a building in a wet state and allowed to dry or cure in place. This category includes structural fireproofing, acoustic or decorative ceilings, and wallboard taping and texturing compounds.
TEM	Transmission electron microscopy.
Thermal system insulation (TSI)	Asbestos-containing material applied to pipes, fittings, boilers, breaching, tanks, ducts, or other structural components to prevent heat loss or gain.
TSI	Thermal system insulation.
TWA	Time-weighted average.

Appendix B

Common ACBM

The following common building materials may contain asbestos:

Acoustic ceilings	Mastics, glue
Asbestos board	Packing
Asbestos cement pipe	Pipe fittings
Asbestos shingles	Pipe gaskets
Automotive brake shoes and clutches	Pipe insulation
Boiler insulation	Plaster
Caulking putties	Roof felt
Ceiling tiles	Roof patch
Duct insulation	Roofing paint
Duct tape	Sheetrock
Electrical insulation	Sheetrock tape
Elevator/crane brake shoes	Structural fireproofing
Fire curtains	Stucco
Fire doors	Textured paint
Floor tiles	Transite panels
Heat-resistant insulation	Waterproof membranes
Joint compound	Window putty
Linoleum	Wire insulation

Appendix C

Compliance Guide for the OSHA Construction Industry Asbestos Standard (29 CFR 1926.1101)^a

Work description	Medical surveillance ^b	HEPA vacuum	Wet processes ^c	Housekeeping requirement	Prohibited activities ^d	Regulated area ^e	Respiratory protection	Protective clothing	NPE ^f	Competent person
All asbestos work	—	X	X	X	X	—	—	—	—	—
Class I asbestos work^g										
Greater than 25 lin. ft or 10 ft ²	X	X	X	X	X	X	X ^h	X	X ⁱ	X ^j
Less than 25 lin. ft or 10 ft ²	X	X	X	X	X	X	X ^h	—	X ⁱ	X ^j
Greater than PEL (TWA or excursion)	X	X	X	X	X	X	X ^h	X	X ⁱ	X ^j
Less than PEL in NEA	X	X	X	X	X	X	X	O	X ⁱ	X ^j
No NEA available	X	X	X	X	X	X	X ^h	X	X ⁱ	X ^j
Adjacent area is occupied	X	X	X	X	X	X	—	—	X ⁱ	X ^j
Outdoors, unoccupied area	X	X	X	X	X	X	X	X	X ⁱ	X ^j
Class II asbestos work^{k,l,m}										
Greater than PEL in NEA	X	X	X	X	X	X	X	X	O ^o	X ^j
Less than PEL in NEA	X	X	X	X	X	O ⁿ	O	O	O ^o	X ^j
Indoor—No NEA available	X	X	X	X	X	X	X	X	O ^o	X ^j
Outdoor—No NEA available	X	X	X	X	X	X	X	X	O ^o	X ^j
Removal not intact or dry	X	X	X	X	X	X	X	—	X ^p	X ^j
Class III asbestos work^q										
Greater than PEL	X	X	X	X	X	X	X	X	X ⁱ	X ^r
No NEA available	X	X	X	X	X	X	X	X	X ⁱ	X ^r
Disturbing TSI or surfacing ACBM	X	X	X	X	X	X	X	—	—	X ^r
Less than PEL in NEA	X	X	X	X	X	O ⁿ	O	O	O	X ^r
Class IV asbestos work^s										
Greater than PEL	X	X	X	X	X	X	X	X ^o	O	X ^r
Work in area requiring neg.-pressure respirator	X	X	X	X	X	—	X	—	O	X ^r
Less than PEL in NEA	O	X	X	X	X	O	O	O	O	O

Work description	Critical barriers	Ventilation system ^t	Full decontamination	Mini decontamination	Surface covering	Glove bag	HVAC isolation	Daily monitoring ^u	Mini-enclosure
All asbestos work	—	—	—	—	—	—	—	—	—
Class I asbestos work^g									
Greater than 25 lin. ft or 10 ft ²	X ^v	X	X	O	X	X ⁱ	X	X	O
Less than 25 lin. ft or 10 ft ²	—	X	O	X	X	X ⁱ	X	X	X ^{i,w}
Greater than PEL (TWA or excursion)	X ^v	X	X	O	X	X ⁱ	X	X	X ^{i,w}
Less than PEL in NEA	O	X	—	—	X	X ⁱ	X	O	X ^{i,w}
No NEA available	X ^v	X	X	O	X	X ⁱ	X	X	X ^{i,w}
Adjacent area is occupied	X ^v	X	—	—	X	X ⁱ	X	—	X ^{i,w}
Outdoors, unoccupied area	O	X	—	—	X	X ⁱ	X	—	X ^{i,w}
Class II asbestos work^{k,l,m}									
Greater than PEL in NEA	X ^v	X	X	O	X	X ^o	X	X	X ^o
Less than PEL in NEA	O	X	O	O	X	X ^o	X	O	X ^o
Indoor—No NEA available	X ^v	X	O	X	X	X ^o	X	X	X ^o
Outdoor—No NEA available	O ⁿ	X	O	X	X	X ^o	X	X	X ^o
Removal not intact or dry	X ^v	X	O	—	X	X ^o	X	X	X ^o
Class III asbestos work^q									
Greater than PEL	X	X	O	X ⁱ	X	X ⁱ	X	O	X ⁱ
No NEA available	X	X	O	X ⁱ	X	X ⁱ	X	O	X ⁱ
Disturbing TSI or surfacing ACBM	X	X	O	—	X	X ⁱ	X	O	X ⁱ
Less than PEL in NEA	O	X	O	O	O	O	O	O	O
Class IV asbestos work^s									
Greater than PEL	O	X	O	X	O	O	O	O	O
Work in area requiring neg.-pressure respirator	—	—	O ^x	—	—	—	—	—	O
Less than PEL in NEA	O	O	O	O	O	O	O	O	O

X = required; O = not required or not allowed; — = not specifically addressed.

^a Characterize work in accordance with all applicable subcategories, and apply and controls required for all subcategories. Some types of work may not be adequately described in this table.

^b Determination is made by the Health Services Department in collaboration with the Hazards Control Department.

^c Except for infeasible conditions, e.g., sloped roofs.

- d Prohibited activities include use of a non-ventilated abrasive disc saw, blow-off, dry sweeping or shoveling, and worker rotation.
- e Posting is required for all regulated areas.
- f Negative-pressure enclosure.
- g Class I asbestos work: Removal of TSI or surfacing ACM or PACM.
- h Pressure-demand, supplied-air respirator with auxiliary escape HEPA or SCBA (>1.0 f/cc) or a PAPR with full facepiece and HEPA filters (<1.0 f/cc).
- i One of the following control methods shall be used: NPE, glove bag, negative-pressure glove bag, water spray, mini-enclosure, or alternative procedures.
- j 40-hr training equivalent to EPA project designer or supervisor training.
- k Class II asbestos work: Removal of ACM that is not TSI or surfacing material (including floor tiles, shingles, and mastics).
- l Specific additional requirements are provided for flooring work, roofing, Transite work, and gasket removal. For other Class II work, material shall be removed intact if feasible. Alternative procedures are allowed if exposure is less than the PEL and a competent person certifies the alternative methods are adequate to keep exposure below the PEL at all times.
- m Certain roofing activities involving ACM are exempt from Class II category.
- n Not required, provided that work is performed in areas where untrained persons do not have access.
- o These procedures may be used in lieu of, or in addition to, other procedures specified for Class II work.
- p An NPE is required for the removal of floor tiles if the tiles cannot be removed intact and breaking of the tiles creates dust.
- q Class III asbestos work: Repair and maintenance where any type of ACM is likely to be disturbed.
- r 16-hr training equivalent to EPA operations and maintenance training.
- s Class IV asbestos work: Custodial-type activities that involve contact with ACM and PACM.
- t Includes local exhaust and general exhaust, enclosure, and isolation (as feasible or necessary).
- u Daily monitoring is usually not required if using supplied-air respirators in positive-pressure mode. (A pressure demand-type respirator is not required to take this credit.)
- v Or equivalent, with the requirement to prove the efficacy of the equivalent method. This includes perimeter sampling with 24-hour turnaround. Perimeter levels shall meet the AHERA clearance levels.
- w A small walk-in chamber that accommodates no more than two persons. Mini-enclosures are to be used only for small jobs.
- x Full decontamination facilities must be provided if working in a regulated area where such facilities are required for persons doing other work.

Appendix D

Process for Limited-Scale Asbestos Work

Limited-scale asbestos work is defined as Class I asbestos work involving less than 25 lineal feet or 10 ft² of ACM, Class II asbestos work involving less than 500 ft² of ACM, the removal of vinyl asbestos tile, or any Class III or IV asbestos work. This appendix outlines the general requirements and flow of activities for limited-scale asbestos work conducted by Plant Engineering personnel or subcontract workers. Unless otherwise specified, the supervisor of an asbestos work crew is responsible for all actions.

D.1 Worksite Setup

To set up a worksite, workers shall:

- Install critical barriers (as specified).
- Cover surfaces.
- Install specified ventilation system.
- Provide HEPA-filtered vacuum system(s).
- Install specified control systems (e.g., NPE and glove bags) and decontamination systems.
- Secure facility HVAC systems, as specified.
- Post the appropriate signs.

Supervisors shall inspect the control and decontamination of systems.

D.2 Work Procedures

Supervisors shall:

- Ensure that medical surveillance is completed, if needed.
- Verify that all personnel receive the required training.
- Obtain the specified types of respirators.
- Inspect worksites at least daily.
- Provide a minimum of two persons for most types of work.

- Contact an industrial hygienist if final visual inspection or clearance sampling is specified.
- Remove any critical barriers, postings, and ventilation systems only after an industrial hygienist has reviewed such removal based on inspection and air samples.
- Improve the work process to the extent feasible by, for instance, purchasing improved removal equipment.

Workers shall:

- Wet material before and during removal.
- Maintain good housekeeping.
- Completely contain waste as the waste is generated.
- Remove ACM in the largest segments feasible.
- Minimize breakage, pulverizing, or damage to ACM.
- Use glove bags properly. Glove bags shall be
 - Used only once.
 - Exhausted before contents are removed.
 - Wetted as needed.
- Decontaminate the area, vacuum surfaces, and remove surface covers.
- Provide feedback to the supervisor regarding how to make improvements in the work process.

D.3 Recordkeeping

The Plant Engineering Asbestos Project Manager shall be notified of all asbestos removed from buildings or equipment.

Appendix E

Asbestos Work Permit

To be completed by the LLNL crew supervisor. Outside contractors should use PE Specification 001310					
Supervisors name _____ WHIZ TAG # _____ IWS# _____ JO# _____					
Affected building: _____ Room/area: _____					
Is area occupied? <input type="checkbox"/> Yes <input type="checkbox"/> No Will work area be posted before start of work? <input type="checkbox"/> Yes <input type="checkbox"/> No					
Brief job description: _____					
Planned work dates: from _____ to _____ Time: from _____ to _____					
Activity to be performed Measured Quantity					
Thermal System Insulation (TSI) removal _____					LF/SF
Thermal System Insulation (TSI) encapsulation _____					LF/SF
Transite panel or pipe removal _____					LF/SF
Vinyl asbestos tile (VAT)/mastic removal _____					SF
Linoleum removal _____					SF
Acoustic or fireproofing removal _____					SF
Cleaning or decontamination of surfaces _____					SF
Sawing, drilling, scoring, or breaking of asbestos _____					SF
Other (Describe project on back of this sheet) _____					LF/SF
Type of Asbestos (chrysotile, amosite, crocidolite): _____ % Asbestos _____ File # _____					
Individuals involved in activity					
Name	Employee #	Training Hrs.	Name	Employee #	Training Hrs.
Asbestos Control Equipment					
HEPA vacuums _____		<input type="checkbox"/> Yes <input type="checkbox"/> No		Amended water _____	
Encapsulant (name _____)		<input type="checkbox"/> Yes <input type="checkbox"/> No		Glove bags _____	
Mastic remover (name _____)		<input type="checkbox"/> Yes <input type="checkbox"/> No		Bridging (name _____)	
HEPA-filtered negative air _____		<input type="checkbox"/> Yes <input type="checkbox"/> No		Estimated neg-air CFM? _____ Qty _____	
Decon chamber <input type="checkbox"/> Yes <input type="checkbox"/> No		Decon type? _____		Shower <input type="checkbox"/> Yes <input type="checkbox"/> No	
Waste Disposal Arrangements					
1. Is this a demolition? <input type="checkbox"/> Yes <input type="checkbox"/> No					
2. Are the material conditions friable or likely to become friable? <input type="checkbox"/> Yes <input type="checkbox"/> No					
3. If the response to step 2 is Yes, are regulated quantities of friable asbestos greater than 100 LF, 100 SF, 35 ft ³ ? <input type="checkbox"/> Yes <input type="checkbox"/> No					
Air Monitoring					
Notify the industrial hygienist at least 48 hours before start of work so arrangements can be made for air monitoring.					
Supervisors signature _____				Date: ____ / ____ / ____	
To be completed by the EPD/PRAG Group					
1. If the response to steps 1, 2 and 3 above is No, then the notification is processed through a Hazards Control industrial hygienist.					
2. If you answered Yes to step 1 or 3 above, then EPD must file notification more than 10 days prior to job start date.					
EPD/PRAG signature (if required) _____				Date: ____ / ____ / ____	
To be completed by the industrial hygienist					
Personal Protective Equipment					
Coveralls: Tyvek™ _____			Other (Specify): _____		
Eye Protection _____			Shoe Covers _____		
Hearing Protection _____			Hard Hats _____		
Gloves _____			Hard Hats _____		
Respirator Protection Requirements					
Issue Point Administrator (if other than Supervisor) _____					
Half Mask _____			Full Face _____		
PAPR (full face piece) _____			Other _____		
Cartridge type if other than HEPA _____			Comments _____		
Additional Control Requirements/Procedures: _____					
Industrial hygienists signature _____				Date: ____ / ____ / ____	
Industrial hygienist name _____		Pager # _____	Phone # _____	FAX # _____	

Appendix F

Signs and Labels

All signs and labels should follow the specifications of Document 12.1, "Access Control, Safety Signs, Safety Interlocks, and Alarm Systems," in the *ES&H Manual*. Older versions may be used if said versions are serviceable and contain the correct text.

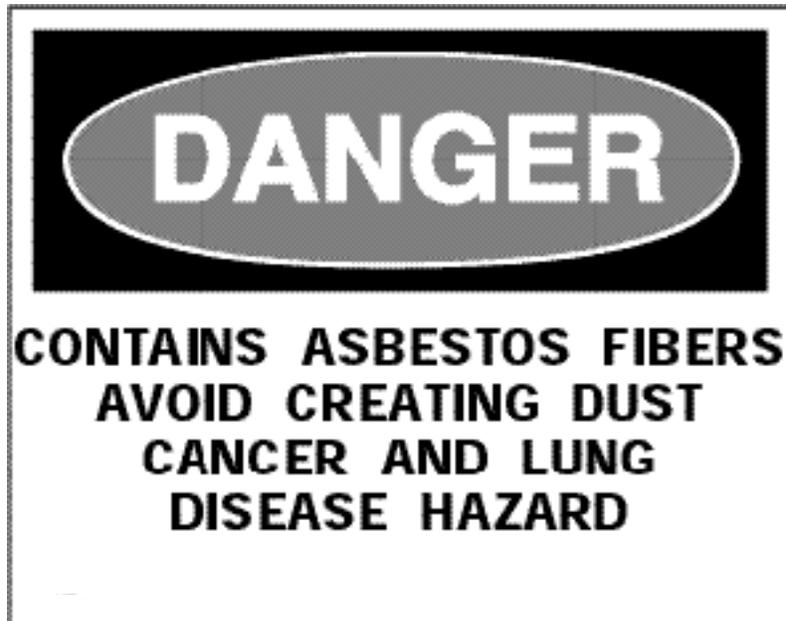


Figure F-1. Sign for use with asbestos-containing materials and containers.

ASBESTOS IS PRESENT IN B- _____ R-_____

UNDAMAGED ASBESTOS IS NOT A HEALTH HAZARD

DO NOT DISTURB THE ITEMS MARKED BELOW:

<u>MATERIAL</u>	<u>LOCATION</u>
<input type="checkbox"/> FLOOR TILES / LINOLEUM	_____
<input type="checkbox"/> ADHESIVE FOR TILES / LINOLEUM	_____
<input type="checkbox"/> PIPE INSULATION-ELBOWS / STRAIGHTS / FITTINGS	_____
<input type="checkbox"/> ASBESTOS-CEMENT BOARD	_____
<input type="checkbox"/> DUCT INSULATION	_____
<input type="checkbox"/> CEILING / WALL(S)	_____
<input type="checkbox"/> ROOFING MATERIALS	_____
<input type="checkbox"/> OTHER	_____
<input type="checkbox"/> OTHER	_____
<input type="checkbox"/> OTHER	_____

CONTACT THE FPOC OR BUILDING COORDINATOR FOR INFORMATION REGARDING ASBESTOS PRODUCTS IN THE AREA. REPORT ANY DAMAGE TO THESE MATERIALS TO HAZARDS CONTROL ES&H TEAM IMMEDIATELY.



**SOME MATERIALS IN THIS ROOM
CONTAIN ASBESTOS FIBERS.
AVOID CREATING DUST.
POTENTIAL CANCER/LUNG DISEASE HAZARD.**

PLEASE DO NOT REMOVE, CONCEAL OR MODIFY THIS SIGN.
IF THIS SIGN IS DAMAGED, NOTIFY THE ASBESTOS PROJECT MANAGER.

Revised 18 July 2000:DB/PD

Figure F-2a. Room sign for use where ACM is present.

<h1 style="margin: 0;">NOTICE</h1>	
Asbestos is present in B-_____ R-_____	
<u>UNDAMAGED ASBESTOS IS NOT A HEALTH HAZARD</u>	
Do not disturb the items marked below:	
Material	Location comments
<input type="checkbox"/> Floor tiles	
<input type="checkbox"/> Tile adhesive	
<input type="checkbox"/> Other	
Please do not remove. If this sign is damaged, return it to _____ the Asbestos Project Manager.	
Contact the FPOC or building coordinator for information regarding asbestos products in the area. Report damage to these materials to the Hazard Control ES&H Team immediately.	
<small>Revised 18 July 2000:DB/PD</small>	

Figure F-2b. Alternative room sign for use where undamaged, encapsulated, or nonfriable asbestos is present.

ASBESTOS-CONTAINING MATERIALS NOTIFICATION

NOTIFICATION TO ALL WORKERS, OCCUPANTS, CONTRACTORS, AND OTHER PERSONS ENTERING _____ . An asbestos survey has been conducted and it confirms the presence of asbestos-containing materials (ACM) in this facility. Any persons authorized to enter this facility may review the results of the asbestos survey. All asbestos-related data will be available from the building coordinator/FPOC during normal business hours in room ____, ext. ____.

ASBESTOS IS PRESENT IN THE FOLLOWING MARKED ITEMS AND AREAS:

<u>Material</u>	<u>Location</u>
<input type="checkbox"/> Textured Ceiling	_____
<input type="checkbox"/> Textured Walls	_____
<input type="checkbox"/> Linoleum /Floor Tiles	_____
<input type="checkbox"/> Pipe Insulation	_____
<input type="checkbox"/> Structural Fire Proofing	_____
<input type="checkbox"/> Asbestos-Cement Board	_____
<input type="checkbox"/> Other _____	_____
<input type="checkbox"/> Other _____	_____

DO NOT DISTURB THESE MATERIALS. CONTACT THE FPOC OR BUILDING COORDINATOR FOR INFORMATION REGARDING ASBESTOS PRODUCTS IN THE AREA. REPORT ANY DAMAGE TO THESE MATERIALS TO HAZARDS CONTROL IMMEDIATELY.

Asbestos is a substance known to cause respiratory diseases and cancer. It is important for all persons to follow proper practices to minimize the potential for disturbing ACM. Avoid touching asbestos materials on walls, ceilings, pipes, or boilers. Do not drill holes or hang objects from ceilings made of ACM. If you find ACM that has been damaged, report it to your supervisor. Do not disturb damaged asbestos material/debris or suspected asbestos material/debris. Only properly trained and authorized persons may perform any work that may disturb ACM. ACM poses no hazard to your health unless asbestos fibers become airborne because of material aging, deterioration, or damage.

If you have any questions or need additional information, contact the FPOC or the Plant Engineering Asbestos Project Manager.

FPOC

Figure F-3. Building entrance sign for use where asbestos-containing material is present.

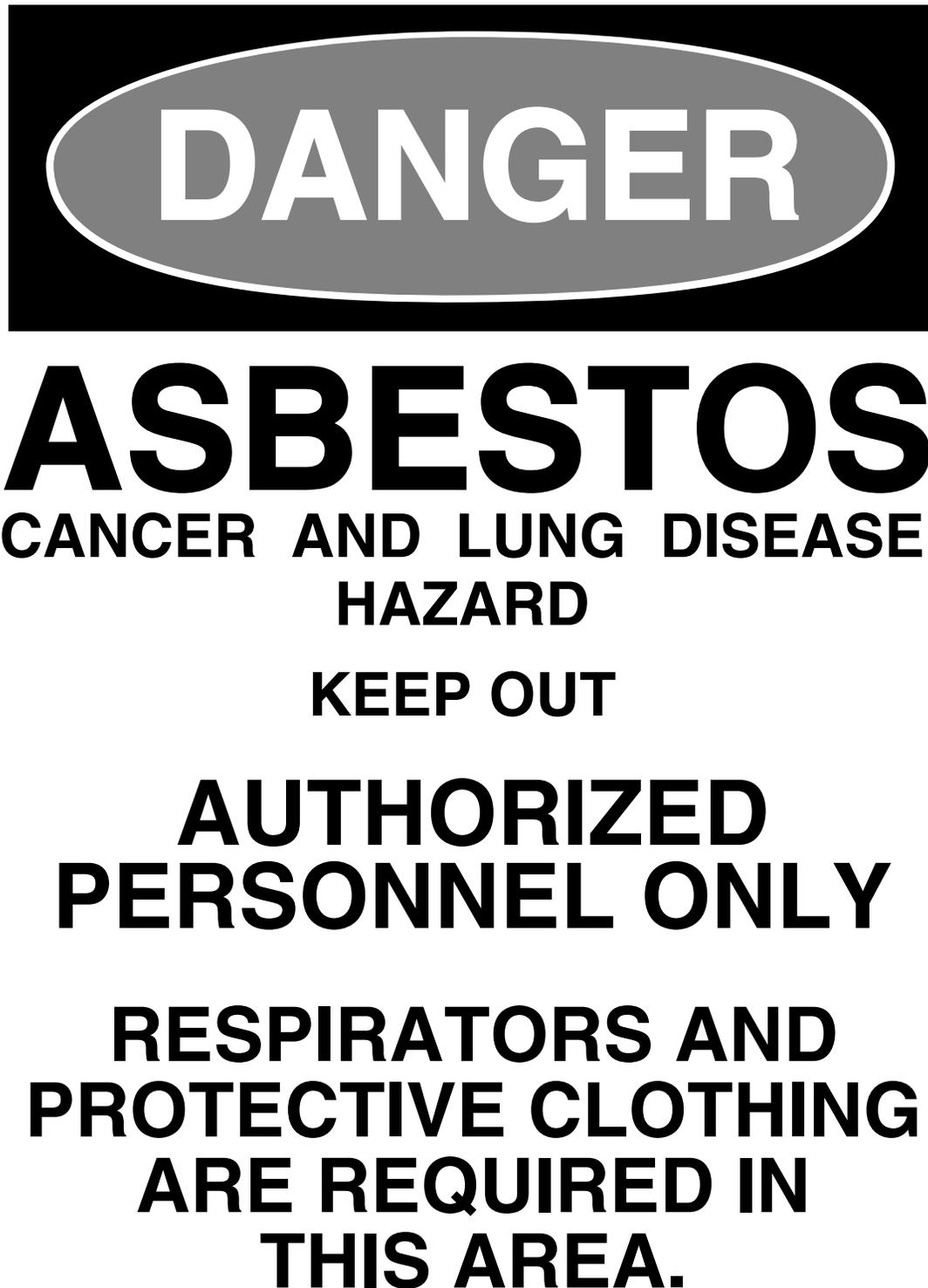


Figure F-4. Sign for posting in regulated asbestos areas.