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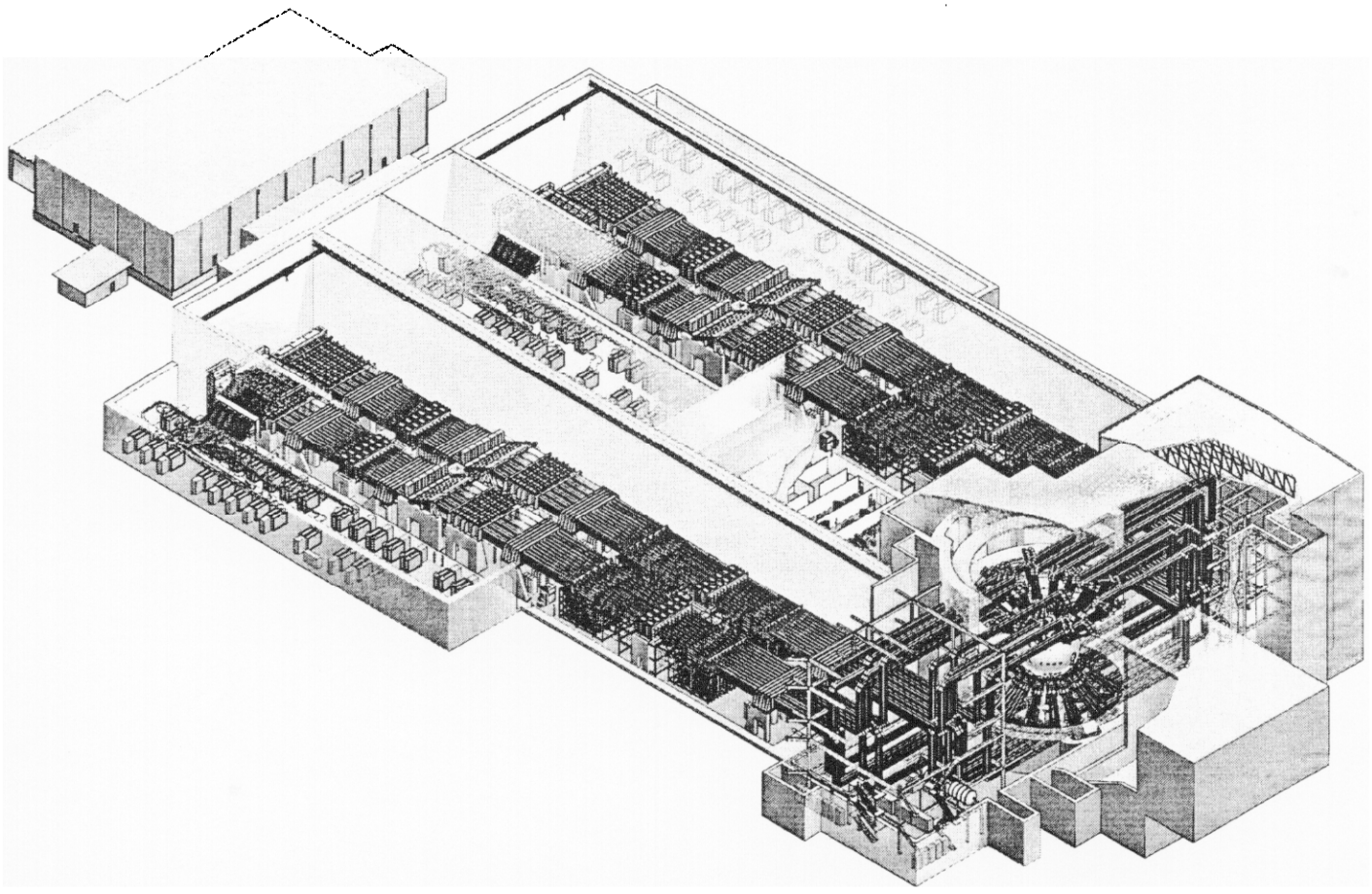
Construction Safety Program for the National Ignition Facility

Appendix B

June 26, 1997



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Construction Safety Program for the National Ignition Facility Appendix B

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June 26, 1997

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This Appendix contains material from the *LLNL Health and Safety Manual* as listed below. For sections not included in this list, please refer to the *Manual* itself.

Asbestos

Lead

Fire Prevention

Lockout and Tag Program

Confined Space

Traffic Safety

Asbestos

Health&Safety Manual

Supplement 21.19

Safe Handling of Asbestos-Containing Material During Construction Work

November 1996

Approved by the ES&H Working Group

_____ date _____

Robert W. Kuckuck
Deputy Director of Operations

Safe Handling of Asbestos-Containing Material During Construction Work*

Contents

Safe Handling of Asbestos-Containing Material during Construction Work

1.0. Introduction

1.1 General

Asbestos refers to a group of six fibrous minerals used in construction materials and other products. Asbestos was used extensively from the turn of the century until recently and thus is present in many LLNL buildings in a variety of products. *Further use of asbestos-containing material (ACM) in LLNL buildings or equipment is generally prohibited.*

Intact ACM is not hazardous unless it is disturbed or the material 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 these two substances act synergistically.

This supplement contains federal requirements and LLNL policy governing asbestos-related work, as well as detailed procedures for carrying such work. Laboratory employees and subcontractors who perform construction work involving asbestos must comply with all requirements in this supplement. Appendix A of this supplement contains terms and definitions; the other appendices provide guidance and supporting material.

1.2 Policy

LLNL has established a Construction-Related Asbestos Control Program to address issues related to asbestos work. The goals of this program are

- To minimize exposure of airborne asbestos dust to employees and visitors.
- To comply with applicable laws, regulations, Department of Energy (DOE) orders, and internal LLNL policy pertaining to asbestos.
- To identify, label, and periodically inspect asbestos-containing building material (ACBM). See Appendix B for a list of common ACBMs.
- To remove, enclose, encapsulate, or repair potentially hazardous ACM. See Appendix B for a list of common ACMs.
- To provide LLNL employees and supplemental labor-only (SLOs) contractors who handle asbestos in construction-related work with appropriate training, equipment, and personal protective equipment (PPE).

- To provide proper industrial hygiene monitoring and referral for medical surveillance if necessary.
- To eliminate the installation of new asbestos-containing items whenever possible.
- To handle untested building materials presumed to be asbestos-containing materials (PACM) as if they contain asbestos until proven otherwise.
- To ensure that subcontracted asbestos work is properly planned, reviewed, and conducted.

2.0 Requirements/Regulatory Summary

2.1 Worker Protection

DOE Order 5480.4 mandates compliance with the Occupational Safety and Health Administration (OSHA) standard (29 CFR 1926.1101) for handling asbestos in construction work. In addition, LLNL must meet the training requirements specified by the Environmental Protection Agency (EPA) under the Asbestos Hazard Emergency Response Act of 1986 (AHERA), 49 CFR 763, as amended by the Asbestos School Hazard Amendments and Reauthorization Act (ASHARA) of 1990.

Historically, the Laboratory has complied with most of California OSHA health and safety requirements for asbestos that are more restrictive than federal OSHA requirements, except for the administrative requirements for registration and job notification.

2.2 Environmental Protection

The Laboratory is subject to asbestos-handling regulations promulgated by the EPA, the Bay Area Air Quality Management District, and (at Site 300) the San Joaquin Area Air Quality Management District. The State of California 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 the *Environmental Compliance Manual.* A list of applicable health and safety regulations also can be found in Section 8.0 of this supplement.

3.0 Applicability

The requirements in this supplement apply to all Laboratory personnel and subcontractors who perform construction work involving ACM or materials that have not been tested but are "presumed to be asbestos-containing materials" (PACM) (see Appendix A for definition). The operations covered by this supplement include

- Construction activities involving, but not limited to
  - — Demolition or salvage of structures where 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 on the site at which construction activities are being performed.
  - — Housekeeping activities involving asbestos or products containing asbestos.
- Sampling of construction or building material to determine the presence of asbestos.
- Inspection of ACBM, as defined in 49 CFR 763 (Building Inspection).
- Planning of ACBM removal, as defined in 49 CFR 763 (Project Design).
- Management of ACM removal.

The requirements in this supplement DO NOT apply to the handling of asbestos in laboratories by researchers, the handling of asbestos-containing materials other than ACBMs (e.g., brake shoes, glassware wrapping), waste processing, or other processes that fall under 29 CFR 1910.1001.

4.0 Controls for Asbestos Work

The handling of ACM present in LLNL facilities may result in exposure to airborne asbestos. Thus, engineering, administrative, and personal protective controls are required to reduce exposure to levels established by regulation and LLNL policy. Engineering controls are the primary means of reducing exposure and are implemented to the extent feasible or necessary. Administrative and personal protective controls supplement engineering controls.

Federal regulation requires asbestos-related construction work to be divided into four categories (see Section 4.1.1) with certain general controls for all categories and specific engineering, administrative, and personal protective

controls for each category. LLNL policy also requires asbestos-related construction work to be further divided into two categories for administrative purposes (see Section 4.1.2).

4.1 Classification of Asbestos Work

4.1.1 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 applied to building surfaces "wet" and allowed to dry in place. This 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 and sheeting, roofing and siding shingles, and construction mastics.

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

Class IV asbestos work involves maintenance and custodial activities where employees 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 Table 1.

4.1.2 Administrative Categories

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

1. Limited-scale asbestos work, which includes
   - — Class I work involving the removal of less than 25 lineal feet or 10 ft^2 of ACM.
   - — Class II work involving less than 500 ft^2 of ACM.
   - — All work involving the removal of vinyl asbestos tiles, regardless of the quantity.
   - — All Class III and Class IV work.

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

2. Large-scale asbestos work, which includes
   - — All Class I work involving more than 25 lineal feet or 10 ft^2 of ACM.
   - — Class II work involving more than 500 ft^2 of ACM, except the removal of vinyl asbestos tile.

   A Hazards Control design review is necessary for large-scale asbestos work.

Table 1 to be inserted here.

4.2 General 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.

Vacuum Cleaners. Vacuum cleaners equipped with high-efficiency particulate air (HEPA) filters shall be used when possible to collect all debris and dust having ACM.

Wet Methods. Wet methods (or wetting agents) shall be used to control employee exposure when handling, mixing, removing, cutting, applying, and cleaning up asbestos—except where the use of such methods is not feasible because they may create electrical hazards, equipment malfunction, and, in roofing, slipping hazards.

Housekeeping. Wastes and debris contaminated with asbestos shall be cleaned up and disposed of promptly in leak-tight containers. ACMs shall be placed in sealed containers as they are removed.

Prohibited Activities. The following engineering controls and work practices shall NOT be used for asbestos-related work, or for work that disturbs ACMs, regardless of the measured levels of asbestos exposure or the results of initial exposure assessments:

- High-speed abrasive disc saws that are not equipped with a point-of-cut ventilator or enclosures with HEPA-filtered exhaust air.
- Compressed air used to remove asbestos or ACM, unless the compressed air is used with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.
- Dry sweeping, shoveling, or other dry cleanup of dust and debris with ACM.
- Employee rotation as a means of reducing employee exposure to asbestos.

Other. All work involving the disturbance of ACM shall be conducted in a manner that minimizes breakage or damage of ACMs; removes ACMs in large segments as is feasible; and complies with any governing Asbestos Work Permit, Operations Plan, safety procedure, or contract document, as applicable. Further details on Asbestos Work Permits (see Appendix D for sample) and Operation Plans can be found in Section 4.13.1.

Fabrics or plastic films used to create enclosures intended for occupancy (or that are capable of being occupied) shall be certified and shall conform to the requirements for large-scale test in the National Fire Protection Agency (NFPA) standard.[1]

4.3 Class I—Engineering and Work Practice Controls

4.3.1 Regulated Area

A regulated area must be established for Class I asbestos work. This area

- Serves to isolate the source of asbestos aerosol generation.
- Keeps unprotected personnel away from exposure to the work being performed.
- Demarcates the specific site where asbestos work is conducted, including any adjoining areas where debris and waste from asbestos work accumulate or work areas within which airborne concentrations of asbestos exceed (or may exceed) the permissible exposure limit (PEL). Signs, such as Fig. E-1 of Appendix E, shall be used to demarcate these areas.

A regulated area shall include all areas, as well as adjacent areas occupied by unprotected personnel, where it is anticipated that exposure may occur above the clearance limits specified in Section 4.7.

4.3.2 Competent Person

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 required by 29 CFR 1926.20 through 1926.32. Training shall be obtained in a comprehensive course for supervisors (e.g., a course conducted by a certified EPA- or State-approved training provider) or a course equivalent in stringency, content, and length. See Section 6.0 for further details.

4.3.3 Critical Barriers

To prevent fiber migration, critical barriers are required for Class I asbestos work involving the removal of more than 25 linear feet or 10 ft^2 of TSI or surfacing material; for activities where the employer (LLNL or subcontractor) cannot produce a negative exposure assessment (NEA), as specified in Section 4.7.2; and where unprotected employees are performing work in areas adjacent to the regulated area.

Usually, critical barriers are physical barriers (e.g., plastic sheeting) to dust that separate regulated areas from unregulated areas. Alternatively, another barrier or isolation method (e.g., simply making the regulated area so large that airborne dust does not migrate to the perimeter) that prevents migration of asbestos from the regulated area may be used. The adequacy of this method must be verified by

- Visual surveillance of the perimeter of the regulated area during each work shift to ensure there is no visible asbestos beyond the boundary of the regulated area.

- Monitoring of the perimeter of the regulated area to ensure that asbestos dust levels, as determined by phase contrast microscopy (PCM) or transmission electron microscopy (TEM), do not exceed the corresponding clearance level; or that the perimeter area levels measured by either of these methods are no more than background levels representing the same area before the asbestos work began.

In almost all cases, critical barriers shall be used. Alternative procedures shall only be used when critical barriers are not feasible. Subcontractors shall use physical barriers in all cases where there is a possibility that asbestos may escape from the regulated area and result in exposure to unprotected personnel above the perimeter limits specified in Section 4.7.

The burden of proving the adequacy of alternative dust control methods is substantial. The cognizant Hazards Control industrial hygienist shall review and approve all alternative dust control methods and determine which analytical method shall be used, including the number and location of samples required to verify the adequacy of this method. This is done by means of the Asbestos Work Permit (Appendix D) or Operations Plan. NOTE: These requirements do not imply that perimeter monitoring (see Section 4.7) is not required when critical barriers are used.

Work conducted outdoors (where no unprotected people are in the vicinity of the work) using a specified control procedure need not have critical barriers, visual surveillance, or perimeter monitoring unless such measures are specified by the cognizant Hazards Control industrial hygienist.

4.3.4 Ventilation

For all Class I jobs that do not have an NEA, or where exposure monitoring shows that the PEL has been exceeded, the employer shall ventilate the regulated area to move contaminated air away from the breathing zone of employees toward a HEPA filtration system or other dust-collection device. Where feasible, this shall be done by means of local exhaust ventilation. Alternatively, or in addition, a HEPA-filtered negative-air-pressure, air-filtration exhaust unit (e.g., general exhaust system) may be used.

4.3.5 Contamination Control

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. An impermeable drop cloth shall be placed on all surfaces where removal activities are conducted. In addition, all objects within the regulated area shall be covered with an impermeable drop cloth or plastic sheeting and secured with duct tape or equivalent material.

4.3.6 Decontamination Areas

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

- 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 employee's use.
- 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, unless this is not feasible. The water for the shower should be at least 32°C with a flow rate of at least 10 L/min.

Employees enter and exit regulated areas through the decontamination area. Thus, each room shall be at least 1 m^2 and 2 m high unless this is not feasible. Below are the steps for entering and leaving a decontamination area:

Entry

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

1. Remove all gross contamination and debris from your protective clothing before leaving the regulated area.
2. Remove your protective clothing in the equipment room, BUT DO NOT REMOVE YOUR RESPIRATOR. Deposit the clothing in labeled impermeable bags or containers.
3. Shower with your respirator on before entering the clean room.
4. Take off the respirator and change into your street clothes in the clean room.

Alternate decontamination procedures may be used for limited-scale Class I work. For example, the employer shall establish an equipment room (or area) adjacent to the regulated area or may use mini-enclosures for the decontamination of employees and equipment. The design and work practices for an equipment room and mini-enclosure follow.

Equipment Room/Area

Design

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

Work practices

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

Mini-enclosure. A small walk-in enclosure (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 enclosure. The design and work practices for this enclosure are as follows:

Design

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

Work practices

- The enclosure shall be inspected by a competent person for leaks before use and smoke tested for breaches. Any breaches shall be sealed. The project inspector shall perform this inspection for subcontracted work.
- The interior of the enclosure shall be completely washed with amended water before use and cleaned with a HEPA vacuum.
- Air movement within the enclosure shall be directed away from the employee's breathing zone.

4.3.7 Control Systems

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

1. Negative pressure enclosures (NPE).
2. Glove bags.
3. Negative pressure glove bags.
4. Negative pressure glove boxes.
5. Water spray systems. These systems shall not be used unless described in detail in an operational safety procedure (OSP), Operation Plan, or contract submittal, and approved by the cognizant Hazards Control industrial hygienist.

These controls are used in addition to the general controls (critical barriers or equivalent) required for all asbestos work.

Negative Pressure Enclosure

Design

- NPEs may be of any configuration.
- At least 4 air changes (6 recommended) per hour shall be maintained in NPEs.
- A minimum of –0.02 column in. of water pressure differential (–0.05 column in. recommended), relative to outside pressure, shall be maintained within NPEs as evidenced by continuous manometric measurements with a continuous data-recording system.
- 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 employees performing asbestos work within the enclosure toward a HEPA filtration system.
- Back-up air filter units and an emergency generator should be staged onsite for all large-scale Class I (and II) work performed in NPEs. Back-up units shall be of a size that will maintain a negative pressure of at least 0.01-in. water gauge during failure of the primary system. In addition, back-up units shall be tested before work begins and staged such that they can be brought on-line 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 where there is a significant possibility of contamination of occupied adjacent areas.

Work Practices

- NPEs shall be inspected by a competent person for breaches and smoke tested for leaks before beginning work and at the beginning of each work shift. The project inspector or a consulting industrial hygienist shall perform this inspection for subcontracted work.
- Electrical circuits in the enclosure shall be deactivated, unless equipped with ground-fault circuit interrupters (GFCIs).

Glove Bags

Design. Glove bags shall be made of 6-mil-thick plastic (or equivalent approved by the cognizant Hazards Control industrial hygienist) and shall be seamless at the bottom.

Work Practices

- Glove bags may be used to remove ACM from piping. Each glove bag shall be installed so that it completely covers the circumference of the pipe or other structure where the work is being performed.

- Glove bags shall be smoke tested inside the bags for leaks, including sealed leaks, before use.
- Glove bags may be used only once and may not be moved.
- Glove bags shall not be used on surfaces whose temperature exceeds 150°.
- Prior to disposal, glove bags shall be collapsed by removing the air from within with a HEPA vacuum.
- Before beginning the operation, loose and friable material adjacent to the 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 ACM waste and water without losing their integrity. A sliding valve or other device shall separate the waste bag from the hose to ensure there is no exposure when the waste bag is disconnected.
- At least two persons shall remove glove bags.
- The length of a glove bag should not exceed 2 m.
- The cognizant industrial hygienist may prohibit the use of multiple glove bags in series or in areas where their removal may disturb more than 10 lineal feet of asbestos-containing pipe insulation.

Negative Pressure Glove Bag Systems. These systems may be used to remove 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) so that they are under a constant negative pressure of at least 0.02-in. water gauge. A means must be provided to prevent the bag from collapsing during removal.

Work Practices

- The HEPA vacuum (or other device) shall run continually 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 it is rinsed clean with amended water.

Negative Pressure Glove Boxes. These glove boxes may be used to remove ACM from pipe runs.

Design

- Glove boxes shall be constructed with rigid sides; they shall be made of metal or other material that can withstand the weight of the 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 of 0.02 in. or more water gauge in the system.
- An air filtration unit shall be attached to any air inlet on the glove box.
- The glove box shall be fitted with gloved apertures.
- An aperture at the base of the box shall serve as a bagging outlet for waste ACM and water.
- A back-up generator shall be present onsite and be of such a size that it can operate the negative-pressure system within 5 minutes of a power failure.
- Waste bags shall consist of 6-mil-thick plastic (or thicker) and double-bagged before they are filled.

Work practices

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

4.3.8 Alternative Controls for Class I Work

Class I work may be performed using controls other than those discussed in this supplement if the following provisions are met:

- The alternate 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 employees.
- An industrial hygienist qualified to evaluate the work area, the projected work practices, and the engineering controls certifies in writing that the alternate method
  - — Is adequate to reduce direct and indirect employee exposure below the PELs under worst-case conditions of use.
  - — Will prevent asbestos contamination from exceeding the clearance level outside the regulated area.

  A Hazards Control industrial hygienist shall conduct the evaluation for work performed by LLNL or SLO employees. Subcontractors who use an alternative procedure shall retain a Certified Industrial Hygienist to perform the evaluation and submit it to a cognizant Hazards Control industrial hygienist for review and approval.
- The evaluation of TSI (25 linear ft or 10 ft^2 or less) or surfacing material (10 ft^2) to be removed may be performed or reviewed by any Hazards Control industrial hygienist. Perimeter or clearance monitoring otherwise required may be omitted.

4.4 Class II—Engineering and Work Practices Controls

Class II asbestos work may be performed using one of the control systems (see Section 4.3.7) allowed for Class I asbestos work. Glove bags and glove boxes are allowed only if they fully enclose the material to be removed. The requirements below as well as the general requirements in Section 4.2 are applicable to Class II asbestos work.

4.4.1 Asbestos Work Permits, Operation Plans

The current version of the National Institute of Building Sciences (NIBS) specifications[2] may be used as a starting point for developing Asbestos Work Permits and Operation Plans. Asbestos Work Permits and Operation Plans are further described in Section 4.13.

4.4.2 Regulated Area

A regulated area must 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 work are the same as those described in Section 4.3.1 for Class I work.

4.4.3 Competent Person

All Class II asbestos work shall be supervised by a competent person, as described in Section 4.3.2.

4.4.4 Critical Barriers

Critical barriers are required for all indoor Class II asbestos work where one of the following applies:

- There is no NEA.
- Conditions change during the job and there is an indication that exposure may be above the PEL.
- The ACM is not removed intact.

To ensure that airborne asbestos does not migrate from the regulated area, either place critical barriers over all openings of the area or use another barrier or isolation method. Other methods are discussed in Section 4.3.3.

4.4.5 Contamination Control

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

4.4.6 Decontamination Areas

Any Class II work that is known to result in exposure above the PEL 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 cognizant industrial hygienist. The design and work

practices for the equipment room for Class II work, including procedures for entering and leaving the decontamination area, are the same as those described in Section 4.3.6 for Class I work.

4.4.7 Removal of Materials with ACM

Floor Tiles. Employees shall comply with the work practices below when removing vinyl and asphalt flooring materials that contain ACM.

- Flooring or its backing shall not be sanded.
- Vacuums equipped with HEPA filters, disposable dust bags, and metal floor tools (no 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 and/or backing shall be performed using wet methods.
- 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 the tile, 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 be asbestos-containing unless an industrial hygienist or qualified building inspector determines that the material is asbestos free by means of microscopic analysis.

NOTE: When vinyl asbestos floor tiles containing no more than 5% chrysotile asbestos are removed intact by personnel appropriately trained and supervised to do Class II asbestos work, it can be assumed that exposure will not exceed the permissible exposure limit.

Roofing. Employees shall comply with the work practices described below when removing roofing material with ACM.

- Roofing material shall be removed intact to the extent feasible.
- Wet methods should be used where feasible. The use of wet methods is not required for roof removal if the ACM is removed intact, exposure does not exceed the PEL, and if wetting will create a substantial slipping hazard. Wet methods are required, to the extent that the procedure does not create a slipping hazard, when cutting machines are used and the material is not removed intact.
- All loose dust from sawing operations must be HEPA vacuumed immediately. Where built-up smooth (non-graveled) roofing is

removed using a power cutter, dust may be wet-swept rather than HEPA vacuumed.

- Wet methods or HEPA vacuuming is not required to remove or repair less than 25 ft^2 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.
- All loose dust from sawing operations must be HEPA vacuumed immediately.
- Roof-level heating and ventilation air-intake sources shall be isolated or the ventilation system shall be shut down.

The removal of asbestos-containing roofing cements, mastics, coatings, and flashings is not classified as Class II work if such materials are non-friable at the start; are not sanded, abraded, or ground; and are removed using manual methods that do not degrade the material. A competent person must determine if the materials are intact and will remain so during removal. Removal of the such materials must be conducted by people trained to perform Class II or Class III asbestos work.

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

- Cutting, abrading, or breaking of siding, shingles, or Transite panels shall be 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), or 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 ACM:

- If a gasket is visibly deteriorated and cannot be removed intact, removal shall be undertaken within a glove bag or glove box.
- The gasket shall be wet thoroughly with amended water prior to removal and immediately placed in a disposal container.
- Any scraping to remove residue must be performed using wet methods.

4.4.8 Alternative Controls for Class II Work

Controls different from those described in this supplement or modified engineering and work practice controls may be used if the following provisions are met:

- The organization planning the work demonstrates by data representing employee exposure that, during the use of such method, employee exposure will not exceed the PEL under any anticipated circumstances.
- An industrial hygienist qualified as a project designer (see Section 6.0 for criteria) (or someone under his/her direction) evaluates the work area, the projected work practices, and the engineering controls and certifies in writing that the alternate method
  - — Is adequate to reduce direct and indirect employee exposure below the PEL under worst-case conditions of use.
  - — Will prevent asbestos contamination from exceeding the clearance level outside the regulated area.

  A Hazards Control industrial hygienist shall perform the evaluation for work done by LLNL or SLO employees. Subcontractors who use an alternative procedure shall retain a Certified Industrial Hygienist (or competent person) to perform the evaluation and submit it to the cognizant Hazards Control industrial hygienist for review and approval.

4.5 Class III—Engineering and Work Practices Controls

4.5.1 Asbestos Work Permits, Operation Plans

The current version of the National Institute of Building Sciences (NIBS) specifications[2] may be used as a starting point for developing Asbestos Work Permits and Operation Plans. Asbestos Work Permits and Operation Plans are further discussed in Section 4.13.

4.5.2 General

The requirements below, including those in Section 4.2, are applicable to Class III asbestos work. Where there is no NEA for a job, or where monitoring results of the NEA show that the PEL has been exceeded, workers shall contain the area using an impermeable drop cloth and plastic sheeting (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 employees and equipment. The design and work practices for the equipment room for Class III work are the same as those described in Section 4.3.6 for Class I work.

4.5.3 Regulated Area

A regulated area must be established for Class III asbestos work. However, it is not required for Class III work for which there is an NEA if the work is

performed in areas where untrained personnel do not have any access. The guidelines for establishing and demarcating a regulated area for Class III work are the same as those described in Section 4.3.1 for Class I work.

4.5.4 Competent Person

All Class III asbestos work must be supervised by a competent person. The training for a competent person in this case can be a 16-hour maintenance and operations course that meets the requirements of 49 CFR 763.

4.6 Class IV—Engineering and Work Practices Controls

4.6.1 Asbestos Work Permits, Operation Plans

The current version of the National Institute of Building Sciences (NIBS) specifications[2] may be used as a starting point for developing Asbestos Work Permits and Operation Plans. Asbestos Work Permits and Operation Plans are further discussed in Section 4.13.

The requirements below, including those in Section 4.2, are applicable to Class IV asbestos work.

4.6.2 Regulated Area

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

4.6.3 Decontamination

Where Class IV work involves the cleanup of ACM debris, the employer shall establish an equipment room (or area) adjacent to the regulated area for the decontamination of employees and equipment. The design and work practices for the equipment room for Class IV work are the same as those described in Section 4.3.6 for Class I work.

4.7 Administrative Controls

4.7.1. Airborne Exposure Limits

Personal Exposure Limits. Personnel involved in asbestos-related work shall not be exposed to an 8-hour, time-weighted-average (TWA) airborne asbestos level exceeding 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 PEL); or 1.0 f/cc averaged over any half-hour period, as determined by PCM (the excursion limit). All persons assigned to conduct Class I asbestos-related work shall be assumed to be potentially overexposed to airborne asbestos until specific monitoring demonstrates otherwise. Thus, all the requirements for air monitoring, PPE, medical surveillance, and training must be met before one is assigned to Class I asbestos-related work. All exposure-monitoring data for these individuals will be provided to Health Services.

Clearance Limits. The acceptable clearance level of asbestos for all samples in the area analyzed using PCM shall be less than 0.1 f/cc or a lower fiber concentration than that which existed before the start of the asbestos work, as determined by the cognizant Hazards Control industrial hygienist. This analysis shall be done in accordance with the 7400 method[3] or the most recent OSHA analytical method.[4]

If TEM analysis is used, the clearance level for samples shall be a mean value of less than 0.02 asbestos structures per cubic centimeter of air, which is statistically equal to (or less than) the mean of the results of baseline samples or statistically indiscriminable from concurrent outside sample results, as determined by the cognizant Hazards Control industrial hygienist. This analysis shall be done in accordance with the AHERA method[5] or Yamate level 2 method.[6] All asbestos structures greater than 0.5 μm shall be tabulated.

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

4.7.2 Air Monitoring Program

Exposure to airborne asbestos for individuals performing asbestos-handling work must be determined by personal air sampling in accordance with the OSHA analytical method,[4] or an equivalent PCM procedure. Hazards Control will characterize asbestos exposure for LLNL employees or SLO personnel 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 ft^2 of ACM or Class II work, other than floor tile, exceeding 500 ft^2), the organization performing the work shall retain an industrial hygienist to characterize employee exposure to asbestos as required by Plant Engineering specifications.[7] The cognizant industrial hygienist may provide this service for Plant Engineering personnel who perform large-scale work, if time permits.

Initial Exposure Monitoring. Either a Hazards Control industrial hygienist or an industrial hygienist certified by the American Board of Industrial Hygiene in the comprehensive practice of industrial hygiene shall conduct initial sampling to accurately assess 8-hour TWA and 30-minute excursion exposures, as appropriate.

Negative Exposure Assessment Criteria. For any asbestos job that will be performed by employees trained in compliance with this supplement, it may be possible to demonstrate that employee exposure will not exceed the PEL. Objective data must show that the product or material containing asbestos minerals, or the activity involving such product or material, cannot release

airborne fibers in concentrations exceeding the TWA and excursion limit under work conditions having the greatest potential for releasing asbestos. Where prior asbestos jobs have been monitored for the PEL and excursion limit within 12 months of the current or projected job, employers (LLNL or subcontractor) must show that

- The monitoring and analysis were performed in compliance with the asbestos standard in effect.
- The data were obtained during work operations conducted 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 employees whose training and experience are no more extensive than that of individuals performing the current job.
- There is a high degree of certainty employee exposures will not exceed the TWA and excursion limit under the conditions prevailing in the current workplace.
- Initial air sampling included monitoring during that portion of the entire asbestos job which is most likely to result in exposure above the 8-hour TWA exposure or 30-minute excursion limit (i.e., the data are worst case).

Only Hazard Controls industrial hygienists are permitted to accept a determination of negative exposure. Generally, NEAs will be developed by Hazards Control for LLNL employees and SLO employees. Subcontractors must submit complete documentation of any NEA to the cognizant industrial hygienist for review. Inadequate NEAs shall not be used for work performed at LLNL.

Periodic Monitoring. Unless an NEA for the entire operation has been developed and accepted by Hazards Control, daily monitoring representative of the 8-hour TWA or 30-minute excursion limit shall be conducted for employees who perform Class I and Class II work and are assigned to work within a regulated area. Periodic monitoring shall be conducted for all operations (except Class I and II) at intervals sufficient to document the validity of the exposure prediction where exposures are expected to exceed the PEL. Monitoring shall be conducted at least annually for these operations.

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

The cognizant industrial hygienist shall provide written notification to the supervisors of LLNL and SLO personnel monitored soon after receiving the air sampling results. If the PEL or excursion limit has been exceeded, notification shall include requirements for medical surveillance and the steps necessary to reduce the airborne asbestos levels. A copy of the notification

shall be provided to Health Services. The contractor shall submit the results of air sampling work conducted by subcontractors to the University, as required by Plant Engineering specifications.[7] All results shall be reported regardless of the protection afforded the affected employee(s) by the respirator in use.

Perimeter Sampling. Perimeter sampling shall be conducted around each regulated area, which, in the event of a failure of asbestos controls, has the potential to expose unprotected personnel to asbestos above the clearance level specified in this supplement. (The limits for airborne asbestos at the perimeter of an asbestos work area are the same as the clearance sample limits.) The frequency, sampling, and analysis procedure shall be determined by the cognizant Hazards Control industrial hygienist and indicated on the Asbestos Work Permit (Appendix D) or Operation Plan, or in the contract specifications for subcontracted work. Hazards Control conducts perimeter sampling for LLNL or SLO employees who perform limited-scale work. Alternatively, the organization conducting large-scale work is responsible for obtaining a Certified Industrial Hygienist to conduct perimeter sampling. If time permits, the cognizant industrial hygienist may provide this service 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 shall be provided to the building coordinator within 15 days of receipt. The building coordinator shall communicate these results to individuals who occupy the affected area of the building.

Clearance Sampling. Clearance samples are used to document the adequacy of decontamination and cleanup after asbestos work. Clearance samples shall be collected (where technically feasible) after all indoor, large-scale, and limited-scale asbestos work; after performing Class I or Class II work that does not have an NEA; and for activities 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 cognizant industrial hygienist may determine that sampling may be appropriate after performing Class III or outdoor asbestos work. Clearance sampling may not be appropriate or feasible after performing glove bag or glove box work in low-occupancy areas such as machine rooms.

Clearance samples collected may be analyzed using either the PCM or TEM method. Generally, PCM analysis will be used. TEM analysis equivalent to the OSHA analytical method[4] or Yamate level 2 method[6] will be used for

- Class I asbestos work that disturbs more than 25 lineal feet or 10 ft^2 of ACM.
- Class II asbestos work, excluding floor tile, involving more than 500 ft^2 of ACM.
- Class II asbestos work involving more than 150 ft^2 of floor tile.

Hazards Control shall conduct sampling for LLNL employees and SLO personnel who conduct limited-scale work. Alternatively, the LLNL organization performing or subcontracting large-scale asbestos work must retain the services of a Certified Industrial Hygienist to conduct clearance sampling. The cognizant Hazards Control industrial hygienist may provide this service for Plant Engineering personnel who perform large-scale work if time permits.

Clearance sampling shall be conducted using "aggressive techniques" when technically appropriate and in accordance with the procedure described in 40 CFR 763(E). Clearance samples shall only be collected after the area has passed a rigorous visual inspection, and where it has been verified that all potentially asbestos-containing dust and debris have been removed. Critical barriers and negative pressure shall be maintained until acceptable results of the clearance samples are obtained.

The cognizant Hazards Control 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. At the discretion of the industrial hygienist, personal, area, or other types of samples may be collected in occupied areas believed to be contaminated with airborne asbestos. The sampling and analytical method used in these 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 building coordinator within 15 days of receipt. The building coordinator shall communicate these results to individuals who occupy affected areas of the building.

Selective Fiber Counting. All fibers meeting the OSHA size criteria[4] (>5 μm in length, 3:1 aspect ratio) shall be counted whenever analysis is performed by PCM, unless the cognizant 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 cognizant Hazards Control industrial hygienist.

4.7.3 Medical Surveillance

Medical surveillance is intended to identify and evaluate employees who are at special risk with regard to asbestos work, to facilitate early detection of asbestos-related conditions, and to assess an employee's ability to wear a respirator. Medical surveillance shall be provided to all employees who

- Engage in Class I, II, or III work for a combined total of 30 days or more a year. (Work lasting less than one hour a day is not to be included in the 30 days.)

- Are exposed at or above the PEL or excursion limit.
- Wear negative-pressure respirators for protection against asbestos for more than 30 days a year. (Days when exposure is less than 1 hour are not to be counted toward the annual total of 30 days for the purpose of medical surveillance.)
- Are required to wear negative-pressure respirators for protection against asbestos.
- Have had a significant occupational work history, as determined by a Health Services clinician.

The supervisor of any employee who might require medical surveillance under the criteria described above shall contact the area ES&H team industrial hygienist and arrange for a hazard assessment. Hazards Control shall conduct hazard assessments for LLNL and SLO employees, document cases where medical surveillance is required, and provide written notification to the supervisor of the affected employee(s). For LLNL employees, a copy of all notifications shall be sent to Health Services. SLO employers will receive copies of the notification and are then responsible for providing medical surveillance for their employees.

Depending on the results of the hazard assessment, the supervisor shall either contact Health Services immediately to schedule the employee (University employees only) for a baseline examination or notify the appropriate supplemental labor site representative. In addition, the supervisor shall provide Health Services or the SLO subcontractor representative with a description of the employee's job duties and the PPE the employee used when handling asbestos. A copy of the air-sampling results and/or hazard assessment shall be sent to Health Services or the SLO site representative, as appropriate.

Exams shall be performed by or under the supervision of a licensed physician and at no cost to the employee. The content of these exams must comply with the requirements in 29 CFR 1926.1101(m). Baseline exams shall be provided to employees prior to assignment in areas where the use of negative-pressure respirators are required for more than 30 days a year, and to employees who are exposed above the PEL within 10 working days of the thirtieth day of the year. Annual re-examinations shall be offered to all personnel who will have baseline exams for the remainder of their employment at LLNL.

Health Services shall provide employees and their supervisors a written opinion of the results of medical exams.

Additional provisions of the Medical Surveillance Program can be found in 29 CFR 1926.1101.

4.8 Personal Protective Equipment

4.8.1 Respiratory Protection

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

- All Class I asbestos work.
- All Class II work where the ACM is not removed in a substantially intact state.
- All Class II and III work that is not performed using wet methods, except the removal of ACM from sloped roofs where wetting creates a slipping hazards.
- All Class II and III work performed without an NEA.
- All Class III work where TSI or surfacing ACM will be disturbed, unless an NEA is available for the work.
- All Class IV work performed within regulated areas, where employees performing other work are required to wear respirators.
- All work specified in this section where employees are exposed above 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 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.

All employees who perform Class I 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 or a HEPA back-up filtration system. Where monitoring data are available for the required job and indicate that exposures do not exceed 1.0 f/cc, tight-fitting PAP respirators may be used.

Negative-pressure respirators used for protection against asbestos must be fit tested every 6 months, rather than the more usual 12-month refitting schedule.

4.8.2 Protective Clothing

Employees shall use protective clothing (including coveralls or similar whole-body clothing) head coverings, gloves, and foot coverings when performing Class I work, where exposure to airborne concentrations of asbestos exceeding the TWA and/or excursion limit is possible, and when performing large-scale work. Protective clothing may be of the disposable type or may be reusable, and shall never be worn outside the immediate work area.

Clean protective clothing shall be provided at the start of each shift or work session during a shift, whichever comes later, or when redonning used protective equipment is impractical because it is heavily contaminated or cannot be reused.

Generally, personal clothing should not be worn under coveralls. However, form-fitting underwear or bathing suits may be worn if approved by the cognizant industrial hygienist.

4.9 Installation of New ACM

Generally, installation of new ACM in LLNL buildings is prohibited—except if no reasonable alternative material can be used. Installation of ACM in such instances must be approved in writing by the cognizant ES&H team industrial hygienist and the cognizant building manager or facility coordinator.

4.10 Waste Disposal

All friable ACM shall be treated as hazardous waste. Contact the ES&H team environmental analyst or Hazardous Waste Management (HWM) technician to determine the friability of a specific waste. Friable asbestos waste shall be placed in 6-mil-thick plastic bags that are gently squeezed, sealed, and placed in outer plastic bags that are also 6-mil thick. The double-bagged waste shall then be packed in Department of Transportation (DOT) 17H 55-gal drums. Outer containers shall be conspicuously labeled with the DANGER sign in Appendix E (Fig. E-1) and the LLNL hazardous waste label, a copy of which can be found in the *Environmental Compliance Manual*.

Waste generated by LLNL employees or SLO contractors is disposed of through 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 HWM before waste can be shipped offsite for disposal.

4.11 Posting and Labeling

The DANGER sign in Appendix E (Fig. E-1) shall be conspicuously posted on or as close as possible to ACM. ACMs shall be labeled directly; if this is not feasible, a sign such as that in Fig. E-2a (or Fig. E-2b) shall be posted in a convenient location on a wall or by a light switch nearest the northwest corner of a room. A sign such as that in Fig. E-3 shall be posted near principal doorways on buildings that contain ACBM. Regulated areas shall be demarcated with signs that contain the wording specified in Fig. E-4.

Posting at the perimeter of regulated areas need not include an admonition regarding respirators and coveralls if these types of gear are not necessary within the regulated area.

4.12 Operations and Maintenance Program

As a minimum, Plant Engineering shall institute an Operations and Maintenance Plan for ACBM. This plan shall include procedures for

- Surveying structures to locate ACBM and evaluate its condition.
- Labeling ACBM with the appropriate signs, as described in Section 4.11.
- 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 building and facility managers of the location and extent of asbestos in their areas of responsibility.
- Notifying facility managers, building coordinators, and Hazards Control annually of the findings of inspections or of changes that have occurred (e.g., removal, replacement, or repair of ACBM). ACBM shall be resurveyed every three years by Plant Engineering, and the condition of previously identified accessible asbestos shall be checked by facility managers during an annual self-assessment.

4.13 Process for Review of Planned Work

In accordance with the requirements in Chapter 6 of the *Health & Safety Manual,* Hazards Control must review all plans for the demolition, renovation, remodeling, or construction of facilities that may disrupt ACMs. This requirement applies to any such activities conducted by LLNL and SLO personnel and subcontractors.

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

4.13.1 Asbestos Work Permit

Asbestos Work Permits are used to document limited-scale asbestos work and are only applicable to work performed by LLNL and SLO personnel. The supervisor is responsible for developing and submitting Work Permits to the ES&H team industrial hygienist 48 hours in advance of the schedule work, if possible.

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

4.13.2 Operating Procedure (Large-Scale Work)

A safe operating procedure that incorporates relevant sections of the Plant Engineering specifications[7] shall be prepared by an accredited project designer (see Table 3 in Section 6.0 for criteria). When feasible, operating procedures shall be submitted to the cognizant industrial hygienist at least four weeks in advance of the scheduled work. Subcontractors must submit detailed operating plans in accordance with Plant Engineering specifications.[7]

4.14 Subcontracted Asbestos Work

Subcontractors performing asbestos-related work shall comply with the requirements of Plant Engineering specifications[7], as applicable, and those in this supplement. Plant Engineering personnel who produce subcontracting documents for asbestos work shall either be accredited as project designers (see Table 3 in Section 6.0 for criteria) or have their work plans and contract documents approved by a Plant Engineering employee who is accredited as a project designer. All work plans and contract documents must be reviewed by the ES&H team.

The organization contracting large-scale asbestos work shall retain a Certified Industrial Hygienist to perform perimeter and clearance monitoring. Unless this organization can provide inspectors who are accredited as asbestos supervisors, the Certified Industrial Hygienist shall also be required to perform health and safety oversight on the project.

Many construction 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 before the contract is sent out for bid, and should either be addressed in the specifications or arrangements should be made for the work to be done by in-house personnel. As part of the design review process, this aspect of the project must be detailed in the submittal provided to Hazards Control.

5.0 Responsibilities

This section describes the general responsibilities for LLNL organizations and employees who perform asbestos-related work. Specific responsibilities are also provided for organizations within LLNL with key asbestos safety roles.

5.1 Plant Engineering Department

Plant Engineering shall

- Appoint an Asbestos Operations and Maintenance Program Officer to serve the Laboratory. This officer shall implement and oversee the LLNL 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.
- Annually provide facility managers and building managers an updated list of ACBM within their facilities.
- Resurvey ACBM every three years.

5.1.1 Plant Engineering Training Officer

The Plant Engineering training officer shall maintain training records for each Plant Engineering employee trained to perform any type of asbestos-related work. The officer shall also ensure that the asbestos training employees receive from outside vendors meets applicable requirements of both OSHA and EPA regulations.

5.1.2 Supervisors

Supervisors of employees who perform asbestos-related work shall

- Provide appropriately trained workers (see Table 3 in Section 6.0 for criteria) to conduct Class III and Class IV asbestos work. Other classes of asbestos work may be conducted by Plant Engineering personnel if they meet all requirements for the particular class of work.

- Ensure that an Asbestos Work Permit, Operation Plan, or NEA is prepared, and that the document is reviewed and approved by a Hazards Control industrial hygienist before starting asbestos-related work.
- Ensure that work practices comply with this supplement. In addition,
  - — Approve the set up of the NPE or other asbestos work containment.
  - — Ensure that the containment remains intact and is effective.
  - — Control entry and exit from the site.
  - — Assure the proper use of personal protective clothing and any decontamination facilities and procedures.
- 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.
- Ensure that personnel receive medical evaluations, as specified in this supplement.
- Ensure that large-scale work carried out by Plant Engineering personnel is done in accordance with Plant Engineering specifications.[7] This includes having design work performed by an accredited project designer; submitting a complete Operation Plan, equipment list, and proposed personnel to the ES&H team for review; and contracting with a Certified Industrial Hygienist to provide air monitoring.
- Ensure that friable ACM and contaminated items are disposed of as hazardous waste through the HWM Division.

5.1.3 Construction Project Manager/Designer

The construction project manager or designer shall

- Participate in the subcontracting process for asbestos-related work, and ensure that subcontractors are qualified in accordance with the requirements in this supplement and the Plant Engineering specifications.[7]
- Ensure that subcontracting documents are prepared or reviewed by a project team member who is a certified project designer (see Table 3 in Section 6.0 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 and approved by Hazards Control.
- Verify that the subcontractor has notified the Bay Area or San Joaquin Area Air Qualify Management District appropriately.
- Arrange to have the worksite inspected to ensure that the contractor performs work in accordance with contract specifications.

- On large-scale subcontracted asbestos abatement worksites, either retain a Certified Industrial Hygienist or make special arrangements with Hazards Control to perform asbestos safety and health oversight of perimeter and clearance monitoring.

5.2 Hazards Control Department

Hazards Control shall

- Provide one or more staff members who are trained in accordance with the requirements in 40 CFR 763 and accredited as Certified Supervisors, Building Inspectors, and Project Managers (see Table 3 in Section 6.0 for criteria).
- Monitor asbestos exposure of Laboratory employees and employees who work on limited-scale work under supplemental labor contracts.
- Conduct initial and periodic monitoring as required.
- Notify supervisors of the air-sampling results of affected employees.
- Monitor the perimeter of the area where limited-scale asbestos work is being conducted by LLNL or SLO personnel, as required.
- Maintain records of monitoring indefinitely.
- Review operations to ensure compliance with applicable regulations.
- Provide
  - — Services to identify ACM through optical microscopy; maintain records of these analyses.
  - — Exposure assessment consultation for historically reported potential exposures.
  - — Health Services with the air monitoring results for all employees exposed at the action level and/or requiring medical surveillance.
  - — SLO employers the air monitoring results for their employees.
- Test LLNL-owned vacuum cleaners, HEPA filters, exhaust hoods, and other engineering controls to ensure they function in accordance with regulations, standards of good industrial practice, or the manufacturer's specifications.
- Review plans, specifications, and procedures for asbestos-related work for compliance with regulations, policy, and best management practice; and review submittals for large-scale asbestos work.
- Provide respirators and guidance for the selection of respirators and other PPE to LLNL and SLO employees. Fit-test respirators in accordance with applicable OSHA requirements.
- Complete and approve Asbestos Work Permits and Operation Plans started by Plant Engineering; conduct pre-work inspections of Plant Engineering asbestos jobs.

- Review triennial surveys of ACM conducted by Plant Engineering, including annual inspections of ACM conducted by facility managers and building coordinators. Notify the respective organizations of deficiencies or omissions to be addressed.
- Notify facility managers and building coordinators when Hazards Control personnel find new ACBM.
- Provide training to employees who may incidentally encounter asbestos. (See Table 3 in Section 6.0 for details.)
- Conduct post-work inspections and collect clearance air samples after LLNL or SLO employees have performed limited-scale asbestos-related work.
- Approve (or disapprove) the removal of engineering controls based on the results of clearance samples and visual inspections.
- Develop NEAs for repetitive operations.
- Review the work performed by consultants on asbestos worksites.

5.3 Health Services Department

Health Services shall

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

5.4 Environmental Protection Department

When required, the Environmental Protection Department (EPD) shall

- Notify the Bay Area or San Joaquin (Site 300) Air Quality Management District of pending asbestos-related renovation and maintenance work as well as planned demolition work, regardless of the asbestos content of the structure.
- Ensure that friable asbestos waste turned over to the HWM Division is properly handled and disposed of as hazardous waste.
- Determine if a particular asbestos-containing waste is deemed "hazardous" for purposes of disposal.

5.5 Facility Managers and Building Coordinators

5.5.1 Facility Managers

Facility managers shall

- Be aware of locations identified by Plant Engineering and Hazards Control as having ACBM.
- Promptly report to Hazards Control those areas where the ACBM is damaged or deteriorating.
- Maintain copies of inspection records, survey reports, and assessment findings related to asbestos in the facility.

5.5.2 Building Coordinators

Building coordinators shall

- Maintain oversight of identified ACBM and respond to incidents involving asbestos release.
- Assist Plant Engineering and Hazards Control in surveying buildings for ACBM.
- Limit access to potentially hazardous, asbestos-containing areas.
- Promptly arrange for the repair or replacement of deteriorated or damaged ACBM.
- Call the area health and safety technician for assistance upon learning of a potential or actual asbestos problem.
- If the identity of the spilled material is unknown, call the area ES&H team to collect a sample for analysis.
- Limit access to asbestos work areas. Assist Plant Engineering and Hazards Control in providing safe working conditions for building occupants, and Plant Engineering and subcontract personnel during asbestos work.
- Replace asbestos warning signs that have been removed or defaced.
- Ensure that proper controls are used for maintenance or renovation activities that disturb ACM.
- Approve the installation of any asbestos-containing item within your area of cognizance.

6.0 Training

The training requirements for each group below are specified in Table 3.

- Supervisors (competent persons)—Individuals who plan and manage asbestos work.
- Asbestos workers—Employees who conduct asbestos work.

Table 3. Training requirements for asbestos-related work. NOTE: 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.

Course title/length	Content	Who should attend	Annual refresher
Asbestos Safety (HS4420)—1–2 hr	General asbestos awareness, health effects, and LLNL policy	Anyone who may incidentally come in contact with asbestos, any interested employee, and Hazards Control health and safety technicians	No.
Worker (Class I and II 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 work—16 hr	Handling asbestos in maintenance and operations	Plant Engineering personnel	Yes. 8 hr
Class IV work—2–4 hr	Cleaning minor asbestos contamination	Plant Engineering and other personnel	Yes. 2 hr
Supervisor—Class I and II work—40 hr	Supervision of Class I and II asbestos work	Supervisors of personnel who perform this work, Plant Engineering Operations and Management Officer, industrial hygienist (at least 1), and construction inspectors assigned to worksites where large-scale asbestos is removed	Yes. 8 hr
Class III work—16 hr	Supervision of employees performing this work	"	Yes. 8 hr
Project designer (certified designer)[a]— 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 Operations and Management Officer, and industrial hygienist (at least 1)	Yes. 8 hr
Building inspector (certified inspector)[a]— 24 hr	Procedures to survey buildings to identify ACBM	Personnel who survey buildings to identify ACBM, Plant Engineering Operations and Management Officer, and industrial hygienist (at least 1)	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] Training content to meet requirements of 49 CFR 763.

- Asbestos project designers—Individuals who prepare operating plans for large-scale work or contract specifications for subcontracted asbestos work of any type.
- Building inspectors—Individuals who survey buildings to identify ACBM.
- Others—People who may have incidental contact with ACM.

All training, except course HS4420 (Asbestos Safety), should be provided by a training center accredited by the State in accordance with 49 CFR 763. Contact the cognizant ES&H team industrial hygienist for information on the availability of training facilities and classes.

7.0 LLNL Contacts

For additional information and guidance regarding this supplement, contact the following as necessary:

- Plant Engineering Operations and Maintenance Officer, ext. 3-1864—Results of asbestos survey.
- Area ES&H team—Asbestos identification and hazard evaluation.
- Plant Engineering, ext. 2-9444—Repair or removal of ACM.
- Environmental analyst or HWM technician—Status of waste material.
- Hazards Control Training and Safety Analysis Group, ext. 2-5263—Course HS4420.
- ES&H team—General information.
- Plant Engineering Training Office, ext. 2-9097—Training for Plant Engineering personnel.
- Health Services, ext. 2-7459; Appointment scheduling, ext. 2-7462.

8.0 References

1. The National Fire Protection Agency, *Standard Methods of Fire Tests for Flame-Resistant Textiles and Films*, NFPA 701, Washington, DC (latest edition).
2. The National Institute of Building Sciences, *Guidance Manual: Asbestos Operations and Maintenance Work Practices*, NIBS, Washington DC (1992).
3. National Institute of Occupational Safety and Health, *Manual of Analytical Methods*, "7400 method," NOISH, 84-100 (latest edition).

4. Occupational Safety and Health Administration, Analytical Method, OSHA ID 160, Salt Lake City, UT (latest edition).
5. Code of Federal Regulation, Title 40, Part 763, "EPA Asbestos Hazard Emergency Response Act (AHERA).
6. Yamate, G., et al. *Methodology for the measurement of airborne asbestos by electron microscopy*, Contract Number 68-02-3266, Washington, DC (July 1984).
7. Plant Engineering Asbestos Contracting Specifications 01310–01319 (latest edition).

Supporting Standards

California Code of Regulation, Title 8, Chapter 1529, "Asbestos Standard for the Construction Industry."

Code of Federal Regulations, Title 29, Part 1926.1101, "Asbestos Standard for the Construction Industry."

Code of Federal Regulation, Title 40, Part 61(M), "EPA National Emission Standards for Hazardous Air Pollutants (NESHAPS)."

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

Appendix A

Terms and Definitions

AHERA	Asbestos Hazard Emergency Response Act of 1986. Amended in 1990.
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 0.1% of asbestos 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 0.1% of asbestos by weight.
asbestos-related work	Any work involving an ACM that may result in the release of any quantity of asbestos fibers into the air.
asbestos work permit	A form (see Appendix D) used to plan and and coordinate limited-scale asbestos-related work. It describes the manner in which the work will be conducted, and is initiated by a supervisor (or competent person), and completed and signed by an industrial hygienist.
certified industrial hygienist	An industrial hygienist certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.
class I asbestos work	Refers to activities involving the removal of thermal system insulation (TSI) and surfacing ACM.
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 and sheeting, roofing and siding shingles, and construction mastics.

class III asbestos work	Refers to repair and maintenance operations where ACM, including TSI and surfacing material, is likely to be disturbed.
class IV asbestos work	Refers to maintenance and custodial activities during which employees can come in contact with ACM, including activities to clean up waste and debris containing ACM.
critical barriers	A positive means to prevent fiber migration.
demolition	Wrecking or removing any load-bearing element in a structure.
friable	Any material that can be reduced to a powder by applying hand pressure.
glove bag	A plastic sack designed to enclose the asbestos being disturbed. It allows personnel access via built-in gloves.
high-efficiency (HEPA) filter particulate air	A filter capable of removing 99.97% or greater of a monodisperse aerosol having a mean diameter of 0.3 μm.
large-scale asbestos work	All Class I work involving more than 25 lineal feet or 10 ft^2 of ACM and Class II work involving more than 500 ft^2 of ACM.
limited-scale asbestos work	Class I work involving the removal of less than 25 lineal feet or 10 ft^2 of ACM; Class II work involving less than 500 ft^2 of ACM; all removal of vinyl asbestos tile; and all Class III and IV work.
medical surveillance	An evaluation of a worker's ability and suitability to perform asbestos-related work and wear a respirator. This typically includes an examination; a 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 of the results. Surveillance is to begin before initial assignment and continues 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.
negative exposure assessment (NEA)	A demonstration based on representative monitoring data from prior operations that worker's asbestos exposures are expected to be consistently below the 8-hour and 30-minute permissible limits.
negative pressure enclosure (NPE)	An enclosure of any configuration, as long as it maintains at least 4 air changes per hour (6 air changes recommended) and has a minimum of –0.02 column in. of water pressure differential (–0.05 column in. recommended), relative to outside pressure, as evidenced by continuous manometric measurements with a continuous data-recording system.
operations and maintenance (O&M) program	A program designed to minimize the exposure of occupants within a building or area to asbestos fibers resulting from damaged or deteriorating ACBM.
PACM	Presumed asbestos-containing material. Building materials, including but not limited to thermal system insulation and surfacing material, that may contain asbestos but have not yet been tested.
regulated area	Any area where airborne asbestos levels may exceed the PEL or excursion limit. A regulated area include areas where unprotected personnel may be exposed to asbestos at levels above the clearance limits. Physical barriers (e.g., temporary enclosures or conspicuous barriers such as cones and warning tape) are used to demarcate the area to prevent unqualified and unprotected persons from entering.
remediation	Any asbestos-related job carried out specifically to correct an asbestos hazard.
renovation	Work, other than demolition, in which ACM is moved or stripped from any part of a structure.

room responsible person	The individual responsible for experiments or programmatic activities conducted in a room or area.
spill (ACM)	An accidental release of asbestos from ACM.
surfacing ACM	Construction ACM that was applied on the surface of buildings wet and allowed to dry or cure in place. This includes structural fireproofing, acoustic or decorative ceilings, and wallboard taping and texturing compounds.
thermal system insulation	Asbestos-containing material applied to pipes, fittings, boilers, breaching, tanks, ducts, or other structural components to prevent heat loss or gain.

Appendix B

Common ACMs and ACBMs

B.1 Asbestos-Containing Materials

Listed below are common types of equipment and products that contain asbestos material.

- Electrical insulation in ovens, furnaces, and other heat-producing systems.
- Clutches and brake shoes in vehicles and other equipment.
- Heat-resistant clothing, such as gloves or aprons.
- Laboratory glassware wrap and insulation.
- Asbestos cement board and Transite in fume hoods, laboratory bench tops, trays, welding and soldering benches, furnaces, and ovens.
- Gasket material for pipes, ducts, and other equipment.
- Older welding blankets and fire blankets.
- Packing for electrical conduit and pipes.
- Specialized adhesives.
- Older electrical wire insulation.

B.2 Asbestos-Containing Building Materials

Common asbestos-containing building materials are

Acoustic ceilings
Asbestos board
Asbestos cement pipe
Asbestos shingles
Boiler insulation
Caulking putties
Ceiling tiles
Duct insulation
Duct tape
Electrical insulation
Fire curtains
Floor tiles
Heat-resistant insulation
Joint compound
Linoleum
Packing
Mastics, glue
Sheet rock
Pipe fittings
Pipe gaskets
Pipe insulation
Plaster
Roof felt
Roofing paint
Roof patch
Sheet-rock tape
Structural fireproofing
Stucco
Textured paint
Transite panels
Waterproof membrane

Appendix C

Process for Limited-Scale Asbestos Work

Limited-scale asbestos work is defined as Class I work involving less than 25 lineal feet or 10 ft^2 of ACM, Class II work involving less than 500 ft^2 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 or SLO employees. Unless otherwise specified, the supervisor of the asbestos work crew is the responsible for all actions.

C.1 Competent Person (PE Supervisor) Reviews Work

Does the work exceeds limited scale?

- ☐ Yes. This appendix does not apply.
- ☐ No. Respond to the remaining questions.

Is the work covered by an NEA?

- ☐ Yes. Proceed as required by the NEA.
- ☐ No. Initiate an Asbestos Work Permit.

C.2 Industrial Hygienist Reviews Work

Is medical surveillance required?

- ☐ Yes.
- ☐ No.

Is a work permit acceptable?

- ☐ Yes. The industrial hygienist (IH) must sign the permit.
- ☐ No. The IH notifies the supervisor of deficiencies. Changes are made as necessary before the IH signs the permit.

C.3 Planned Work

Is sampling required?

- ☐ Yes. Notify the IH 3 days in advance.
- ☐ No. Notify the IH 1 day in advance.

Is work to be performed in building?

- ☐ Yes. Notify the building manager/ facility coordinator.
- ☐ No.

Is work to be performed on a Type A or B roof?	☐ Yes. Notify the building manager and negotiate time to do work. A Roof Access Permit is required. ☐ No.
Does the work involve demolition?	☐ Yes. Notify the environmental analyst for air quality district notification. ☐ No.
Does the work involve renovation?	☐ Yes. Evaluate the need for EPD notification. ☐ No.

C. 4 Worksite Set Up

To set up the worksite, employees shall

- Post the appropriate signs.
- Install critical barriers (as specified).
- Cover surfaces.
- Install specified ventilation system.
- Provide HEPA-filtered vacuum system(s).
- Install specified control systems (NPE, glove bag, etc.) and decontamination systems.

Supervisors shall inspect the control and decontamination of systems.

C.5 Work Procedures

The supervisor shall

- Ensure that medical surveillance is completed, if needed.
- Verify that all personnel receive the required training.
- Obtain the specified types of respirators.
- Inspect the worksite at least daily.
- Provide a minimum of 2 persons for most types of work.
- Contact the industrial hygienist if final visual inspection or clearance sampling is specified.
- Remove any critical barriers, postings, and ventilation systems only after the industrial hygienist has approved such removal based on inspection and air samples.

Employees shall

- Wet material before and during removal.
- Maintain good housekeeping.
- Completely contain waste as it is generated.
- Remove ACM in large segments as is feasible.
- Minimize breakage, pulverizing, or damage to ACM.
- Use glove bags properly (single use; exhaust before removal; water, as needed).
- Decontaminate the area, vacuum surfaces, and remove surface covers.

C.6 Recordkeeping

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

Appendix D

Asbestos Work Permit

This appendix contains a sample Asbestos Work Permit, which is used to document limited-scale asbestos work and is only applicable to work performed by LLNL and SLO personnel.

Appendix E

Signs and Labels

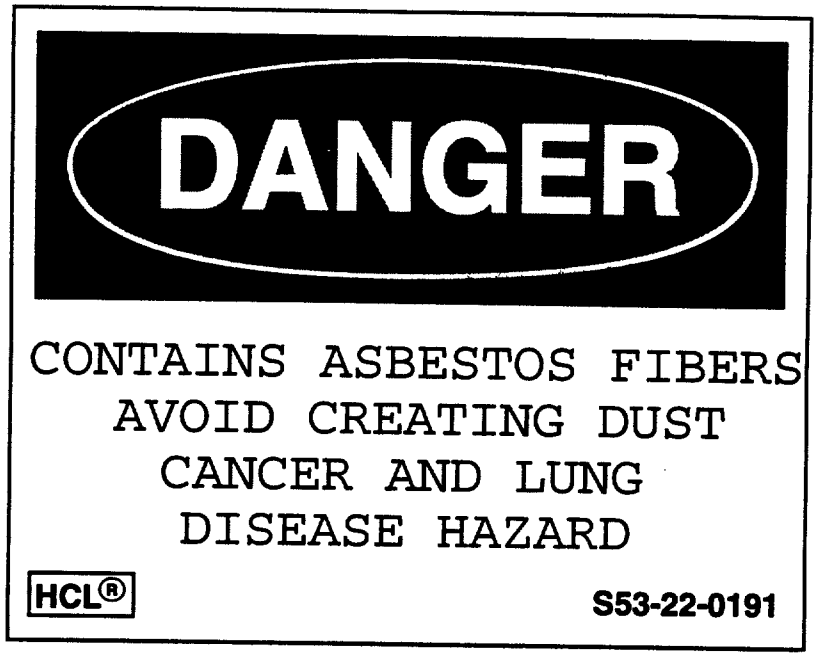
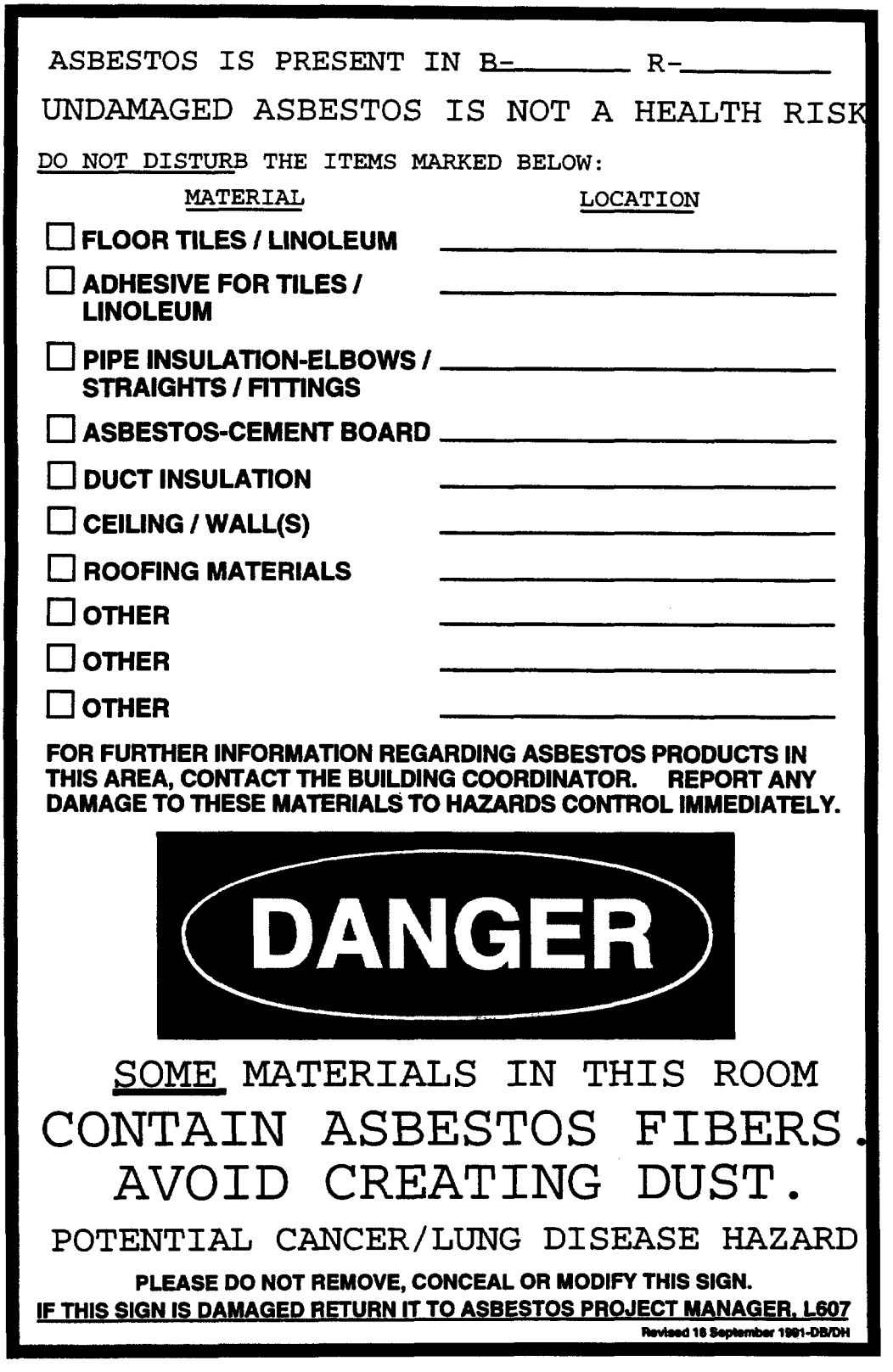


Figure E-1. Sign for use with asbestos-containing materials and containers.



ASBESTOS IS PRESENT IN B-_____ R-_____

UNDAMAGED ASBESTOS IS NOT A HEALTH RISK

DO NOT DISTURB THE ITEMS MARKED BELOW:

MATERIAL	LOCATION
☐ FLOOR TILES / LINOLEUM	_____
☐ ADHESIVE FOR TILES / LINOLEUM	_____
☐ PIPE INSULATION-ELBOWS / STRAIGHTS / FITTINGS	_____
☐ ASBESTOS-CEMENT BOARD	_____
☐ DUCT INSULATION	_____
☐ CEILING / WALL(S)	_____
☐ ROOFING MATERIALS	_____
☐ OTHER	_____
☐ OTHER	_____
☐ OTHER	_____

FOR FURTHER INFORMATION REGARDING ASBESTOS PRODUCTS IN THIS AREA, CONTACT THE BUILDING COORDINATOR. REPORT ANY DAMAGE TO THESE MATERIALS TO HAZARDS CONTROL IMMEDIATELY.

DANGER

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 RETURN IT TO ASBESTOS PROJECT MANAGER, L607

Revised 16 September 1991-DB/DH

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

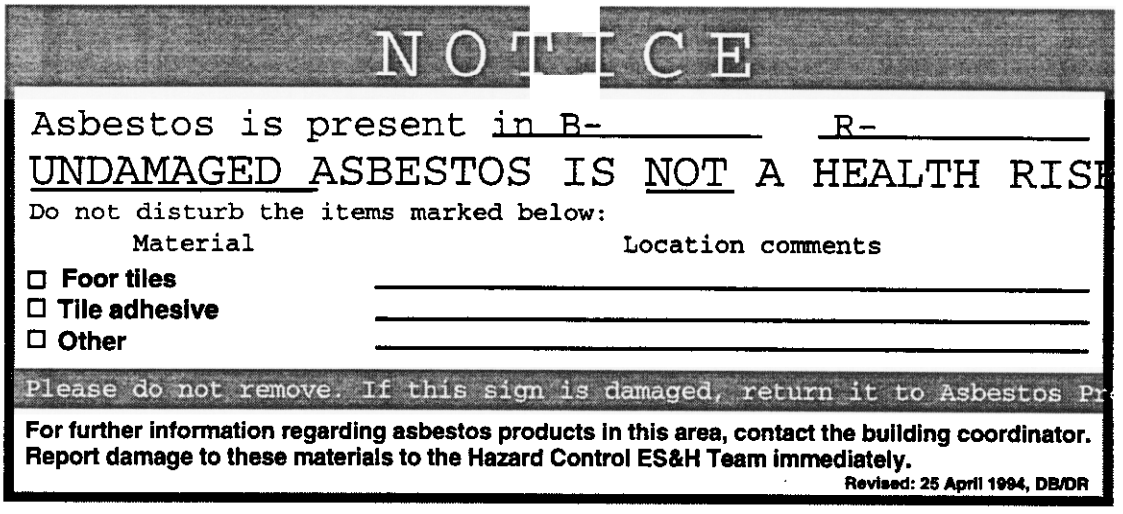


Figure E-2b. Alternative room sign for use where undamaged, encapsulated, or nonfriable asbestos is present.

ASBESTOS-CONTAINING MATERIALS NOTIFICATION

NOTIFICATION TO ALL EMPLOYEES, 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 during normal business hours in room_____, ext. _____.

ASBESTOS IS PRESENT IN THE FOLLOWING ITEMS AND AREAS

	Material	Location
☐	Textured Ceiling	_____
☐	Textured Walls	_____
☐	Linoleum /Floor Tiles	_____
☐	Pipe Insulation	_____
☐	Structural Fire Proofing	_____
☐	Asbestos-Cement Board	_____
☐	Other _____	_____
☐	Other _____	_____

DO NOT DISTURB THESE MATERIALS. FOR FURTHER INFORMATION REGARDING ASBESTOS PRODUCTS IN THIS AREA, CONTACT THE BUILDING COORDINATOR. 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 threat 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 building coordinator or the LLNL Asbestos Project Manager at extension 3-1864.

_____

Building Coordinator

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

ASBESTOS

CANCER AND LUNG DISEASE HAZARD

KEEP OUT

AUTHORIZED PERSONNEL ONLY

RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA.

Figure E-4. Sign for use in regulated asbestos areas.

Lead

Health & Safety Manual

Supplement 21.20

Safe Handling of Lead and Lead Compounds in General Industry and Construction Operations

September 1995

Approved by the ES&H Working Group

_____ date _____

Robert W. Kuckuck
Deputy Director of Operations

Safe Handling of Lead and Lead Compounds in General Industry and Construction Operations*

Contents

* New supplement

* **New supplement**

Section I. General Information

1.0 Introduction

1.1 Purpose and Scope

Lead, element number 82, is a gray metal with a mean atomic weight of 207.19. Lead forms many organic and inorganic compounds and a wide range of alloys. Lead has been used for thousands of years, and until recently was commonly found in a wide range of commercial and industrial products. Lead has been used as a pigment in paints, solder, surfacing for galvanized metal, as an additive in gasoline, and in alloys such as brass and pewter. At LLNL, lead has also been widely used in radiation shielding and as a reagent in laboratories.

This supplement outlines the requirements for work involving lead. The general information in this section applies to both General Industry Operations (Section II) and Construction Operations (Section III). General Industry Operations include research activities, the handling of lead shielding, building of experimental equipment, and machining of lead or lead alloys. Construction Operations include maintenance, the demolition or remodeling of buildings, new building construction, the removal of lead paint from equipment or buildings, and the use of paint that contains lead for road demarcation.

Appendix A contains terms and definitions used in this supplement; the other appendices contain requirements applicable to both Sections II and III.

All Laboratory employees, subcontractors, and supplemental labor employees must follow the procedures outlined in this supplement when performing lead work. Certain employees may perform work that falls under both Sections II and III. For example, an individual may be assigned to demolish a large piece of equipment coated with a lead-containing paint (Section II), and the task may require the disturbance of walls coated with a leaded paint or roofing sheets made of lead-galvanized metal (Section III). In many cases, there may seem to be only little differences between the two sections. But it is important for each employee to fully understand which set of requirements applies to each aspect of the particular job.

1.2 Health Effects

Lead is a potentially serious occupational health hazard. Lead and most lead compounds are toxic by inhalation or ingestion of dust. A few lead compounds are considered possible carcinogens (lead acetate, lead chromate, lead phosphate and lead subacetate). Volatile organic lead compounds may generate vapors that are toxic when inhaled. Liquid organic lead compounds may be absorbed through the skin, and some organic and inorganic lead compounds may directly irritate the skin.

Lead is a teratogen that can cause fetal malformation, a mutagen that can affect both sperm and eggs, and a reproductive toxin that can impair fertility. Acute, high-level poisoning with lead can lead to encephalopathy with seizures, coma, and, in severe cases, death. In many cases, the effects of lead poisoning are irreversible (or only partially reversible) and can lead to permanent impairment of the function of the brain, kidney, nervous system, or reproductive system. More chronic exposure can lead to qualitatively similar effects, including damage to blood-forming organs, the nervous system, urinary tract, digestive tract, and reproductive system. Chronic exposure to relatively low levels of lead may cause neurological and neurobehavioral problems, especially in children. These effects may not be fully reversible if the exposure has been ongoing for a long time, or if it occurs during critical developmental phases.

Section II. General Industry Operations

2.0 Requirements and Procedures for Compliance and Risk Reduction

The requirements in this section are applicable *only* to General Industry Operations (e.g., machining lead-containing materials, moving lead bricks, and soldering with lead-containing alloys in Programmatic shops). These requirements are not applicable to construction activities, including building maintenance activities, or to the handling of lead compounds in chemistry research laboratories. See Section III for the requirements for construction activities that involve the handling of lead or lead compounds. Controls for research laboratories can be found in Supplement 21.16A (Safe Handling of Chemical Carcinogens in Research Laboratories) and Supplement 21.01 (Chemical Hygiene Plan for Laboratories).

2.1 Requirements/Regulatory Summary

The guidance and requirements in this section are based on the following:

- 29 CFR 1910.1025, "General Industry Lead Standard." This standard applies to elemental lead, all inorganic lead compounds, and lead soaps. It does not apply to other organic lead compounds.
- 29 CFR 1926.62, "Construction Industry Lead Standard." Parts of the medical surveillance provisions of this standard that are more conservative than those found in 29 CFR 1910.1025 are adopted for use in this section.
- 29 CFR 1910.1000, "Air Contaminants." This regulation specifies exposure limits for tetraethyl lead and tetramethyl lead.
- Department of Housing and Urban Development "Guidelines for the evaluation and control of lead-based paint hazards in housing."[1] Guidelines for certain aspects of lead work are referenced from this publication.
- Limits for lead in paint established by the Stewart B. McKinney Homeless Amendments Act to the Lead-Based Paint Poisoning Prevention Act, PL-100-628. These limits are used as an administrative guideline.
- The Biological Exposure Index for Lead, as established by the American Conference of Governmental Industrial Hygienists.[2]

2.2 Procedures for Risk Reduction

2.2.1 Lead Exposure limits

Airborne Limits. The permissible exposure limit (PEL) for metallic lead, any inorganic lead compound, or lead soaps is 50 $\mu g/m^3$ of air averaged over an 8-hour period. The corresponding PEL for tetramethyl and tetraethyl lead is 75 $\mu g/m^3$ of air. There is no PEL for other organic lead compounds.

The medical surveillance action level for metallic lead, any inorganic lead compound, or lead soaps (for people who are or may be reasonably expected to be exposed for more than 30 days a year) is 30 $\mu g/m^3$ of air averaged over an 8-hour period. There is no action level for tetramethyl or tetraethyl lead or other organic lead compounds.

A negative exposure assessment (NEA) is a statement written or approved by an LLNL industrial hygienist indicating that a specific lead-disturbing job (or a class of very similar lead-disturbing jobs) does not result in employee exposure above the action level. Work conducted pursuant to an NEA can proceed without subsequent review, provided that the controls specified in the NEA are adhered to.

Blood Limits (Biological Monitoring). A biological monitoring program limits blood lead levels. See Appendix B, "Medical Surveillance Requirements," for details.

Surface Contamination Limits. When lead-containing materials are disturbed such that airborne dust is generated, residual surface contamination may pose a hazard to people who subsequently occupy the area. In such cases, surface sampling is conducted periodically as determined by the cognizant industrial hygienist. This is intended to verify the adequacy of housekeeping (see the section entitled "Housekeeping and Decontamination" in Section 2.2.3). The recommended limit for surface contamination in these areas is 100 $\mu g/ft^2$ (HUD limit).[1] A higher limit may be acceptable in areas where employees regularly use respiratory protection and other appropriate personal protective equipment, at the discretion of the cognizant industrial hygienist.

2.2.2 Monitoring Program

Personal Monitoring Program. Personal air sampling is conducted to assess an individual's (or group's) exposure to airborne lead during work that disturbs lead-containing materials. Initial samples are required for all operations where exposure above the action level may occur. The frequency of subsequent sampling is dependent upon the results of the initial samples.

The process for initiating and collecting air samples is as follows:

- Supervisors shall notify the cognizant industrial hygienist at least 48 hours in advance of planned lead operations so that air sampling can be arranged.

- The cognizant industrial hygienist or a health and safety technician working under the guidance of an industrial hygienist shall do the following:
  - — Collect the initial personal air samples for uncharacterized operations that may generate airborne lead and submit them to the Hazards Control laboratory for analysis.

    If the results of the representative samples are below the action level, no further sampling is required as long as the operation continues unchanged. If the results are above the action level but below the PEL, air sampling must be repeated at least every 6 months. For results greater than the PEL, air sampling must be repeated every 3 months and a written compliance plan (e.g., a Lead Work Permit [see Appendix C] or an operational safety procedure [OSP]) detailing the steps to be taken to reduce the airborne lead levels must be developed and implemented.

  - — Inform the supervisors of affected employees in writing within 5 work days if the samples show that exposure exceeds the PEL. Supervisors are then responsible for notifying each affected employee. Exposure results are reported without any consideration of respiratory protection worn during the operation. Provide these supervisors with a description of the corrective actions to be taken to reduce exposure, and the Health Services Department with a copy of the notification.

The results of air sampling conducted to measure exposure during operations at the Laboratory may be used to represent the level of exposure for other similar operations. The decision to accept these results, however, is at the discretion of the cognizant industrial hygienist.

Surface Monitoring. Samples should be obtained at least semiannually from areas where activities such as those described in Section 2.2.3 (Lead Work Permits) are conducted or where exposure above the action level may occur. The health and safety technician or industrial hygienist shall obtain these samples by making two S-shaped swipes with a prewetted wipe at a 90° angle over a 1-ft^2 area and submit the swipes to the Hazards Control laboratory for analysis. Details on this sampling method can be found in Section 10 (Requirements/ Regulatory Summary) of the HUD Guidelines.[1]

Laboratories that analyze lead swipes or bulk samples must be accredited by the American Industrial Hygiene Association or another organization accredited by the Environmental Protection Agency (EPA) specifically to perform lead analysis.

Medical Surveillance and Removal

Applicability. The biological monitoring, medical surveillance, and removal provisions in this supplement are applicable to all LLNL and non-LLNL employees who are exposed to the limits described in this supplement. The

LLNL Health Services Department performs medical surveillance for LLNL employees only. The employers of non-LLNL employees provide medical surveillance for their employees.

The requirements below, including the general requirements detailed in Appendix B, apply to biological monitoring and medical surveillance.

1. For every employee who is (or may be) exposed to lead above the action level for 30 days or more a year, the supervisor will provide Health Services the number of days of exposure.
2. 29 CFR 1926.62 expresses the blood lead concentration in terms of micrograms of lead per deciliter (μg/dl) of blood, whereas 29 CFR 1910.1025 uses the roughly equivalent unit of micrograms of lead per 100 grams (μg/100 g) of whole blood. For the sake of consistency, this supplement uses micrograms of lead per deciliter of whole blood.
3. Biological monitoring includes the measurement of blood levels of zinc protoporphyrin (ZPP). The interpretation of ZPP results is within the discretion of the examining clinician.
4. Where required, a comprehensive physical exam must comply with the requirements of 29 CFR 1926.62(j)(3)(ii)(A-F).
5. Employees who are under work restriction because of an elevated blood lead level may request a second examination. Generally, the employees' Program or Department will cover the expenses of this examination, provided that these employees notify Health Services and their supervisors within 15 days of making an appointment with a physician of their choice. Any differences between the findings of two examining physicians shall be resolved in accordance with 29 CFR 1910.1025(j)(iii). Additional requirements relating to the temporary removal of employees from lead work areas can be found in 29 CFR 1910.1025(k).
6. Pregnant women, and women and men who are actively trying to conceive a child are urged to contact Health Services for a medical review. If the employee has been exposed to lead above the action level, Health Services will follow the rules in Table B-1 and Fig. B-1 of Appendix B. If the employee has not been exposed above the action level, Health Services will provide appropriate counseling and take the necessary action based upon the individual circumstances of the case.

2.2.3 Exposure Controls

Three types of controls are used to mitigate exposure to lead: engineering controls, administrative controls, and personal protective equipment. Of these, engineering controls are the preferred method.

Where employees are exposed above the PEL for 30 days or more a year, both engineering and administrative controls shall be used to reduce exposure to or below the PEL. If these controls are not adequate, respiratory protection shall be

used in addition to engineering and administrative controls. Where employees are exposed above the PEL for more than 30 days a year, engineering controls must be used to reduce exposure to levels close to the PEL but at least to 200 $\mu g/m^3$. In addition, any combination of controls can be used to further reduce exposure to the PEL (50 $\mu g/m^3$).

Engineering Controls. Ventilation systems used to control lead aerosols must be evaluated qualitatively or quantitatively every 6 months. These systems must be re-evaluated within 5 days of a process or ventilation change that may alter employee exposure. Ventilation systems used for unique, temporary, or infrequent lead operations shall be evaluated before use. The nature of these evaluations shall be determined by the cognizant industrial hygienist. At a minimum, quantitative evaluation shall be conducted annually. (NOTE: This requirement applies only to elemental lead, inorganic lead compounds, and lead soaps.)

Where they will not interfere with their shielding properties, lead items used for shielding or weighting should be encapsulated in a suitable coating to protect the lead from corrosion and to reduce employee contact. Corroded lead materials may be particularly hazardous and should be encapsulated or replaced if feasible. Newly purchased shielding bricks should be encapsulated to prevent corrosion.

Administrative Controls

Lead Work Permits. Permits are used for short-term operations and must be developed for any operation that will result (or may be reasonably expected to result) in exposure above the PEL, unless the operation is described in a current safety procedure or a current NEA. Permits must specify the manner in which the work will be altered to reduce exposure level to the PEL using both engineering and administrative controls.

The responsible supervisor must develop a Lead Work Permit for the following activities:

- Machining of lead or alloys with more than 0.06% of lead.
- Sanding of lead, lead coatings, or lead alloys with more than 0.06% lead.
- Burning, welding, or torch brazing of any material containing or coated with any amount of lead.
- Abrasive blasting of any material containing or coated with any amount of lead.
- Handling of 25 or more lead bricks, unless the bricks are encapsulated.
- Handling of more than 25 lb of lead shot or beads, unless they are fully encapsulated.
- Spray paints or coatings containing more than 0.06% lead.

- Volatile organic lead compounds used other than as a reagent in chemistry laboratories.
- All operations that may result in exposure over the PEL.
- Use of any lead compound identified as a potential carcinogen.

The supervisor shall submit the permit to the cognizant industrial hygienist for approval at least 48 hours in advance of beginning the scheduled work.

Lead-disturbing activities that are smaller in scope than those listed above (e.g., handling of <25 lead bricks) are designated as "minuscule lead work." It is assumed that this type of work will not result in exposure above the PEL. A Lead Work Permit is not required for minuscule lead work; however, lead awareness training is required for personnel performing the work.

It should be noted that the exemption for minuscule lead work is based on best industrial hygiene judgment, and that there may be unusual circumstances under which the work may result in hazardous levels of airborne lead. This exemption is not applicable where lead compounds determined to be possible carcinogens are disturbed or used.

Safety Procedures. OSPs may be used in lieu of Lead Work Permits. An OSP is appropriate where lead work is ongoing or repetitive and may be reasonably expected to result in exposure above the PEL. Operations adequately covered in an OSP do not require a Lead Work Permit. The cognizant industrial hygienist will determine if an OSP is adequate or if a supplemental Lead Work Permit is required. Lead OSPs must be reviewed *every* 6 months.

Housekeeping and Decontamination. These are important elements in the control of lead exposure. Dry sweeping and blowing of lead-containing dusts are prohibited. Contaminated work surfaces should be cleaned sufficiently to reduce lead levels to less than 100 $\mu g/ft^2$. A higher level may be accepted for industrial areas, at the discretion of the cognizant Hazards Control industrial hygienist. Recommended clean-up methods include vacuuming the area with a HEPA-filtered vacuum or wet-wiping with disposable cloths. Consult the cognizant environmental analyst for guidance on the proper waste disposal practices.

Personal Hygienic Practices. The precautions below apply to areas where lead is disturbed, unless the work is covered by an NEA or is minuscule work.

- Designate a separate location for eating, storing, and preparing food and beverages, and for using tobacco products and cosmetics to avoid the possibility of ingesting lead. *No lead work shall be performed in these designated areas.*
- Wash your hands and face before eating, drinking, using tobacco products, or applying cosmetics.
- Designate change rooms where employees can segregate street clothes from clothing used for work.

- Provide shower facilities. Showers located throughout the Laboratory may be used, provided that other employees do not use these showers while they may be potentially contaminated with lead dust. Showers used for lead work must be decontaminated before use by other employees. Portable shower units may be used for required decontamination activities.

Signs. Signs with the wording below shall be posted at all possible entrances to areas where lead work (other than minuscule lead work or work performed pursuant to an NEA) is being conducted. These signs shall be well illuminated so that they are easily visible to employees and visitors. Contact your ES&H team for guidance if you have any questions about signs.

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

Personal Protective Equipment. Personal protective equipment such as coveralls, shoe covers, head covers, gloves, and respirators are required for operations that may generate airborne lead levels above the PEL (50 $\mu g/m^3$) and operations that require a Lead Work Permit for which there is no NEA. Safety shoes will be required for many operations. Leather gloves (or equivalent) shall be used when handling unencapsulated lead bricks or shielding. Additional requirements may be applicable if the exposure is known or expected to exceed 200 $\mu g/m^3$. Where required, such equipment shall be specified in an OSP, Lead Work Permit, or on a Hazard Assessment Form that has been reviewed and approved by the cognizant industrial hygienist.

Respirators shall be selected by a Hazards Control industrial hygienist in conformance with LLNL's and OSHA's requirements. No employee shall be required to wear a negative pressure respirator for more than 4.4 hours a day during the installation of feasible engineering controls. Fit-testing of negative pressure respirators must be conducted within 6 months prior to lead work. If requested by the employee, a powered air-purifying respirator must be provided in lieu of a negative pressure respirator.

2.3 Responsibilities

2.3.1 Hazards Control Department

The Hazards Control Department shall

- where possible, establish NEAs for consistent types of lead work;
- perform required air monitoring;
- notify supervisors of air sample results;

- notify supervisors of the need for medical surveillance when sampling so indicates;
- assist in the design and implementation of engineering control systems;
- provide the necessary training or assist in identifying an alternative source of training;
- provide exposure information to the Health Services Department.
- review OSPs or Lead Work Permits to ensure they incorporate adequate controls;
- select the most appropriate type of respirator for employees involved in lead work;
- provide respirators to qualified personnel;
- assist supervisors in identifying potential lead-disturbing activities; and
- perform surface swipe testing as required.

2.3.2 Health Services Department

The Health Services Department shall

- perform required medical surveillance exams and blood tests;
- determine when employees must be removed from exposure because of abnormalities detected during medical surveillance;
- determine when employees who are removed from work involving lead because of medical abnormalities can return;
- notify employees of any medical findings, as required;
- contact Hazards Control and request a worksite evaluation for any employee found to have a blood-lead level above that specified in Section 2.2.1; and
- determine if measured elevations in blood lead are occupational.

2.3.3 Safeguards and Security

Safeguards and Security shall

- ensure that all firing range instructors have a blood lead test at least every 6 months; and
- provide engineering and administrative controls that maintain exposure below the action level for firing range instructors and other persons on the firing line or in the immediate area.

2.3.4 Supervisors

Supervisors shall identify all employees who may be reasonably expected to be exposed to lead. In addition, they shall

- request that the ES&H team evaluates the workplaces of all employees who may be exposed to lead above established limits;

- schedule employees who are exposed above the medical surveillance action level for medical exams;
- ensure that all available and specified engineered and administrative controls and personal protective equipment are used appropriately;
- ensure that individuals who may be potentially exposed to lead receive appropriate training;
- initiate Lead Work Permits or OSPs when required;
- notify employees of the results of personal air samples;
- conduct lead awareness training;
- provide an alternate workplace and job for employees who Health Services has removed from work involving lead exposure; and
- notify the industrial hygienist at least 48 hours prior to lead work, as required.

2.3.5 Employees

All employees shall follow the requirements outlined in this supplement for work involving lead. In addition, any employee who is pregnant or actively trying to conceive a child should notify the Health Services Department.

2.4 Training

2.4.1 OSHA-Required Training

29 CFR 1910.1200 (Hazard Communication Standard), 29 CFR 1910.1450 (Laboratory Hazards Standard), 29 CFR 1910.1025 (General Industry Lead Standard), and several other OSHA regulations require training for lead hazards. 29 CFR 1910.1025 stipulates two levels of training.

Level 1. 29 CFR 1910.1025 states that employees who are occupationally exposed to lead at *any* level above background must be informed of the content of the standard and its appendices. A short, job-specific training session (lead awareness training) is appropriate to fulfill this requirement. In this training, employees should be provided a copy of the standard and its appendices and the task-specific aspects of the operation should be addressed (e.g., expected degree of hazard, health effects, good practices, personal hygiene, and sources of additional information). Lead awareness training fulfills part of the requirement of the Health Hazard Communication Standard (see Supplement 7.02).

Level 2. Lead worker training is required annually for employees who may be reasonably expected to be exposed at or above the action level or for whom the possibility of skin irritation exists. Lead worker training consists of a review of

elements of the lead standard (29 CFR 1910.1025) in more detail. These elements include the following:

- The content of the lead standard and its appendices. Copies of this standard must be given to employees.
- The specific nature of the operation that could result in exposure above the action level.
- Respirator-use training, as outlined in 29 CFR 1910.134.
- A description of the Medical Surveillance Program, the procedure for removing affected employees from work involving lead, and information on the adverse health effects of lead. Particular emphasis is placed on the male and female reproductive systems.
- A description of engineering and administrative controls and personal protective equipment.
- The content of any compliance plans, including information on the proper uses of chelating agents.

2.4.2 Other Training

The Hazards Control Department does not routinely offer lead training because exposure above the action level in General Industry Operations is expected to be rare at LLNL. However, supervisors are responsible for ensuring that employees receive training appropriate to their job functions. The cognizant ES&H team arranges for appropriate lead training, and the cognizant industrial hygienist determines the length and content of the training material. Special classes can be provided by the cognizant industrial hygienist.

All completed training shall be submitted to the Laboratory Repository of Completed Courses (LROCC).

Section III. Construction Operations

3.0 Requirements and Procedures for Compliance and Risk Reduction

This section is applicable to construction-type activities that involve the handling of lead or lead compounds, including demolition, renovation, new construction, lead abatement, and maintenance activities. Non-construction activities are addressed in Section II of this supplement. Research laboratory activities involving lead are addressed in Supplement 21.16A (Safe Handling of Chemical Carcinogen in Research Laboratories) and Supplement 21.01 (Chemical Hygiene Plan for Laboratories).

3.1 Requirements/Regulatory Summary

The guidance and requirements in this section are based on the following:

- 29 CFR 1926.62, "Construction Industry Lead Standard." This standard applies to elemental lead, inorganic lead compounds, and lead soaps. It does not apply to other organic lead compounds.
- 29 CFR 1910.1000, "Air Contaminants." This regulation specifies exposure limits for tetraethyl lead and tetramethyl lead.
- Department of Housing and Urban Development, "Guidelines for the evaluation and control of lead based paint hazards in housing."[1] Guidelines for certain aspects of lead work are referenced from this publication.
- Limits for lead in paint established by the Stewart B. McKinney Homeless Amendments Act to the Lead-Based Paint Poisoning Prevention Act, PL-100-628. These limits are used as an administrative guideline.
- California Code of Regulations, Title 17, Division 1, Chapter 8, "Accreditation of Training Providers and Interim Certification of Individuals Engaged in Lead-related Construction Work." Accreditation requirements are referenced from this publication. The California licensing requirements current and in effect are applicable.
- The Biological Exposure Index for Lead, as established by the ACGIH.[3]

3.2 Procedures for Risk Reduction

3.2.1 Lead Exposure limits

Airborne Limits. The permissible exposure limit for metallic lead, any inorganic lead compound, or lead soaps is 50 $\mu g/m^3$ of air averaged over an 8-hour period.

The corresponding PEL for tetramethyl and tetraethyl lead is 75 $\mu g/m^3$ of air. There is no PEL or TLV for other organic lead compounds.

The medical surveillance action level for metallic lead, any inorganic lead compounds, or lead soaps is 30 $\mu g/m^3$ of air averaged over an 8-hour period. There is no action level for tetramethyl or tetraethyl lead or other organic lead compounds.

A negative exposure assessment (NEA) is a statement written and approved by an LLNL industrial hygienist indicating that a specific lead-disturbing job (or a class of very similar lead-disturbing jobs) does not result in employee exposure above the action level. Work conducted pursuant to an NEA can proceed without subsequent review, provided that the controls specified in the NEA are adhered to. If a change in process, equipment, material, personnel, or task result in a different lead exposure, the NEA may not be applicable.

Blood Limits (Biological Monitoring). A biological monitoring program limits blood lead levels. See Appendix B, "Medical Surveillance Requirements," for details.

Surface Contamination Limits. When lead-containing materials are disturbed such that an aerosol is generated, residual surface contamination may pose a hazard to people who subsequently occupy that area. In such cases, surface sampling is conducted at the end of the lead activity. This is intended to verify the adequacy of decontamination procedures. The maximum recommended permissible surface contamination level is 100 $\mu g/ft^2$ for general-occupancy areas. Higher values may be acceptable for industrial areas, at the discretion of the industrial hygienist.

3.2.2 Monitoring Program

Preconstruction Paint Sampling. Lead is present in paint on the surfaces of many LLNL buildings. Thus, it is necessary to identify maintenance, renovation, remodeling, and demolition activities that will disturb lead-coated surfaces so that the appropriate controls can be implemented before work begins. Until a survey of LLNL structures is conducted, it will be necessary to test the interior and exterior of most building surfaces before beginning activities that disturb potential lead-containing material. Alternatively, it may be assumed that the material disturbed includes lead. If it is known that the building was constructed after 1979 and paints containing lead at concentrations above 0.06% were not used, testing is not required. However, it is generally not possible to make this determination with certainty. The supervisor of the persons performing the work should exercise this option only if he/she knows for sure that lead-containing paints were not used at any time on the surface to be disturbed.

Specifically, painted surfaces must be tested before beginning construction activities that involve

- scraping, abrasive blasting, or sanding;

- demolishing buildings;
- cutting, sawing, or otherwise penetrating a wall or other painted surface;
- burning, torch cutting, arc cutting, welding, brazing;
- using a heat gun to remove paint; or
- performing other activities that generate lead-containing dust.

Testing also must be conducted on other potential lead-containing construction materials that will be disturbed such that a lead aerosol may be generated, including but not limited to

- galvanized metal that is to be cut with a torch, burned, or otherwise heated to the melting point of lead (>320°C);
- brass, bronze, and pewter that is to be sanded or heated to the melting point of lead (>320°C); and
- solders that are to be sanded.

Testing and Analysis Techniques. Testing can utilize bulk-sampling, with subsequent analysis conducted using atomic absorption or inductively coupled plasma emission spectroscopy (ICPES) or a portable x-ray fluorescence lead detector. Alternative techniques (e.g., laboratory x-ray fluorescence) may be approved by the cognizant industrial hygienist.

A paint is generally determined to be lead-containing if the bulk sample analysis indicates it has more than 600 parts per million (ppm) of lead. Portable x-ray fluorescence equipment measures lead in terms of units of milligrams of lead per square centimeter of surface—not in ppm. These units are not readily interconvertable. Further, at this time, portable equipment usually is not sensitive to lead in paints at levels of 600 ppm. Negative findings using portable x-ray fluorescence equipment must generally be confirmed by laboratory analysis; however, it is permissible to accept positive results obtained with this equipment.

Laboratories that analyze lead swipe or bulk samples must be accredited by the American Industrial Hygiene Association or another organization accredited by the EPA specifically to perform lead analysis.

Work Performed by Plant Engineering Personnel. Preconstruction testing is conducted by Plant Engineering personnel who must (1) complete the State Accreditation Program for Lead Inspectors or be certified by the American Board of Industrial Hygiene in Comprehensive Practice of Industrial Hygiene, or (2) work under the direct supervision of a Certified Industrial Hygienist or an accredited inspector.

Work Performed by Subcontractors. Plant Engineering personnel shall either (1) test all potentially lead-containing surfaces before releasing a construction proposal for work that may disrupt lead, or (2) require the contractor to perform the sampling before disrupting any potential lead-containing materials. Contractors who make lead determinations must be accredited by the State of California as

lead building inspectors or lead technicians or the work must be conducted *directly* by a Certified Industrial Hygienist.

Work Performed by Other LLNL Organizations. Programs shall ensure that testing is performed by or under the supervision of the ES&H team.

Personal Air Sampling. Personal air samples are collected to characterize an individual's (or group's) exposure to lead. Initial and periodic sampling may be required, depending on the nature of the work and the exposure level. Every construction-related procedure (other than minuscule lead work) that will disturb lead should have personal sampling until an NEA is established.

Following is the general procedure for personal air sampling:

- Supervisors shall notify the cognizant industrial hygienist at least 48 hours in advance of planned lead operations so that air sampling can be arranged.
- The cognizant industrial hygienist or a health and safety technician working under the guidance of an industrial hygienist shall then do the following:
  - Collect the initial air samples for uncharacterized operations that may generate airborne lead and submit them to the Hazards Control laboratory (or other laboratory) for analysis.

    If the results of these representative samples are below the action level, no further sampling is required if the operation continues unchanged. A change in equipment, process, personnel, or task must be evaluated by the cognizant industrial hygienist to determine if further sampling is required. If the results are above the action level but below the PEL, air sampling must be repeated at least every 6 months. For results greater than the PEL, air sampling must be repeated every 3 months. In addition, a written compliance plan (e.g., Lead Work Permit or an OSP) detailing the steps to be taken to reduce airborne lead levels must be developed and implemented.
  - Inform the supervisors of affected employees in writing within 5 work days if exposure exceeds the PEL. Supervisors are then responsible for notifying each affected employee. Exposure results are reported without any consideration of respiratory protection worn during the operation. Provide these supervisors a with description of the corrective actions to be taken to reduce exposure, and the Health Services Department with a copy of the notification.

The results of air sampling conducted to measure exposure during operations at the Laboratory may be used to represent the level of exposure for other similar operations. The decision to accept these results, however, is at the discretion of the cognizant industrial hygienist.

Surface Contamination Sampling. The floors and other surfaces in construction work areas where lead is disturbed should be tested for residual lead

contamination before LLNL employees can re-occupy those areas. Specifically, this requirement applies when the work involves any of the activities listed in the section entitled "Lead Work Permits" (in Section 3.2.3) for which there is no NEA, when the work is lead hazard abatement or involves exposure above the action level, and when the work area is inside and will subsequently be re-occupied on a regular basis.

These samples are obtained by making two S-shaped swipes with a prewetted wipe at a 90° angle over a 1-ft^2 area and submitting the swipes to the Hazards Control laboratory for analysis. Details on this sampling method can be found in Section 10 (Requirements/Regulatory Summary) of the HUD Guidelines.[1]

Clearance swipe samples for work performed by subcontractors shall be obtained and analyzed by the subcontractor in accordance with the HUD Guidelines.[1] However, LLNL reserves the right to request changes in the sampling and analysis procedure or to obtain parallel clearance samples.

The analytical laboratory the subcontractor uses must be accredited by the American Industrial Hygiene Association or another organization accredited by the EPA specifically to perform lead analyses.

Medical Surveillance and Removal

Applicability. The biological monitoring, medical surveillance, and removal provisions in this supplement are applicable to all LLNL employees, supplemental labor employees, and subcontractors who are exposed above the limits specified in this supplement.

The LLNL Health Services Department performs medical surveillance for LLNL employees only, and the employers of non-LLNL employees provide medical surveillance to their employees.

The requirements below, including the general requirements detailed in Appendix B, apply to biological monitoring and medical surveillance.

1. For every employee who is (or may be) reasonably expected to be exposed to lead above the action level for one or more days, or who performs tasks that require a Lead Work Permit or lead OSP, the supervisor will provide Health Services the number of days of exposure.

2. 29 CFR 1926.62 expresses the blood lead concentration in terms of micrograms of lead per deciliter (µg/dl) of blood, whereas 29 CFR 1910.1025 uses the roughly equivalent unit of micrograms of lead per 100 grams (µg/100 g) of whole blood. For the sake of consistency, this supplement uses micrograms of lead per deciliter of whole blood.

3. Biological monitoring includes the measurement of blood levels of zinc protoporphyrin (ZPP). The interpretation of ZPP results is within the discretion of the examining clinician.

4. Where required, a comprehensive physical exam must comply with the requirements of 29 CFR 1926.62(j)(3)(ii)(A-F).

5. Employees who are under work restriction because of an elevated blood lead level may request a second examination. Generally, the employees' Program or Department will cover the expenses of this examination, provided that these employees notify Health Services and their supervisors within 15 days of making an appointment with a physician of their choice. Any differences between the findings of two examining physicians shall be resolved in accordance with 29 CFR 1926.62. Additional requirements relating to the temporary removal of employees from lead work areas can be found in 29 CFR 1926.62.

6. Pregnant women, and women and men who are actively trying to conceive a child are urged to contact Health Services for a medical review. If the employee has been exposed to lead above the action level, Health Services will follow the rules in Table B-1 and Fig. B-1 of Appendix B. If the employee has not been exposed to lead above the action level, Health Services will provide appropriate counseling and take the necessary action based upon the individual circumstances of the case.

All LLNL construction subcontracts, including labor only, supplemental labor, and job-specific contracts, must have a provision excluding the use of prophylactic chelation therapy at any time where there is a possibility that employees may be exposed to lead above the action level.

3.2.3 Exposure Controls

Three types of controls are used to mitigate exposure to lead: engineering controls, administrative controls, and personal protective equipment. Of these, engineering controls are the most preferred method. Both engineering and administrative controls shall be used to reduce employee exposure to or below the PEL, or as close to the PEL as is feasible.

Engineering Controls. Lead work that is known to result in exposure above the PEL, or activities such as those that require a Lead Work Permit or safety procedure (see the section entitled "Administrative Controls"), will typically require the following engineering and administrative controls:

- Use of HEPA-filtered exhaust systems at the source of aerosol generation or, if this is not feasible, within the general work area.
- Establishment of a regulated area that will keep unprotected employees out and prevent the spread of lead dust beyond the boundaries of the area. For work inside buildings, this will involve erection of critical barriers over ventilation system vents, doors, open areas, and other penetrations. Further, it may be necessary to arrange the ventilation system to place the work area under negative pressure relative to the

surrounding areas. The cognizant industrial hygienist shall specify the necessary controls.

- Use of exhausted power tools with HEPA filters.
- Use of wet methods.

Administrative Controls

Lead Work Permits. Permits are used for short-term operations and must be developed for any operation that may result in exposure above the PEL, unless the operation is described in a current safety procedure or a current NEA. Permits must specify the manner in which the work will be altered to reduce exposure level to the PEL using both engineering and administrative controls.

A Lead Work Permit (Appendix C) is required for the following activities where lead-containing paint or other lead sources can be disturbed:

- Demolishing buildings; scraping and sanding paint; using a heat gun; spray-painting; cleaning power tools with a HEPA-filtered dust-collection system; or other similar processes where the material contains more than 0.06% lead. (Exposure of 10 times the PEL for these operations shall be assumed unless data indicate otherwise.)
- Using leaded mortar; lead burning; rivet busting; cleaning power tools without a HEPA-filtered, dust-collection system; using dry expendable abrasives for clean-up activities; and moving or removing abrasive blasting enclosure where the material contains 0.06% lead. (Exposure of 25 times the PEL shall be assumed for these operations unless data indicate otherwise.)
- Performing activities where leaded paints, leaded coatings or lead-containing alloys are disturbed by abrasive blasting, welding, cutting and torch burning where the material contains *any* lead. (Exposure of 50 times the PEL shall be assumed for these operations unless other data indicate otherwise.)
- Performing other operations that may result in exposure above the PEL.
- Performing lead abatement work.

Until an NEA is developed for each of these tasks, employees shall be provided with suitable respiratory protection, protective clothing, change areas, hand-washing facilities, biological monitoring, and training.

No Lead Work Permit is required for minuscule work involving potentially lead-coated surfaces as long as the work is conducted by employees who have had lead awareness training (see Section 3.4) and the procedures specified in that training are used. Minuscule work is defined as

- the disturbance of paint containing less than 0.06% lead, except processes or activities that heat the material to near the boiling point of lead;

- the drilling of no more than 12 holes per room (or area) that are less than 1/2 in. in diameter;
- the removal of no more than 12 screws per room (or area);
- the installation of no more than 12 screws per room (or area) smaller than 1/2 in. in diameter; and
- the installation of no more than 12 nails (per room or area), up to 2 in.

It should be noted that exemptions for minuscule lead work are based on best industrial hygiene judgment, and that there may be unusual circumstances under which this type of work may result in hazardous levels of airborne lead.

Safety Procedures. Activities involving more than 40-person hours should be described in a safety procedure, rather than on a Lead Work Permit, unless the cognizant industrial hygienist determines that a Lead Work Permit would be adequate and waives the safety procedure requirement. Operations adequately covered in a safety procedure are not required to be described in a Lead Work Permit. The cognizant industrial hygienist shall determine if the work is adequately addressed in a safety procedure or if a supplemental Lead Work Permit is required.

Subcontract Work. Lead work conducted by subcontractors (other than supplemental labor) requires prior submission of either an NEA pursuant to 29 CFR 1926.62(d)(3) that is satisfactory to the cognizant industrial hygienist or a Lead Compliance Program that incorporates all the elements specified in 29 CFR 1926.62(e). Contractors also are required to perform lead-disrupting work in accordance with Plant Engineering specifications and the guidance given in this supplement. Use of a Lead Work Permit will not meet this requirement. The Lead Compliance Program or an NEA shall be submitted to the cognizant industrial hygienist for approval before beginning work that disturbs lead.

Personal Hygienic Practices. The precautions below apply to areas where lead and lead compounds are used; they do not apply to minuscule lead work or work addressed in an NEA.

- Designate separate lunch rooms, food storage and preparation areas, and eating areas to avoid the possibility of ingesting lead. *No lead work shall be performed in these designated areas.*
- Wash your hands and face before eating, drinking, using tobacco products, or applying cosmetics.
- Designate change rooms where employees can segregate street clothes from clothing used for lead work operations that generate airborne lead levels exceeding the PEL.
- Have shower facilities in the area if the airborne levels are greater than the PEL and for operations in the section entitled "Lead Work Permits" for which there is no NEA. Showers located throughout the Laboratory may be used for these purposes, provided that other employees do not use the

showers while they are potentially contaminated with lead dust. Showers used for lead work must be decontaminated before they can be used by other Laboratory employees. Portable shower units may be used for required decontamination activities.

- Make sure that surfaces are free of any accumulation of lead dust. Use HEPA-filtered vacuum cleaners to remove dust and debris. Dry shoveling and sweeping are prohibited.
- Promptly place lead-coated or lead-containing demolition or renovation debris (e.g., sheet rock) in plastic bags or other sealable containers. Do not allow them to accumulate in the workspace.

Signs. Signs with the wording below shall be posted at all possible entrances to areas where lead work (other than minuscule lead work) is being conducted and for which there is no NEA. These signs shall be well illuminated so that they are easily visible to employees and visitors. Contact your ES&H team for guidance if you have any questions about signs.

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

Personal Protective Equipment. Personal protective equipment includes disposable coveralls, gloves, head covers, work shoes with disposable covers, respirators, and other necessary equipment. Such equipment is required for operations that generate airborne lead levels above the PEL (50 $\mu g/m^3$) or for activities for which there is no NEA and a Lead Work Permit or safety procedure is required.

Employees may be issued reusable work coveralls in lieu of disposable coveralls. These coveralls shall not be worn home as an alternative to disposable coveralls. Coveralls shall be laundered by LLNL (or the subcontractor for subcontracted work) and provided to employees at least weekly, or daily, if exposure levels exceed 200 $\mu g/m^3$. Reusable clothing must comply with the requirements in 29 CFR 1926.62(g)(2).

Respirators shall be selected by a Hazards Control industrial hygienist in conformance with LLNL and OSHA requirements. Fit-testing for respirators must be conducted within 6 months prior to lead work. If requested by the employee, a powered air-purifying respirator must be provided in lieu of a negative pressure respirator.

3.2.4 Application and Installation of Lead-Containing Products

With the exception of the use of leaded solder in electrical work, materials containing more than 0.06% lead shall not be used, specified, or allowed in the

construction of buildings or infrastructure. In addition, paint shall not contain more than 0.06% lead, and solder used in potable water distribution systems must not contain lead. An exception to this requirement is allowed where the user (or specifier) can demonstrate that no adequate non-leaded replacement product is available. The use of leaded construction materials in such cases requires prior approval of the cognizant industrial hygienist and building or facility manager.

3.2.5 Lead Paint Abatement

Lead abatement refers to construction activities undertaken specifically to remediate an imminent or potential hazard to humans or the environment from lead paint. This may include the removal, enclosure, or encapsulation of paint.

All lead abatement work involving less than 40-person hours that is performed by LLNL personnel or supplemental labor only employees must be described in a Lead Work Permit. An OSP may be required by the cognizant Industrial Hygienist for lead abatement work involving more than 40-person hours.

All subcontracted lead abatement work must be conducted by a contractor licensed by the California Department of Health Services and in accordance with the HUD "Guidelines for the evaluation and control of lead based paint hazards in housing."[1]

All indoor lead abatement areas will be subjected to a final visual inspection and final surface sampling in accordance with the HUD Guidelines.[1]

3.3 Responsibilities

3.3.1 Hazards Control Department

The Hazards Control Department shall perform required air monitoring and notify supervisors of air sample results. In addition, the Department shall

- where possible, establish NEAs for consistent types of lead work;
- notify supervisors of the need for medical surveillance when sampling so indicates;
- assist in the design and implementation of engineering control systems;
- provide the necessary training, other than accredited training;
- provide exposure information to the Health Services Department;
- review lead work plans, OSPs, and Lead Work Permits to ensure they incorporate adequate controls;
- approve the type of respirator and other personal protective equipment used by employees involved in lead work;
- review applications for waivers to prohibit the use of leaded construction products;

- obtain samples to detect lead where work is conducted by Programmatic personnel;
- assist supervisors in identifying potential lead-disturbing activities; and
- perform surface swipe-testing as required.

3.3.2 Health Services Department

The Health Services Department shall

- perform required medical surveillance exams and blood tests;
- determine when employees must be removed from exposure because of abnormalities detected during medical surveillance and when they can return to doing that type of work;
- notify employees of any medical findings, as required;
- request the Hazards Control Department to perform a worksite evaluation for any employee found to have possible health effects because of occupational lead exposure; and
- determine if measured elevations in blood lead are occupational.

3.3.3 Plant Engineering

Plant Engineering shall ensure that personnel who disturb or use leaded products receive the required training. In addition, Plant Engineering shall

- test surfaces and material to determine if lead is present before beginning construction work that will disturb materials that may contain lead (e.g., paint, galvanized metal, caulking, flashing) or potentially result in airborne lead exposure;
- where required, develop Lead Work Permits or OSPs and have them reviewed and approved by the cognizant industrial hygienist;
- obtain the necessary equipment to conduct work on leaded materials;
- ensure that persons working on leaded products receive the required medical examinations and biological sampling;
- prohibit its personnel, supplemental labor personnel, and construction contractors from using construction products containing more than 0.06% lead (this does not apply to electrical solder);
- specify in construction contracts if and where lead will be disturbed; alternatively require that subcontractors determine the presence of lead before disturbing materials that may contain lead; and
- develop and maintain a "Bidding Specification" that implements the LLNL Lead Safety Program in construction, renovation, and demolition contracts where lead material may be encountered.

3.3.4 Procurement Department

The Procurement Department shall ensure that a clause requiring the use of protective measures, other than chelation therapy, is inserted into all procurement service contracts that may involve exposure to lead.

3.3.5 Supervisors

Supervisors shall identify all employees who may be potentially exposed to lead and request that the ES&H team performs an evaluation. They shall also

- schedule employees who are exposed above the action limit specified in this supplement for medical examinations;
- where required, ensure that surfaces or materials are tested for lead before beginning construction work;
- where required, initiate a Lead Work Permit or OSP and have the cognizant industrial hygienist review it;
- ensure that all available and specified engineering and administrative controls and personal protective equipment are used appropriately;
- ensure that persons potentially exposed to lead receive appropriate training; and
- provide an alternative workplace and job for those who are removed from work involving lead exposure by the Health Services Department.

3.3.6 Employees

All employees shall follow the requirements outlined in this supplement for work involving lead and appropriately use the equipment provided by their supervisors. In addition, any employee who is pregnant or actively trying to conceive a child shall notify the Health Services Department.

3.4 Training

3.4.1 OSHA-Required Training

Two OSHA regulations require training for personnel potentially exposed to lead: 29 CFR 1926.59, "Construction Industry Hazard Communication Standard," and 29 CFR 1926.62, "Construction Lead Standard." These regulations specify two levels of training.

Level 1: Lead awareness training shall be provided to all employees who perform construction work that generates lead aerosols at levels below the action level or to employees who perform the activities listed in the section entitled "Lead Work Permits" for which the exposure level has not been determined. This includes plumbers and electricians who use leaded solders and carpenters who disturb small amounts of lead paint. This training meets the requirements of 29 CFR 1926.59. Contact the cognizant ES&H team to arrange for training, as necessary.

Level 2: Lead worker training is required annually for employees who are exposed to lead at levels exceeding the action limit specified in this supplement and for those who are subject to exposure to lead compounds that cause skin irritation. The requirements for this training can be found in 29 CFR 1926.62(l).

Lead worker training is best obtained at an accredited provider. The State of California has an accreditation program that consists of specific training for lead workers and their supervisors. Accredited training is not mandatory for work conducted at LLNL but may be required in the future. (Future regulations established by the EPA or the State of California may require this training.) Alternatively, a custom class can be designed by the Hazards Control Department for lead workers.

3.4.2 Inspector Training

The State of California offers a course for lead inspectors. Employees who conduct surveys to determine the lead content in materials should complete this course, unless they are a Certified Industrial Hygienist or work directly under the supervision of a Certified Industrial Hygienist or trained inspector. Subcontractors that perform lead surveys must meet either the training or certification requirement.

Section IV. References

1. Department of Housing and Urban Development, *Guidelines for the evaluation and control of lead-based paint hazards in housing*, HUD (February 1995).
2. American Conference of Governmental Industrial Hygienists, *The Biological Exposure Index for Lead*, ACGIH, Cincinnati, OH (1995).

Appendix A

Terms and Definitions

action level	The Medical Surveillance Action Level is 30 $\mu g/m^3$. This is the level of airborne lead to which an employee is exposed that may trigger the need for testing of the blood for lead levels. Exposure above this level on a single day in a year will trigger blood testing for construction work; exposure must exceed this level for more than 30 days per year during general industry work to trigger blood testing.
certified industrial hygienist	An industrial hygienist certified by the American Board of Industrial Hygiene in the Comprehensive Practice of Industrial Hygiene.
construction industry work	All work involving lead other than general industry work or chemical laboratory research. This includes all building and building-related equipment maintenance and repair activities, demolition, remodeling, or new construction.
general industry work	All work involving lead other than construction activities or chemical laboratory research. This includes work such as moving lead shielding bricks; using lead solder in electronics assembly shops; and machining leaded alloys in machine shops.
lead alloys	Metals made up of a mixture of metallic elements. For example, brass consists mostly of copper, but it usually contains 2–10% of lead as well.
lead compounds	Chemical compounds that include lead. These may be inorganic (e.g., lead oxide) or organic (e.g., tetramethyllead).
lead-containing material	Any material with any lead content. Certain limited exemptions apply for materials containing less than 0.06% lead.

lead soap	A lead salt of a long chain, naturally occurring carboxylic acid.
lead work area	Any area where lead-containing materials are disturbed such that exposure to airborne lead above 30 $\mu g/m^3$ may occur. Also, any area where a lead-disturbing activity occurs, other than minuscule lead work, for which there is no NEA.
minuscule lead work	Work involving lead that is not likely to result in exposure approaching the action level or permissible exposure limit. This includes handling fewer than 25 lead bricks (general industry) and drilling up to 12 holes less than 1/2 in. into lead-painted surfaces (construction work).

Appendix B

Medical Surveillance Requirements

Table B-1 and Fig. B-1 in this appendix list requirements and procedures for biological monitoring and medical surveillance.

Table B-1. Biological monitoring and medical surveillance requirements.

Blood lead level (g/dl)	Frequency of retest	Physical exam	Administrative action
Less than 30	Perform the test every 6 months as long as the employee continues to work with lead and is exposed 30 days or more per year. If the exposure is less than 30 days per year, retest every year.	Repeat exam is not required. (Refer to Fig. B-1 to determine whether an initial exam is required.)	None
30–39.9	Repeat the test within 60 days, then every 6 months.	Do a comprehensive physical if none has been done within the last 12 months and if the clinician determines that the elevated blood lead level is work related.	1. Interview the employee to determine if there is a non-occupational exposure. 2. Notify Hazards Control and request a worksite evaluation.
40–49.9	Test every 2 months until two consecutive tests show that the level is less than 40 g/dl.	Do a comprehensive physical if none has been done within the last 12 months.	1. Notify the employee in writing within 5 days about test results and the possible consequences. 2. Notify Hazards Control and request a worksite evaluation.
Greater than or equal to 50	Repeat the test in 2 weeks, then perform the test every month until 2 consecutive tests show that the level is less than 40 g/dl.	Do a comprehensive physical if none has been done within the last 12 months.	1. Remove the employee from work. 2. Notify the employee in writing within 5 days about test results. 3. Notify Hazards Control and request a worksite evaluation. 4. Do not have the employee return to work until two consecutive tests indicate that the level is less than 40 g/dl.

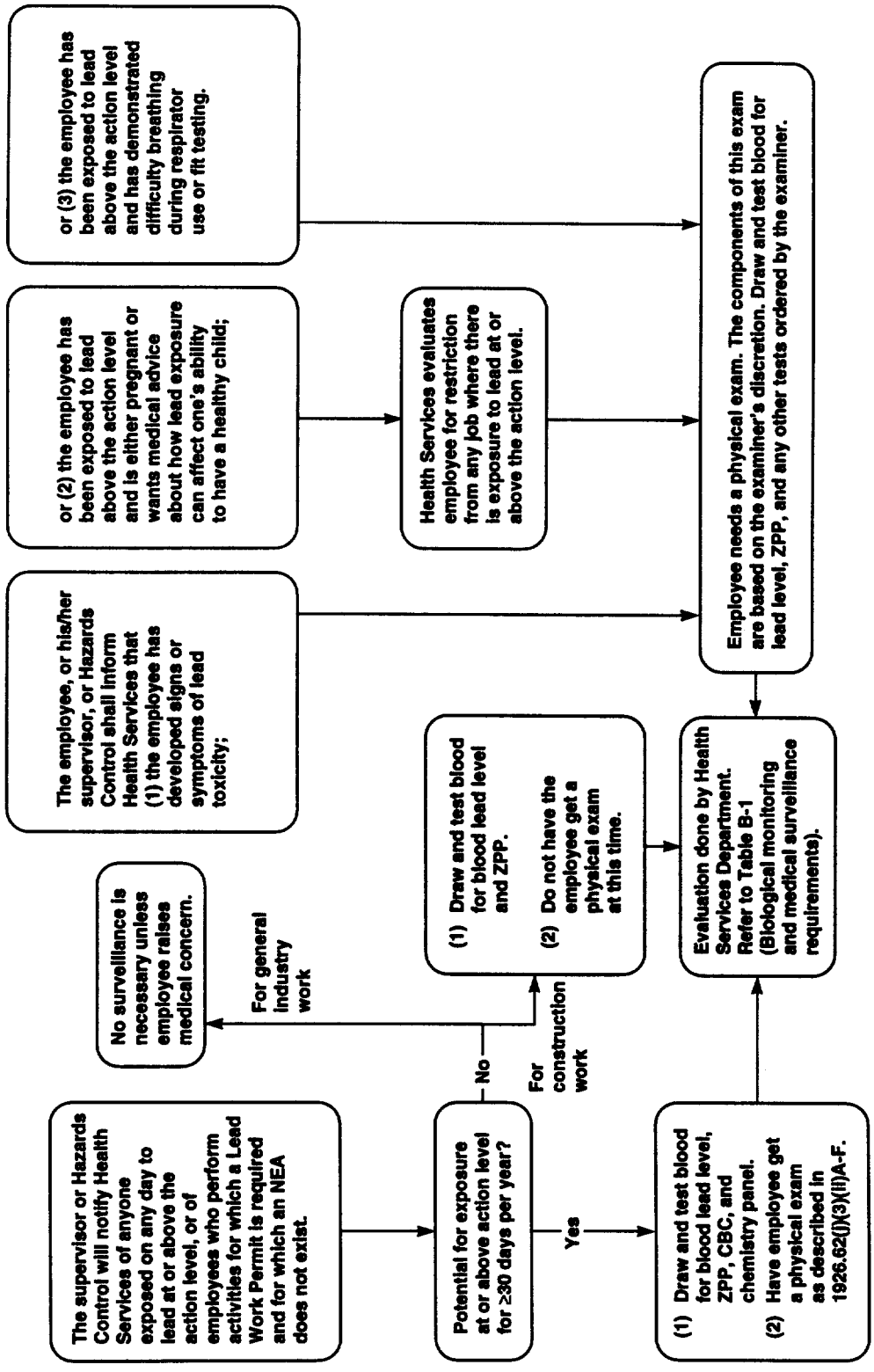


Figure B-1. Medical surveillance process.

Appendix C

Example of Lead Work Permit

GENERAL INFORMATION

Building _____ Room/Area _____ Subarea _____

Leaded material _____ Concentration _____ Condition _____

Area to be reoccupied _____ Clearance sample by _____

General work description _____

Lead/aerosol-generating operations _____

Expected duration _____ Dates _____

ENGINEERING CONTROLS

Local exhaust	_____	General ventilation	_____
Wetting	_____	HEPA vacuum	_____
Enclosure	_____	Drop sheets	_____
Critical barriers	_____	Glove bag	_____

OTHER ENGINEERING CONTROLS _____

OTHER TECHNOLOGY CONSIDERED _____

PERSONAL PROTECTIVE EQUIPMENT

Respirator (design) _____

Coveralls	_____	Shoe covers	_____
Gloves	_____	Safety shoes	_____
Safety glasses	_____	Hard hats	_____

OTHER _____

LEAD WORK PROCEDURES _____

_____

_____

HYGIENIC CONTROLS

Change area _____ Shower facility _____ Hand-wash facility _____

WORKER TRAINING

Name	ID No.	Training	Notes	Expiration

Supervisor's signature _____ Date _____

Industrial hygienist _____ Date _____

This Lead Work Permit is only good for the work described. Any change in scope, procedures, or personnel requires re-approval of the permit. If necessary, attach the names of additional workers on a separate piece of paper (see Supplement 21.20 of the *Health & Safety Manual* for further details). Keep a copy of the permit at the job site. The industrial hygienist and the building manager should also keep a copy.

Fire Prevention

Health&Safety Manual

Supplement 25

Fire

May 1995

Approved by the ES&H Working Group

_____ Date _____

Robert Kuckuck
Deputy Director for Operations

Fire

Contents

* Revised

Fire

25.1 Introduction

The most common hazard that surrounds us, whether at work or at home, is the presence of combustible materials that can be ignited, leading to a fire. However, if proper control methods are applied, the risk of injury, illness, and property damage can be reduced to an acceptable level. To minimize the risk from fire, LLNL will do the following:

- Design facilities using fire-resistant materials or those of limited combustibility.
- When applicable, use building materials and components that have been tested and approved by a nationally recognized testing laboratory.
- Provide and maintain adequate corridors, exits, and fire barriers (including door assemblies, dampers, and windows).
- Install fire detection and suppression systems that can quickly react to the presence of fire.
- Control the presence and use of ignition sources and combustibles within each facility.
- Conduct routine fire inspections to identify fire hazards and areas that are not sufficiently protected.
- Conduct periodic inspections, tests, and maintenance of fire and life safety equipment and systems to ensure that they operate properly.

25.2 Overview of Regulations and LLNL Policies

The requirements and guidance provided in this chapter comply with (1) the National Fire Protection Association (NFPA) codes and standards, (2) Code of Federal Regulations, Title 29, Part 1910, Subparts E and L, and (3) DOE Order 5480.7A (Fire Protection). A detailed list of these codes and additional guidance on LLNL-prescribed environmental, safety, and health (ES&H) standards applicable to fire safety can be found in the *Fire Protection Program Manual* (UCRL-MA 116646) and LLNL Fire Protection Engineering Standard #1.2 (LLNL Fire Protection Program Criteria). Both of these documents are available from the Fire Protection Engineering Technical Leader (ext. 2-5148). For guidance, construction criteria, and safety inspections, contact your area ES&H team.

25.3 Applicability

The requirements and guidance in this supplement apply to all LLNL work processes including those performed by subcontractors, guests, visitors, and construction or labor contractors.

25.4 Process for Compliance and Risk Reduction

25.4.1 Classes of Combustibles

In general, there are three classes of combustible material:

1. Ordinary solids: wood, paper, rags, and plastics.
2. Fluids: liquids and gaseous fuels. These are further divided into the following classifications:
   - *Class IA liquids* have flash points below 73°F (22.8°C) and boiling points below 100°F (37.8°C).
   - *Class IB liquids* have flash points below 73°F (22.8°C) and boiling points at or above 100°F (37.8°C).
   - *Class IC liquids* have flash points at or above 73°F (22.8°C) and below 100°F (37.8°C).
   - *Class II liquids* have flash points at or above 100°F (37.8°C) and below 140°F (60°C).
   - *Class III liquids* have flash points at or above 140°F (60°C).
3. Other: oxidizing chemicals, fast-reacting or explosive materials, and combustible metals. Undesirable reactions from these materials can be surprisingly fast and can easily cause secondary fires.

This chapter does not contain guidance on flammable gases. For information and guidance on flammable gases, refer to Chapter 21 of this Manual or contact your area ES&H team.

25.4.2 Safe Handling of Ordinary Solid Combustibles

To minimize the risk of fires involving ordinary solids, follow these precautions:

- Avoid excessive accumulations of waste.
- Keep the work area orderly to minimize fuel paths that facilitate the spread of fire.
- Keep combustibles away from ignition sources (e.g., hot plates, soldering irons, and other heat- or spark-producing devices).
- Use an ash tray when smoking cigarettes. Ensure that the contents of ash trays are extinguished and cold to the touch before emptying into a waste receptacle. LLNL policy does not allow smoking inside buildings.

- Obtain a permit from the Emergency Management Division (Fire Department) of the Hazards Control Department for hot-work operations (see Section 25.4.6).
- Plan work to minimize the storage of excess combustibles in operating areas.
- Keep soiled rags in an approved container with an automatically self-closing lid (Central Supply Stock No. 7960-30353). Consult the environmental analyst for your area ES&H team regarding any additional environmental requirements for rags containing solvents or other hazardous materials.
- Frequently inspect and check the area to ensure that these precautions are followed.

25.4.3 Safe Handling of Liquid Combustibles

To minimize the risk of fire involving liquid combustibles, follow these precautions:

- Obtain a material safety data sheet (MSDS) from the supplier for any combustible or flammable liquid, or contact your ES&H team to obtain an MSDS.
- Store flammable and combustible liquids that are to be dispensed in safety cans. (See Table 25-1 for exceptions and maximum sizes of containers.)
- Store flammable and combustible liquid waste in approved containers when they are kept inside buildings. Specially designed safety cans for flammable liquid wastes are available (see Table 25-1). Label the container "For Flammable Liquid Waste Only." If necessary, contact the environmental analyst or hazardous waste management technician for additional labeling requirements. Never put corrosive materials in a flammable liquid waste container; to do so could result in a fire or explosion. Waste may be transferred to drums or other larger shipping containers that meet the Department of Transportation (DOT) requirements for storing such materials outside buildings.
- Use properly labeled containers.
- When using such liquids, ventilate the area to prevent buildup of ignitable vapor/air mixtures or inhalation of toxic vapors or gases.
- Carefully avoid ignition sources (e.g., hot material, flames, and sparking equipment) in the general vicinity of these liquids.
- Electrically interconnect (i.e., bond) equipment likely to produce a static spark.
- Limit the quantity of these materials in operating areas.

Table 25-1. Maximum size of containers for combustible and flammable liquids.[a]

	Flammable liquids			Combustible liquids	
Container type[b]	Class IA	Class IB	Class IC	Class II	Class III
Glass	1 pt	1 qt	1 gal	1 gal	5 gal
Metals (other than DOT drums) or approved plastic	1 gal	5 gal	5 gal	5 gal	5 gal
Safety cans	2 gal	5 gal	5 gal	5 gal	5 gal
Metal drums (DOT specifications)	60 gal	60 gal	60 gal	60 gal	60 gal
Approved portable tanks	660 gal	660 gal	660 gal	660 gal	660 gal

[a] See Section 25.4.1 of this chapter for definitions of liquid classes.

[b] Container exemptions: medicines, beverages, foodstuffs, cosmetics, and other common consumer items when packaged according to commonly accepted practices.

The volatility and hazards of liquids are increased by heating. Thus, additional requirements may be necessary where flammable and combustible liquids are exposed to storage conditions, use conditions, or process operations where they are naturally or artificially heated to or above their flash points. These requirements include consideration for items such as ventilation, exposure to ignition sources, and electrical area classifications. Consult your ES&H team for further assistance.

Storage Cabinets

Flammable and combustible liquids, including wastes, in quantities greater than a one-day supply (maximum of 25 gal in safety cans, 10 gal in containers other than safety cans) must be stored in approved flammable liquid storage cabinets. Flammable and combustible liquids removed from flammable liquid storage cabinets should be returned to the cabinet when they are not in use. These cabinets (Stock Nos. 7195-70992 and 7195-63051) are available from Central Supply and must meet the following requirements:

- Cabinets must be placed where they will not obstruct egress.
- Cabinets must be properly tied down to meet seismic requirements.
- If ventilation is required, cabinets must be vented outdoors in such a manner that they will not compromise their fire resistance. Consult your ES&H team industrial hygienist for ventilation requirements.

Safety Cans

Safety cans are available from Central Supply (group-class 7960). These containers are constructed of stainless steel, monel, or tin and come equipped with a flame arrestor and spring-loaded cap on both the filling and pouring spouts. The double-perforated metal surface of the flame-arrestor screen prevents flames from entering the container. Safety cans are available for both dispensing products and collecting waste. These cans have been tested

and listed by a nationally recognized testing laboratory and shall not be modified.

Drums and Drum-Storage Areas

Follow the requirements below for drums and drum-storage areas:

- Store drums in the vertical position.
- Keep drum bungs closed when liquids are not being transferred into or out of drums.
- Shield drums from the sun.
- When transferring flammable liquids into drums, use an approved funnel with an installed flash arrestor (available from Central Supply, group-class 8110).
- Allow a minimum distance of 25 ft between a drum storage area and a building. There is no minimum distance requirement when the drum storage area faces a blank masonry wall. For further guidance, contact your area ES&H team.
- Post a "No Smoking" sign in the area. (This sign is available from the health and safety technician for your area ES&H team.)
- Keep an emergency spill kit near the drum storage area. The kit consists of a garbage can, dust pan, whisk broom, and absorbing compound. The absorbing compound is available from Central Supply (Stock No. 7930-67325).
- Install a 20-lb, dry-chemical fire extinguisher no less than 10 ft or more than 50 ft from the storage area. Contact either the Fire Department (ext. 2-7595) or the ES&H team Fire Protection Engineer for assistance in acquiring fire extinguishers.
- Contact the environmental analyst for your area ES&H team regarding environmental requirements for drum storage.

Transportation

Contact Transportation (ext. 2-7489) for onsite transport of drums containing hazardous materials. For drums containing hazardous waste, contact the hazardous waste technician for your area ES&H team.

25.4.4 Safe Handling of Other Combustibles

Many other combustible materials (oxidizing chemicals, fast-reacting or explosive materials, and combustible metals) present special fire safety and extinguishing problems. The hazards and safe handling of many of these materials are covered in Chapter 21 and various supplements of this Manual. Consult your area ES&H team for specific safety procedures and guidance.

25.4.5 Refrigerator Storage

Commercially available, domestic refrigerators contain built-in ignition sources and shall not be used to store flammable liquids or explosive chemicals. Light bulbs, switches, temperature controls, standard plugs, motor-starting relays, thermal-overload devices, and heater strips (for frost control) are all ignition sources.

Anyone who needs a refrigerator to store flammable liquids or explosives should contact the area ES&H team about available refrigerators specifically designed and approved for such use. Refrigerators and freezers that have either been specifically designed or modified to store flammable and/or combustible liquids safely shall be labeled as such. Labels are available from your area ES&H team.

25.4.6 Permits for Welding, Burning, or Other Hazardous Operations

As part of the LLNL program to control fire hazards, welding, soldering, and other hot-work operations with a high fire potential require permits. To obtain permits and additional information, call the Emergency Dispatch Center (ext. 2-7595) at the Livermore site or the Fire Department (ext. 3-5201) at Site 300.

Operations requiring permits include the following:

- Cutting and welding (arc, oxyacetylene, and heliarc) outside an approved location.
- Soldering when using a torch outside an approved location.
- Roofing or road work using tar pots.
- Using open fires for any purpose.
- Spray-painting when using flammable paints outside an approved spray booth.
- Barbecuing.
- Leaving portable electric appliances unattended (see Section 25.4.7).
- Altering, maintaining, or modifying any system that contains or may contain explosives or flammable liquids or gases when using heat-producing, spark-producing, or impact tools (e.g., electric power tools and cartridge-actuated tools)

Permits must be posted in the work area until the work is completed. Approved locations for hot work are areas that have either been designed specifically for that purpose or areas that have been modified to accommodate these operations safely. These areas must be reviewed by the Hazards Control Department to ensure that the necessary safeguards (e.g., adequate ventilation, noncombustible construction, and proper gas distribution systems) have been installed. For further guidance, contact your area ES&H team.

25.4.7 Portable Electric Appliances

Portable appliances should be obtained from Central Supply because Laboratory specifications ensure that these items meet Underwriters Laboratories (UL) requirements and are safe to use under approved circumstances. When installing or operating portable electric appliances, always follow these precautions:

- Place noncombustible material under the appliance.
- Maintain a clearance of at least 12 in. between the appliance and any combustible material.
- Ensure that the appliance is properly grounded or double-insulated.
- Use only those appliances that have been listed or labeled by a nationally recognized testing agency (e.g., UL or Factory Mutual Research Corp.).
- Use a timer to control unattended equipment that operate during off-hours. These timers will automatically de-energize the appliance during off-hours and energize it no more than 30 min before personnel arrive in the area.
- Keep the area immediately around an appliance clean and free of combustibles.
- Do not use electric appliances near combustible or explosive vapors or dust.

25.4.8 Fire Protection Equipment

Fire-protection equipment in operating areas consists of both fixed and portable items to detect fires, alert personnel, and suppress and minimize the spread of fire. Fixed equipment includes detectors, alarms, fire doors, fire dampers, automatic sprinkler systems, and other automatic fire-suppression systems. Portable equipment consists of fire extinguishers, which are required and available in buildings, and any specialized equipment the fire-fighting team brings to the area.

Before installing any fire-protection equipment, consult your ES&H team. The team is responsible for ensuring that the equipment selected is appropriate, reliable, and compatible with other systems in use at LLNL.

Fire Detection and Alarm

Several types of fire-detection systems will detect fire and transmit an alarm to the emergency dispatcher for purposes of initiating emergency action. In high-hazard areas, fire detectors also alert the building occupants and, in some cases, activate an automatic extinguishing system.

Fixed Fire Suppression Systems

Fires can be suppressed using automatic sprinklers or flooding systems (carbon dioxide, Inergen, or Halon. NOTE: Because of their potential for

depleting atmospheric ozone, Halon systems will no longer be installed at LLNL.). Automatic sprinklers contain a heat-sensitive element in the sprinkler head that usually activates at 165°F (70°C), causing the sprinkler head to open and spray water over the fire. The action of the water flowing through the sprinkler line activates an alarm at the Emergency Dispatch Center.

Sprinkler heads can be damaged and their functions impaired through mechanical or thermal abuse or careless handling. To ensure that sprinkler systems operate properly, employees and supervisors shall observe the following guidance:

- Contact the Plant Engineering Pipe Shop (ext. 3-0467) to have protective cages installed over sprinkler heads wherever mechanical damage could be likely.
- Keep normal and maintenance-type heat sources (i.e., torches or soldering irons) away from sprinkler heads.
- Keep furniture, equipment, and other materials away from sprinkler heads so that they do not interfere with the water-spray pattern.
- Allow 18 in. of clearance below sprinkler heads. Materials located closer than 18 in. interfere with the sprinkler spray pattern.
- Provide at least 3 ft of clearance around sprinkler control valves to allow fire-safety personnel access to them.
- Do not paint sprinkler heads.
- Do not use sprinkler piping to support other objects such as hanging plants and wiring.
- Ask the ES&H team Fire Protection Engineer to review the sprinkler system when planning to modify a work space (permanent or temporary) and before installing large equipment items.

Gaseous fire-suppression systems, such as carbon dioxide, Inergen, or Halon, are used to control or extinguish fires in normally unoccupied spaces. These systems have unique properties and require specialized knowledge in their design and application. For information regarding the use of such systems, consult the ES&H team Fire Protection Engineer.

Fire Extinguishers

Fire extinguishers are manually operated, portable devices that will discharge an extinguishing agent when properly activated. They are designed as a method of controlling a fire during the time between discovery and arrival of the Fire Department. It is essential that personnel be familiar with the

location and type of extinguishers in their work area. Successful results depend on the following (in the order of preference):

1. Notification of the Fire Department immediately upon learning of a fire.
2. Knowledge and proper training in the use of fire extinguishers.
3. Choice of the proper extinguishing agent (see Table 25-2).
4. Proper size of extinguisher for the size of the fire.
5. Proper operation of the extinguisher before attacking the fire.

Fire extinguishers are required to be inspected monthly and serviced at least annually. The monthly inspection is a quick check intended to give reasonable assurance that the extinguisher is accessible, fully charged, and operable. The following shall be checked as a minimum:

- The extinguisher is located in the designated area.
- There are no obstructions to access or visibility.
- Operating instructions on the name plate are legible.
- Seals and tamper indicators are not broken or missing.
- The extinguisher is full (determine fullness by weighing or "hefting").
- There is no obvious physical damage, corrosion, leakage, or clogged nozzles.
- The pressure-gage reading or indicator is in the operable range or position.

Table 25-2. Effective extinguishants for burning materials.

Class of fire	Characteristics of burning materials	Extinguisher
Class A	Ordinary combustible materials such as cellulose products, wood, paper, cloth, plastics, or rubber	Water, multipurpose dry chemical (ABC), or Halon
Class B	Flammable and combustible liquids such as oils, gasoline, alcohol, and solvents (see SAFETY NOTE 1 below)	Carbon dioxide, Halon, or dry chemical (BC or ABC) (see SAFETY NOTE 1 below)
Class C	Electrical equipment and wire installation while electrical current is on (see SAFETY NOTE 2 below)	Carbon dioxide, Halon, or dry chemical (BC or ABC) (see SAFETY NOTE 2 below)
Class D	Burning magnesium, thorium, uranium, potassium, and sodium metals	G-1 power (special graphite) or Metl-X (sodium chloride)

SAFETY NOTE 1: Do not use water on a flammable or combustible liquid fire because it will spread and accelerate the fire. An explosion may result if water is used.

SAFETY NOTE 2: Do not use water on energized electrical equipment. Many electrical fires can be controlled by safely turning off the power for equipment such as personal computers and photocopiers.

The Emergency Management Division performs this monthly inspection using a checklist incorporating the items previously mentioned.

Annual maintenance is a thorough examination of fire extinguishers that is performed by a qualified fire extinguisher service technician assigned to the Emergency Management Division of the Hazards Control Department. It includes an examination and any necessary repair or replacement, and is intended to give maximum assurance that extinguishers will operate effectively and safely. As part of an effective self-assessment plan (see Supplement 2.04 of this Manual), facility management should verify that the inspections noted and service are performed. Contact the Fire Department (ext. 2-7595) or the ES&H team Fire Protection Engineer for assistance in acquiring fire extinguishers.

Employees are urged to enroll in a one-hour, fire-extinguisher training class (course HS1670; see the *LLNL Course Catalog*) conducted by the Emergency Management Division of the Hazards Control Department. *It is unsafe for personnel who have not taken this course to use a fire extinguisher to control a fire.* Personnel who have not been trained in the use of fire extinguishers must not attempt to use them.

Fire Barriers

Fire barriers such as fire doors and windows, fire dampers and fire walls are placed in strategic locations to block the spread of smoke and fire. The following requirements shall be observed:

- Fire doors must never be blocked or wedged open.
- Fire doors must be allowed to operate freely without obstructions.
- Fire doors and their frames contain labels from testing laboratories; these labels must never be removed or painted over.
- All penetrations made to walls and floors to accommodate piping, electrical conduit, wiring or ducts must be properly sealed with approved fire-stopping material.
- Ceiling tiles removed to accommodate maintenance or construction activities must be replaced at the completion of the job or whenever work on the project is significantly delayed (i.e., for two weeks or longer).

Fire Hydrants

Fire hydrants are primarily used by the Emergency Management Division in emergency situations. But certain temporary activities (e.g., connections by gardeners and construction subcontractors) may be authorized by the Fire Chief. In such cases, call the Fire Department (ext. 2-7595) for authorization and observe the following guidance:

- Use only the valved outlets provided by the Plant Engineering Pipe Shop.

- Use only a hydrant spanner provided by the Pipe Shop; other types of wrenches can damage the flats on the valve stem.
- Do not leave connections unattended—connections to fire hydrants may remain only while attended. (This requirement does not apply to connections at construction sites.)
- Slowly open hydrant valves fully and then close one-eighth turn. This procedure is necessary to minimize the chance of damaging the valve if it is inadvertently turned and forced in the wrong position.
- When securing water, close the valve slowly.
- After using a hydrant, manually screw on the caps (hand-tight only).

25.4.9 Corridors and Exits

All Laboratory buildings are provided with egress systems (corridors, stairs, doors) to meet the requirements of NFPA Life Safety Code. This egress system provides building occupants with a safe way out of the building as well as the Fire Department with a way into buildings when responding to emergencies. To maintain the integrity of the egress system, the requirements below shall be observed.

Corridors

- When used as part of the egress system, corridors must have a minimum clear width of 44 in. in office buildings and 36 in. in laboratory buildings. In certain cases, corridors in existing laboratory or shop buildings may be permitted to have a clear width of 28 in. (check with the ES&H team Fire Protection Engineer).
- Corridors must always remain free of obstructions or impediments.

Exit Doors

- Exit doors and the routes to reach them must be properly identified and illuminated. Emergency lighting may also be required. Refer to Chapter 6 of this Manual for guidance on emergency lighting.
- No locks or fastening devices that will prevent free escape from the building are permitted.
- Doors must be openable by a single operation. Locks requiring multiple operations or special knowledge or effort to open are not permitted.
- The minimum door width shall not be less than 28 in. For new doors, contact your area ES&H team for requirements.
- Exit doors, including the floor area on both sides of the exit door, must be kept clear and accessible at all times.

When conflicts arise regarding security requirements and safe exiting requirements, contact the ES&H team leader for your area. The ES&H team leader can arrange for the proper parties to resolve the issue.

25.4.10 Construction Areas

Construction areas shall be maintained in a fire-safe condition. This includes maintaining egress paths and ensuring that the construction site is accessible to the Fire Department. The Fire Department (ext. 2-7595) should be consulted regarding specific access requirements for construction sites. Accumulations of combustible waste material, dust, and debris shall be removed fromstructures and their immediate vicinity at the end of each work shift or more frequently if necessary for safe operations.

Subcontractors must be made aware of the need for permits and portable fire extinguishers, provisions for the safe use of combustible materials, requirements for storing flammable and combustible liquids in approved safety containers, requirements for disposing excess construction materials, and LLNL's emergency telephone numbers. The LLNL representative who supervises the subcontractor is responsible for ensuring that this information is available to the subcontractor.

For facilities under construction, automatic sprinkler systems must be placed in service as soon as possible. The absence of a working detection or flow alarm system is not a reason to delay placing the sprinklers in service.

25.4.11 Fire Department Access

Proper access to all LLNL facilities is important to ensure a timely response to emergencies. Fire lanes have been established throughout the Laboratory to allow the Fire Department to gain access to buildings when responding to emergencies. These fire lanes are posted and must be kept clear at all times. No vehicles are allowed to park in these lanes under any circumstances. The Fire Department reviews all plans for building construction, trailer relocation, and fencing changes to ensure proper access. If you need assistance or have any questions about the Fire Department's vehicle access requirements or the adequacy of fire lanes, call ext. 2-7595.

25.4.12 Emergency Reporting

For emergency reporting purposes, at least one readily accessible analog telephone shall be located in all LLNL facilities. This telephone shall be in an area that is not subject to being locked (e.g., a lobby or hallway). For larger facilities, telephones shall be placed such that the travel distance to the nearest one is no more than 200 ft.

> NOTE: The emergency dispatcher may request only brief information when you call. He/She will put you on hold to dispatch the Fire Department, then ask for more detailed information.

In an emergency,

- Call 911.
- Briefly state what happened and where it happened.

- Indicate if anyone was hurt and how badly.
- Give your name and the extension you are calling from; do not hang up unless the dispatcher tells you to.
- Wait in the area until the Fire Department arrives and to provide information to the Incident Commander.
- In large facilities, have someone meet the Fire Department personnel at the entrance to guide them to the scene

The emergency dispatcher may need the following additional information for specific types of emergencies:

- Fires
  - — What is burning?
  - — Is the fire small or large?
- Emergency Medical Assistance
  - — Is the person conscious or unconscious?
  - — How many people are injured?
- Hazardous Spills
  - — The name of the material spilled, including the correct spelling if known.
  - — Is it a liquid, solid, or gas?
  - — Has anyone been exposed to the material?
  - — Has the flow been stopped?

Also report any actions that may have or are being taken (e.g., attempts to extinguish the fire, whether the area has been evacuated, or whether CPR has been started). This information will help emergency response personnel anticipate actions that may be required upon arrival.

25.5 Responsibilities

Line management is responsible for maintaining a fire-safe working environment throughout all LLNL facilities. Individual supervisors are responsible for keeping their operating areas orderly and free of potential sources of ignition. Supervisors must ensure that employees understand and follow the guidance provided in this chapter. They should also notify their area ES&H team of any operational changes that alter the fire risk in their area so that protection can be adjusted accordingly. All employees must perform their work in a way that minimizes the possibility of starting a fire.

25.6 Training

OSHA regulations require that anyone who uses a fire extinguisher must be trained in its use. Course HS1670 fulfills this requirement.

25.7 LLNL Contacts

For further information or assistance in the areas below, contact the Emergency Management Division (Fire Department) at ext. 2-7595, L-388.

- Emergency reporting
- Fire department access
- Fire extinguishers (including fire extinguisher training course)
- Hot-work permits

For fire safety information or assistance in subjects not covered above, contact your area ES&H team or the Fire Protection Engineering Technical Leader at ext. 2-5148, L-388.

25.8 References/Supporting Standards

National Fire Codes and Standards, National Fire Protection Association, Quincy, MA (latest edition).

DOE Order 5480.7A, *Fire Protection*, February 17, 1993.

Fire Protection Program Manual, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-MA 116646 (latest edition).

LLNL Fire Protection Engineering Standards, Hazards Control Department, Lawrence Livermore National Laboratory, Livermore, CA (latest edition).

Code of Federal Regulations, Title 29, Part 1910, *Labor*, Occupational Safety and Health Administration, U.S. Government Printing Office, Washington, DC.

Code of Federal Regulations, Title 29, Part 1926, *Construction Standard*, Occupational Safety and Health Administration, U.S. Government Printing Office, Washington, DC.

Lockout and Tag Program

Health & Safety Manual

Supplement 26.13

LLNL Lockout and Tag Program

April 1996

Approved by the ES&H Working Group

_____ date _____

Robert W. Kuckuck
Deputy Director of Operations

LLNL Lockout and Tag Program*

* Major Revision

*** Major Revision**

1.0 Introduction

1.1 Purpose

This supplement describes the LLNL Lockout and Tag Program. The Program establishes minimum requirements for the lockout and tag of energy-isolating devices whenever servicing and maintenance activities are performed on equipment. Where "unexpected" energization or startup of the equipment or the release of stored energy could occur and possibly result in injury, these requirements shall be applied to ensure that the equipment is stopped, isolated from all potentially hazardous energy sources, and locked out and tagged before employees begin servicing and maintenance activities. Note that the term "equipment" as used in this supplement to refer to machines, facility and research and development (R&D) equipment, and equipment components.

Appendix A of this supplement contains terms and definitions; Appendix B contains a Lockout and Tag Procedure Self-Assessment Checklist and a Lockout and Tag Inspection Form. Supervisors shall use the checklist to ensure compliance with the requirements of the LLNL Lockout and Tag Program. The form shall be used to document the equipment on which lockout and tag procedures (described in Section 4 of this supplement) were performed and to identify any discrepancies uncovered.

1.2 Compliance

All personnel shall comply with the requirements of the Lockout and Tag Program. Failure to comply with this program may result in corrective action, as described in Section E of the LLNL *Personnel Policies and Procedures Manual.*

2.0 Applicability

The Lockout and Tag Program applies to all LLNL personnel (see Appendix A for definition). It also applies to subcontractor personnel who do not have an equivalent lockout and tag program that satisfies the requirements of the Occupational Safety and Health Administration (OSHA). Section 4.4.4 provides further details on subcontractor personnel.

In addition, the program applies to servicing and maintenance activities (including lock out and tag) that are part of a facility or program's normal operations. These include

- The removal or bypass of a guard or other safety device.
- Activities that require a person to place his/her body into an area of the equipment where work is being performed on material (point of operation) or where an associated danger zone exists during a machine-operating cycle.

The Lockout and Tag Program does not apply to

- Minor tool changes, adjustments, and other minor servicing activities that take place during normal operations provided that such activities are routine, repetitive, and integral to the use of the equipment and the work is performed using alternative measures that provide effective personnel protection.
- Work on cord and plug-connected electric equipment if exposure to the hazards of unexpected energization or start up of the equipment is controlled by unplugging the equipment from the energy source or if the plug is under the exclusive control of the employee performing the servicing or maintenance activity. Pneumatic tools may also fall into this category provided that they can be completely isolated from their energy source.
- Hot tap operations that involve transmission and distribution systems for electricity or substances (e.g., gas, steam, water, or petroleum products) when these activities are performed on energized electrical systems or pressurized pipelines, provided that the supervisor can demonstrate
  - — Continuity of service is essential.
  - — Shutdown of the system is impractical.
  - — Documented procedures are followed and special equipment that will provide proven, effective protection for employees is used.

A wide variety of energy sources that may need to be locked out and tagged during servicing or maintenance of the equipment is covered under this Program. These include, but are not limited to

- Electrical
- Hydraulic
- Pneumatic
- Mechanical
- Gravity
- Thermal
- Chemical
- Fluids and gases
- Water under pressure
- Steam

3.0 Requirements/Regulatory Summary

The LLNL Lockout and Tag Program meets the requirements in 29 CFR 1910.147, "The Control of Hazardous Energy (Lockout/Tagout)," and Subpart S, "Electrical."

4.0 Lockout and Tag Procedures

This section contains procedures to properly lock out and tag equipment when performing servicing and maintenance activities. Section 4.3 describes the procedure for equipment that does not require written lockout and tag procedures. Section 4.4 describes activities that require written procedures. The other sections provide supporting information.

A lockable energy-isolating device shall be installed on equipment before personnel begin any servicing or maintenance activity that might result in the unexpected release of hazardous energy. Non-lockable energy-isolating devices shall be designed or modified to accept a lockout device whenever equipment is replaced, new equipment is installed, or a major modification is performed. In addition, personnel must use personal protective equipment (PPE) when performing these activities. See Appendix A for the definition of PPE.

4.1 Required Documentation

No written procedure is required if the equipment meets *all* the criteria in Section 4.3, "LLNL Single-Point Lockout and Tag." If the equipment does not meet these requirements, however, a written lockout and tag procedure will be required as described in Section 4.4. The procedure shall describe controls for potentially hazardous energy when personnel are engaged in the activities covered by the LLNL Lockout and Tag Program. It shall also include

- A specific statement of the intended use of the procedure.
- Specific steps for shutting down, isolating, blocking, and securing machines or equipment to control hazardous energy.
- Specific steps for the placement, removal, and transfer of lockout devices and associated tags and the person responsible for these devices.
- Specific requirements for testing the equipment to determine and verify the effectiveness of the lockout and tag, and other energy control measures.

The procedure may be included in an OSP or FSP or may be a separate procedure maintained by the equipment supervisor. The procedure shall be readily available to any authorized employee and for periodic inspection.

A single, generic procedure may be developed for facilities that have more than one example of a specific type of equipment (e.g. water pumps, air conditioning units) provided that each of the following elements is clearly identified:

- Types and locations of equipment operating controls.
- Types and locations of energy-isolating devices.
- Types of stored/residual energies and methods to dissipate or block those energies.
- Method of verifying isolation of the equipment.

4.2 Protective Materials and Hardware

The functional supervisor or the equipment supervisor shall provide authorized employee the appropriate PPE, including locks and tags. The functional supervisor shall also provide any additional locks and tags that authorized Plant Engineering electricians; heating, ventilation, and air conditioning (HVAC) mechanics; plumbers; authorized Engineering Mechanical or Electronics Technicians; or other authorized LLNL employees may need while working in a facility. The equipment supervisor normally shall provide any special chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware required for isolating, securing, or blocking the equipment from energy sources.

The Occupational Safety and Health Administration (OSHA) requires lockout devices and associated tags to be singularly identified, durable, standardized, and substantial. To meet this requirement, only the following locks and tags shall be used at LLNL:

- **Standard Master keyed locks.** These locks shall be the only device used to lock out and tag equipment; when labeled with "Danger" stickers, they shall not be used for any other purpose. The locks shall have approved "Danger" stickers as shown in Fig. 1 (Brady/Signmark Division Catalog number 65507). Use of the "name" and "department" sections of these stickers is optional.
- **LLNL lockout tags.** (See Fig. 2, Form LLNL-DNR-30575-SLT, stock number 4280-71737. These tags conform to the requirements in Chapter 11 of the *Health & Safety Manual* and are to be used for all personnel safety-related lockouts. They shall have the name of the employee applying them. All other applicable information on the tag shall be supplied by that authorized employee. Each tag shall be used only once.

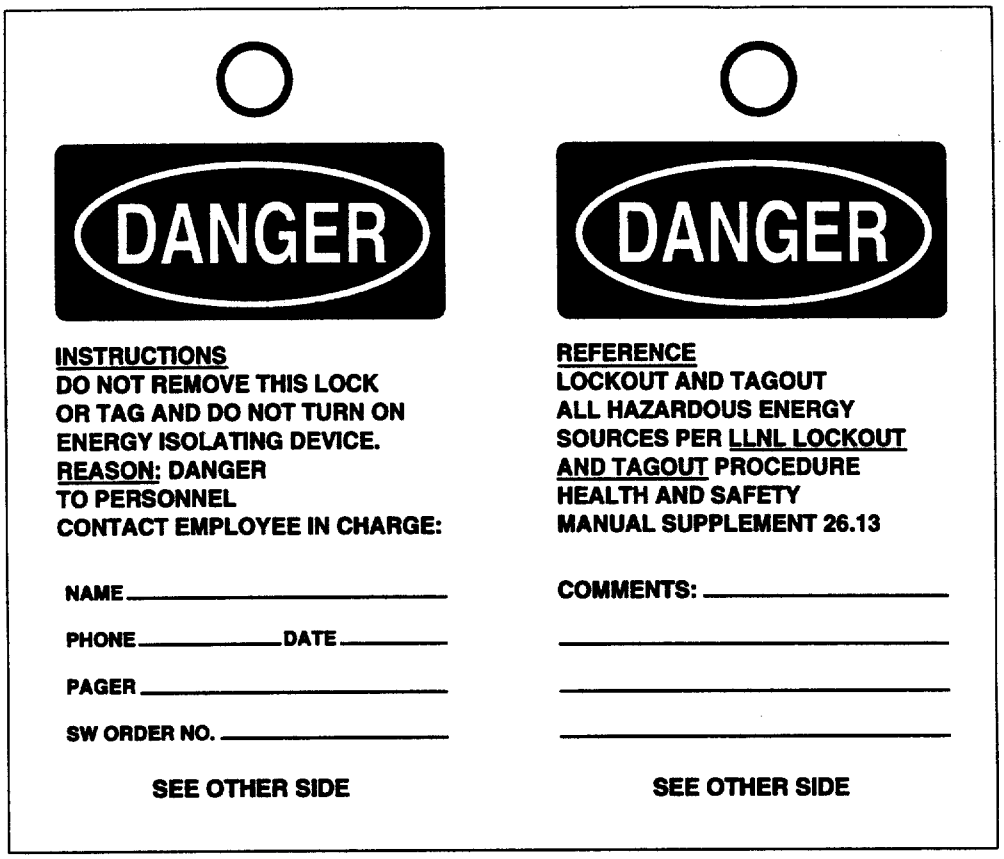


Figure 1. Danger sticker.

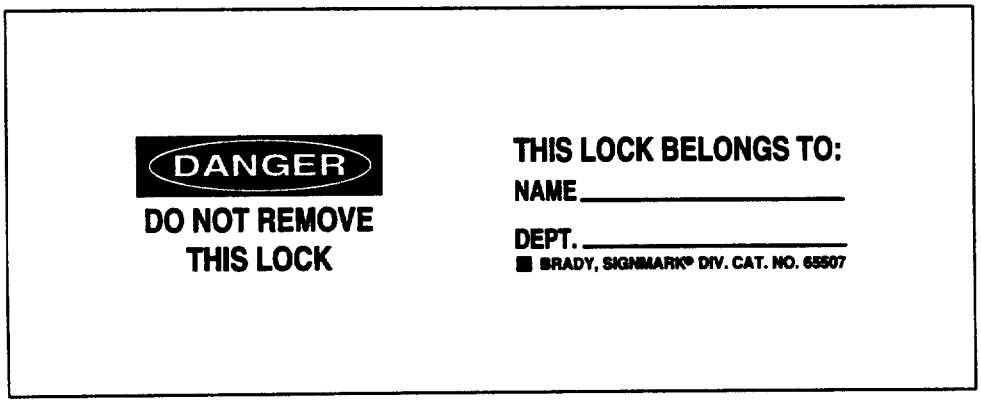


Figure 2. LLNL lockout tag.

NOTE: Equipment may be locked for administrative or operational purposes. A lock of suitable size (with no danger sticker attached) shall be used with the yellow CAUTION tag (Form LLNL-CNOC-30575-SLT, stock number 4280-71958), if appropriate.

4.3 LLNL Single-Point Lockout and Tag

When performing servicing and maintenance on equipment that meets the criteria below, a written procedure is not required. A laminated sign, painted sign, or similar durable device shall be placed next to the equipment indicating the location of the single energy-isolating device.

- The equipment has no potential for stored or residual energy or re-accumulation of stored energy after shutdown that could endanger employees.
- The equipment has a single energy source that can be readily identified and isolated.
- The isolation, lockout, and tagging of the energy source will completely de-energize and deactivate the equipment.
- The equipment is isolated from the energy source and locked out and tagged during servicing or maintenance.
- A single lockout device and tag will achieve a locked out and tagged condition.
- The lock is under exclusive control of the authorized employee performing the servicing or maintenance activities. If the lock has two keys, the second key shall be under the positive control of the authorized employee. At the discretion of the authorized employee, the functional supervisor may have custody of the second key. Under no circumstances shall there be more than two keys for a lock.
- Servicing or maintenance does not create hazards for other personnel.
- The equipment has no record of incidents involving unexpected activation or re-energization of the equipment during servicing or maintenance.

4.4 General Lockout and Tag Procedures

NOTE: The process of locking out and tagging complicated electrical systems is considered work on energized equipment and is therefore classified as a Class 3 or Class 4 hazard until the sequence of lockout and tag described in Section 4.4.1 is complete. As a minimum, such operations require an authorized employee and a co-worker to perform the work as described Chapter 23 and Supplement 23.01 of the *Health & Safety Manual.*

4.4.1 Sequence of Applying Lockout and Tag

The following procedure shall be used to lock out or tag equipment during servicing or maintenance activities:

1. The equipment supervisor shall notify all affected employees that servicing or maintenance is required on the equipment and that it must be shut down, locked out, and tagged.

2. The authorized employee shall refer to the equipment supervisor's procedure to identify the type and magnitude of the energy that the equipment utilizes, understand the hazards of the energy, and know the methods for controlling the energy sources.

3. If the equipment is operating, shut it down using the normal shutdown procedure (e.g., depress the stop button; open the switch; and close valve).

4. De-activate the energy-isolating device(s) to isolate the equipment from the energy source(s).

5. Lock out the energy-isolating device(s) with the authorized employee's lock(s) and attach a completed tag to each lock.

6. Stored or residual energy (such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure) must be dissipated or restrained by methods such as grounding, repositioning, blocking, or bleeding down.

7. Ensure that the equipment is disconnected from the energy source(s). First check that no one is exposed, then verify that the equipment is isolated by pressing the push button or operating other normal control(s), or by testing the equipment to make certain it will not operate. Use of appropriate test equipment may be required to verify that the equipment is de-energized. Whenever the authorized employee will be working near normally energized equipment or parts, these must be verified as de-energized using appropriate test equipment. Test equipment shall be verified as operational prior to use.

   CAUTION: Return operating control(s) to the neutral ("off") position after verifying that the equipment is isolated.

   CAUTION: Ensure the integrity of the lockout and tag procedure following any extended absence of the authorized employee.

4.4.2 Group Lockout and Tag Procedures

When servicing or maintenance activities are performed by a crew, craft, department, or other group, the procedures used shall afford these personnel a level of protection equivalent to that provided by the implementation of a personal lockout device and associated tag. Group lockout and tag procedures must include, but are not necessarily limited to the following specific requirements:

- One authorized employee, designated by the group's supervisor, shall have primary responsibility for a defined number of other personnel working under the protection of a group lockout and tag;

OR

- One authorized employee shall be designated to ascertain the exposure status of individual group personnel with regard to the lockout and tag procedure for the equipment. When more than one crew, craft, or department is involved, that designated authorized employee shall be responsible for the overall job-associated lockout and tag procedure and shall coordinate the affected work forces and ensure continuity of protection. Each authorized employee shall affix a personal lockout device and associated tag to the group's lockout device, lock box, or comparable mechanism when he/she begins work and shall remove those devices when he/she completes work.

4.4.3 Lockout and Tag during Shift or Personnel Changes

To maintain continuity in the protection provided for those involved in the lockout and tag procedure, and for the orderly transfer of the lockout and tag device, the steps below are necessary when personnel or shifts change.

1. *Personnel Change.* The arriving authorized employee's lock and tag shall be applied before the departing authorized employee's lock and tag are removed.
2. *Shift Change.* The lock and tag of at least one authorized employee on the arriving shift shall be applied before any locks and tags of the departing shift are removed. The departing crew will inform the arriving crew of the status of the equipment and the work in progress.

4.4.4 Outside Subcontractors Lockout and Tag Procedures

Whenever outside servicing personnel (i.e., independent contractors, service vendors) are to be engaged in activities covered by the scope and application of the LLNL Lockout and Tag program, the onsite equipment supervisor (or the LLNL Technical Representative for the University) and the outside subcontractor supervisor shall inform each other of their respective lockout and tag procedures. The onsite equipment supervisor shall ensure that his/her employees understand and comply with the requirements of the outside supervisor's procedures. Note that this may include the use of locks and tags that are similar but not identical to those used with the LLNL

Lockout and Tag Program. Outside contractors who do not have a lockout and tag program shall be required, by terms added to the contract, to comply with LLNL's program. In such cases, the LLNL organization using the subcontractor personnel shall furnish the required locks and tags.

4.5 Energy-Isolating Device Limitations

If the energy-isolating devices cannot be locked out,

- Have a qualified person install a suitable lockout attachment on the energy-isolating device, then proceed with the lockout and tag procedure in Section 4.4.1.

OR

- If approved by the equipment supervisor and facility management, locate a lockable energy-isolating device (e.g., a panel board or switch board feeding the unlockable device) that will effectively isolate the device. Properly isolate, lock, and tag the device.

OR

- Have a qualified person open (or close) the energy-isolating device (i.e., circuit breaker or valve), disconnect the wiring or piping (or insert a blank flange) from the device, tag the wiring or piping (or blank flange), tag the energy-isolating device, then proceed with the lockout and tag procedure in Section 4.4.1.

  NOTE: Any tag used with disconnected wiring, as described above, or any tag used with a blank flange or physically disconnected piping shall indicate the point of disconnect or the location of the blank flange.

OR

- Open (or close) and tag the energy-isolating device. Assign a person as a safety watch to ensure that the energy remains isolated for the duration of servicing or maintenance, then proceed with the lockout and tag procedure in Section 4.4.1.

4.6 Sequence of Removing Lockout Devices and Associated Tags

4.6.1 Removal of Lockout Devices and Associated Tags by Authorized Supervision

Lockout devices and their associated tags shall be removed from each energy-isolating device only by the authorized employee who applied them.

Exception: When the authorized employee who applied the lockout devices and associated tags is not available to remove them, the lockout devices may

be removed by the authorized employee's functional supervisor in coordination with the equipment supervisor if

- The authorized employee's payroll supervisor and the equipment supervisor verify that the authorized employee who applied the lockout devices and associated tags is not at the Laboratory.
- All reasonable efforts have been made to contact the authorized employee to inform him/her that the lockout devices and associated tags have been removed.
- The authorized employee is informed that the lockout devices and associated tags were removed before he/she resumes work.

4.6.2 Requirements for Testing or Repositioning Equipment

If the lockout devices and associated tags must be temporarily removed from the energy-isolating device and the equipment that is energized to test or position or any of its components, follow the sequence of actions below.

- Clear the equipment of tools and materials and have employees leave the equipment area.
- Remove the lockout devices and associated tags from the energy-isolating devices in accordance with Section 4.7.
- Energize the equipment, then proceed with testing or positioning the equipment.
- De-energize all systems and reapply the energy control measures in accordance with Section 4.4.1. Continue servicing and/or maintenance activities.

4.7 Sequence of Restoring the Equipment to Service

When servicing or maintenance is completed and the equipment is ready to be returned to a normal operating condition, follow the sequence of actions below.

1. Check the equipment and the immediate area to ensure that nonessential items have been removed, that all components are operationally intact, and that all guards or other protective features are restored.
2. Check the work area to ensure that all personnel are safely positioned away from the equipment.
3. Verify that the controls are in the neutral position.
4. Remove the lockout devices and associated tags, then re-energize the equipment. Note that removal of some forms of blocking devices may require re-energizing the machine before the blocking device can be safely removed.

5. Notify affected employees that servicing or maintenance is completed and the equipment is ready for use.

6. Complete the lockout and tag log entry.

4.8 Periodic Inspections

Functional supervisors shall periodically (at least annually) inspect the lockout and tag procedures conducted by authorized employees to ensure that these procedures and the requirements of the LLNL Lockout and Tag Program are being followed. Periodic inspections shall include a review of the responsibilities (as defined in the lockout and tag procedures being inspected) of the authorized employees assigned to work on the equipment.

Functional supervisors shall perform periodic inspections or they may designate an authorized employee (other than the employee being inspected) to perform the inspections. If another authorized employee performs the inspection, the functional supervisor shall accompany him/her and observe the procedures.

The functional supervisor shall certify that the inspection was performed by identifying on the Lockout and Tag Inspection Form (Appendix B) the equipment for which the lockout and tag procedure was being utilized, the date of the inspection, the names of the employees included in the inspection, and that of the person who performed the inspection. Any deviations or inadequacies identified during the inspection shall be corrected before further lockouts are performed.

4.9 Maintaining Lockout and Tag Logs

Lockout and tag logs shall be maintained in accordance with individual Directorate's administrative procedures. As a minimum, lockout and tag logs shall include the name of the authorized employee, the name of the equipment, the date the lock(s) and tag(s) were installed, and the date when they were removed. The functional supervisor is responsible for ensuring that authorized employees complete the required logs and records.

4.10 Deactivation and Mothballing

During de-activation or mothballing of a facility or building, it may be necessary to secure, lock, and tag electrical, compressed air, water, or other utility or programmatic services but no maintenance is to be performed. Locks and tags may be installed by the facility manager, building coordinator, or by someone designated by facility management if that individual is an authorized employee.

5.0 Responsibilities

5.1 Supervisors

5.1.1 Equipment Supervisors

Equipment supervisors are responsible for

- Maintaining a list of names and contact information for each affected employee involved with specific equipment, and for making this list available upon request.
- Maintaining specific steps for shutting down, isolating, locking, tagging, blocking, or relieving stored energy for the equipment in their area of responsibility.
- Ensuring that procedures clearly and specifically outline the scope, purpose, authorization, rules, and techniques to be utilized to lock out and tag sources of hazardous energy for equipment in their area of responsibility, and for making these procedures available for periodic inspection.
- Exchanging information with outside subcontractor supervisors about their respective lockout and tag procedures.
- Ensuring that their personnel understand and comply with the requirements of outside subcontractors' lockout and tag procedures.
- Notifying all affected employees that servicing or maintenance is required on the equipment and that it must be shut down, locked out, and tagged before servicing or maintenance can be performed.
- Ensuring that appropriate training has been conducted for those affected employees working in the facility. (This training is the responsibility of payroll supervision).
- Providing PPE (including locks and tags) for authorized employees if it is not provided by the functional supervisor.
- Providing any special chains, wedges, blank flanges, key blocks, adapter pins, self-locking fasteners, or other hardware required for isolating, securing, or blocking energy sources.

5.1.2 Functional Supervisors

Functional supervisors are responsible for

- Ensuring and certifying that periodic inspections of the lockout and tag procedures used by authorized employees are conducted.
- Providing PPE, including locks and tags, to authorized employees.
- Removing lockout and tag devices, in accordance with the procedure in Section 4.5, when the authorized employee who applied them is not available.

- Ensuring that authorized employees complete the required logs and records.
- Ensuring that personnel understand the purpose of the LLNL Lockout and Tag Program and that they have the knowledge and skills required for the safe application, usage, and removal of energy controls.

5.1.3 Payroll Supervisors

Payroll supervisors are responsible for ensuring that all required training is provided to authorized employees.

5.2 Employees

5.2.1 Affected Employees

Affected employees are responsible for

- Obtaining the training and retraining specified in Section 6.0, "Training," of this supplement.
- Complying with all requirements of the LLNL Lockout and Tag Program. In particular, affected employees shall not attempt to start or energize equipment or systems that are locked out and tagged.

5.2.2 Authorized Employees

Authorized employees are responsible for

- Performing lockout and tag procedures in accordance with the LLNL Lockout and Tag Program.
- Coordinating with other authorized employees when using the procedures in Section 4.4.2 for groups and during personnel and shift changes.
- Referring to the equipment supervisor's procedure to identify the type and magnitude of the energy that the machine or equipment utilizes, understanding the hazards of the energy, and knowing the methods to control the energy.
- Performing periodic inspections of the lockout and tag procedures in use when designated by the functional supervisor.
- Obtaining the training and retraining specified in Section 6.0 of this supplement.

5.3 Hazards Control Department

Hazards Control is responsible for providing course HS5245, "Lock and Tag Program."

6.0 Training

6.1 Employee Training

6.1.1 Authorized Employees

Each authorized employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control. This training shall include a combination of classroom education (course HS5245) offered by Hazards Control and on-the-job training (OJT) for the specific equipment.

In addition, the functional supervisor shall ensure authorized employees understand the purpose of the LLNL Lockout and Tag Program and that they have the knowledge and skills required for the safe application, use, and removal of energy controls.

6.1.2 Affected Employees

The equipment supervisor is responsible for ensuring that each affected employee working in the area is instructed in the purpose and use of lockout and tag procedures, including test procedures. (Course HS5245 may be used to fulfill this requirement.) (Although this training is the responsibility of payroll supervision, equipment supervisors shall ensure the training is completed prior to authorizing lockout and tag procedures for their equipment).

6.1.3 Others

All other employees whose work operations are or may be in an area where energy control procedures may be utilized shall be informed of the LLNL Lockout and Tag Program, and that they shall not attempt to restart equipment that is locked out and tagged.

6.2 Retraining

Retraining shall be provided as necessary for all authorized and affected employees whenever there is a change in job assignments, when a change in the equipment or processes present a new hazard, or when there is a change in the energy control procedures.

Additional retraining shall be conducted whenever a periodic inspection reveals, or the supervisor has reason to believe that there are deviations from the lockout and tag procedures or inadequacies in the employee's knowledge. Retraining shall re-establish personnel proficiency and introduce new or revised control methods and procedures, as necessary.

6.3 Training Records

Training records shall be maintained in accordance with the individual Directorate's administrative procedures. Some training records may be entered into an LLNL training record repository. Hazards Control courses are entered into the Laboratory's Repository of Completed Courses (LROCC). Other training records are maintained locally (i.e., in the employee's department).

7.0 LLNL Contacts

If you have questions or need additional information about the topics discussed in this supplement, contact the following as necessary:

- ES&H teams—Field support of the Lockout and Tag Program
- Industrial Safety—Institutional issues about the Lockout and Tag Program

8.0 Supporting References and Standards

Code of Federal Regulations, Title 29, Section 1910.147, "The Control of Hazardous Energy (Lockout and Tagout)."

Code of Federal Regulations, Title 29, Part 1910, Subpart S, "Electrical."

Appendix A

Terms and Definitions

affected employee	An LLNL person whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is to be performed under lockout and tag, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.
authorized employee	An LLNL person who locks out and tags machines or equipment to perform servicing or maintenance. An affected employee becomes an authorized employee when that employee's duties include performing servicing or maintenance covered under the Lockout and Tag Program.
capable of being locked out	An energy-isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed or if it has a locking mechanism built into it. Energy-isolating devices are capable of being locked out if lockout can be achieved without having to dismantle, rebuild, or replace the energy-isolating device or permanently alter its energy control capability.
energized	Connected to an energy source, or containing residual or stored energy.
energy-isolating device	A mechanical device that physically prevents the transmission or release of energy, including but not limited to a manually operated electrical circuit breaker, a disconnect switch, a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and no pole can be operated independently, a line valve, a block, and any similar device used to block or isolate energy. Push buttons, selector switches, interlocks, and other control circuit-type devices are not energy-isolating devices.

energy source	Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.
hot tap	A procedure used during repair, maintenance, and servicing activities that involves welding on a piece of equipment (pipelines, vessels or tanks) under pressure, or tapping into an energized electrical circuit, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems; or to obtain electrical service from an energized electrical distribution system.
installed real property	Equipment including building air conditioners, substations, and building power and distribution systems. Usually, installed real property equipment is maintained by Plant Engineering, and the costs of maintenance are charged to the Plant Engineering M&O accounts.
LLNL personnel	The term includes all Laboratory personnel, including full time employees (FTE), term (including students and post-doctoral researchers), and part time. It also includes Supplemental Labor (SLO), guests, and participating guests. (See "outside subcontractor").
LLNL single point lockout and Tag	A specific procedure for a machine tool or other piece of equipment with only one energy-isolating device that can be readily identified and isolated. For some equipment with only one energy-isolating device, a detailed written lockout and tag procedure is not required. For a detailed discussion, see Section 4.3.
LLNL technical representative for the University	An LLNL person, delineated in contracts, who is responsible for day-to-day supervision of a contractor or subcontractor doing work for the Laboratory. This person may be an equipment supervisor or a functional supervisor, or both. (See the definitions of "supervisor, equipment" and "supervisor, functional").

lockout and tag	The placement of a lockout device and associated identifying tag on an energy-isolating device, in accordance with an established procedure, to ensure that this device and the equipment being controlled cannot be operated until the lockout device and associated tag is removed.
lockout device	A device that utilizes a positive means such as a lock to hold an energy-isolating device in a safe position and prevent a machine or equipment from energizing. Included are blank flanges and bolted slip blinds.
normal production operations	Utilization of a machine or equipment to perform its intended production function.
outside subcontractor	Service and maintenance contractors, construction contractors, salvage contractors, and labor-only contractors.
other employees	Personnel other than authorized or affected employees whose work is or may be in an area where lockout and tag procedures may be used.
personal protective equipment (PPE)	Appropriate protective equipment, including personal protective equipment for eyes, face, head, and extremities; protective clothing; respiratory devices; and protective shields and barriers. Such equipment shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, electrical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through adsorption, inhalation or physical contact.
programmatic equipment	Equipment used for programmatic purposes, including lasers, power supplies, vacuum pumps, and walk-in refrigerators. This type of equipment may be maintained by programmatic personnel, or the program may have an arrangement with Plant Engineering for maintenance.

safety watch	A person designated and assigned by the functional supervisor to assist an authorized employee in performing maintenance or servicing on equipment that has no lockout attachment. This person shall be posted at an unlocked energy-isolating device to ensure that the device is not operated for the duration of the operation. The safety watch shall have no other duties.
servicing and/or maintenance	Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubricating, cleaning, or unjamming machines or equipment and making adjustments or tool changes where personnel may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.
setting up	Any work performed to prepare a machine or equipment for its normal production operation.
supervisor, equipment	The person designated by line management to be in charge of a piece of equipment. This person may be a building coordinator, principal investigator, room responsible person, Plant Engineering crafts person, or administrative specialist. The equipment supervisor may not "own" the equipment, but is the responsible user or caretaker of the equipment. The equipment might be programmatic equipment or installed real property. The equipment supervisor would usually be the first person to notice (or have reported to them) that a piece of equipment was not working properly.
supervisor, functional	The person designated by management to be the day-to-day supervisor of an authorized employee. For an authorized employee assigned a specific, short-term assignment in an area, this may be the payroll supervisor. Authorized employees assigned duties in more than one area may have more than one functional supervisor. The functional

	supervisor shall ensure that the authorized employee is trained and qualified to perform assigned tasks.
supervisor, payroll	The person administratively in charge of the authorized employee assigned to perform maintenance, including lockout and tag. This supervisor provides training, assigns activities to authorized employees and maintains a list of their names, and has access to all training records. This is usually the supervisor who writes the authorized employee's performance appraisal. He/she may also be the functional supervisor.
tag	An approved LLNL form (see details in Section 4.4) that can be securely fastened to an energy-isolating device with a lock and in accordance with procedures established in the LLNL Lockout and Tag Program. This tag indicates that the energy-isolating device and the equipment being controlled shall not be operated until the lock and tag is removed.
testing	Determination that machinery, equipment, or equipment parts are de-energized. This involves the use of approved, properly operating test equipment designed for and capable of determining if any energized conditions exist.
verification	Operating equipment controls for the purpose of determining that equipment cannot be restarted after an energy-isolating procedure has been performed and before maintenance or repair work is initiated.

Appendix B

Lockout and Tag Procedure Self-Assessment Checklist and Lockout and Tag Inspection Form

Supervisors shall use this checklist as a guide to ensure that authorized employees adhere to the requirements of the LLNL Lockout and Tag Program before completing the Lockout and Tag Inspection Form.

B.1 Authorized Employee Knowledge

- Can the authorized employee demonstrate knowledge about the Lockout and Tag Program?
- Can the authorized employee demonstrate knowledge about the appropriate lock and tag devices?
- Can the authorized employee demonstrate knowledge about the location of all energy-isolating devices?
- Can the authorized employee demonstrate knowledge about any (or all) secondary or residual energies?
- Can the authorized employee demonstrate knowledge about the energy-isolation verification procedures?
- Can the authorized employee demonstrate knowledge about the necessary procedures if the equipment does not have a lockable energy-isolating device?
- Can the authorized employee demonstrate knowledge about the log-keeping requirements?
- Has the authorized employee received the required training?

B.2 Lock and Tag Devices

- Is there an adequate number of locks and tags?
- Are the locks properly labeled?
- Are the LLNL danger tags the correct version?
- Is a lockout and tag log available and current?
- Are copies of the applicable energy control procedures available?

B.3 Equipment

- Are energy-isolating devices properly labeled?
- Are energy-isolating devices lockable?
- Are energy-isolating devices (other than electrical) required for lockout and tag (e.g., valves)?
- Are valves adequately identified, and are suitable locking devices available?
- Are other devices (e.g., blank flanges, blocks, chains) required for lockout and tag, and are these devices available?

Lockout and Tag Inspection Form

This form shall be completed by the functional supervisor (or designated authorized employee) inspecting the lockout and tag procedures. (NOTE: The person completing this form must be someone other than the employee performing the lockout and tag procedure.)

Date _____

1. List the equipment/machines on which the lockout and tag procedure is being used.

   _____

   _____

   _____

2. Provide the names of the authorized employees who performed the lockout and tag procedure for this inspection. (Include the names of affected employees, if applicable.)

   _____ _____

   _____ _____

   _____ _____

3. Identify any discrepancies found on the Lockout and Tag Procedure Self-Assessment Checklist. List any corrective actions.

   _____

   _____

   _____

   _____

_____ _____

Signature of inspector Date

_____ _____

Signature of functional supervisor Date

Confined Space

Health&Safety Manual

Supplement 26.14

Working in Confined Spaces

October 1994

Approved by the ES&H Working Group

_____ **date** _____

Ronald W. Cochran
Laboratory Executive Officer

Working in Confined Spaces*

Contents

1.0 Introduction

1.1 Purpose and Scope

This supplement outlines the responsibilities for individuals who work in confined spaces. It also provides requirements for controlling ignition sources; testing and monitoring the work environment; and isolating, purging, ventilating, entering, and rescuing personnel in confined spaces. Individuals who do not comply with these requirements risk the possibility of injury or death.

Appendix A contains terms and definitions used in this supplement. The other appendices provide additional information and guidance.

1.2 General

A "confined space" is defined as an enclosed area that

- is large enough for an employee to enter and perform assigned work;
- has limited or restricted means of entry or exit; and
- is not designed for continuous human occupancy.

Below are examples of confined spaces that may exist.

- Storm drainpipes
- Sewers
- Vaults
- Storage tanks
- Utility pipelines
- Manholes
- Large vacuum vessels
- Transformer tanks

Confined spaces must be periodically inspected, cleaned, and repaired. Because these spaces are used to store and transport flammable, toxic, corrosive, or oxygen-consuming materials, and because these materials can leak into confined spaces, it is important to enter these areas properly or only as a last resort.

Entry into a confined space occurs when *any* part of an employee's body passes through an opening into a confined space. The cardinal rule for anyone planning to enter a confined space is "never trust your senses." What may look like a harmless situation may become a potential threat, and what may smell strange at first can impair the sense of smell and lull you into a false sense of safety. In fact, some of the deadliest gases and vapors have no odor at all.

The two categories of confined spaces are low-hazard confined space (nonpermit confined space) and high-hazard confined space (permit-required confined space).

- **Low-Hazard Confined Space**—A space that does not contain or, with respect to atmospheric hazards, have the potential to contain a hazard capable of causing death or serious physical harm. Examples of low-hazard confined spaces include a pit or vault that does not have actual or potential hazards, the crawl space of a building with limited means for entry and exit, and a false ceiling plenum.

  Note that in the event of equipment failure, chemical usage, or other incident, a low-hazard confined space may become a high-hazard confined space. For example, use of cleaners, paints, solvents, compressed gas bottles, and welding equipment could turn a low-hazard confined space into a high-hazard confined space.

- **High-Hazard Confined Space**—A confined space that
  - — contains or has the potential to contain a hazardous atmosphere;
  - — contains a material with the potential to engulf an entrant;
  - — has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or a floor that slopes downward and tapers to a smaller cross section; or
  - — contains any other serious safety or health hazard.

  Examples of high-hazard confined spaces include mixing tanks, tank pits, manholes, waste retention tanks, and target chambers.

  Facility personnel (or the space/equipment owner) shall post the appropriate signs in confined spaces judged to be high-hazard spaces. An alternate method for informing employees of these areas may be used but only with the approval of the Hazards Control Department. An area may be designated as a confined space even if no signs are posted.

For information on how to evaluate confined spaces, see Appendix B, "Evaluation Guide for Confined Spaces."

2.0 Requirements/Regulatory Summary

The information provided in this supplement is guided by DOE Order 5483.1A, "Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities," and Code of Federal Regulations, Title 29, Part 1910.146, "Permit-Required Confined Spaces." Other information relevant to this supplement can be found in Supplement 26.13, "General Lockout and Tagout Procedures," of the *Health & Safety Manual* and in the references given in Section 7.0 of this supplement.

3.0 Applicability

This supplement is applicable to all activities that may require LLNL employees, supplemental labor contractors, and other contractors to enter confined spaces. Activities that LLNL personnel perform offsite are governed by the rules and regulations of the offsite organizations involved, provided that those organizations have primary responsibility for health and safety.

4.0 Process for Compliance and Risk Reduction

4.1 Hazardous Atmospheric Conditions

Oxygen-deficient atmospheres, or those that contain combustible or toxic gases and vapors, constitute serious hazards in confined spaces. Normal air contains approximately 20.9% oxygen. An atmosphere is defined as oxygen deficient if it contains less than 19.5% oxygen. If an ignition source is present in or is introduced into an environment that contains flammable gases, solvents, or dust, the atmosphere may burn or explode. Serious injury or death may result when the atmosphere contains even low concentrations of toxic gases (e.g., hydrogen sulfide, sulfur dioxide, or nitrogen dioxide). Everyday operations (e.g., welding, painting, and using solvents or inert gases) that are normally safe can quickly become hazardous when performed in a small, poorly ventilated area. This can change a low-hazard confined space into a high-hazard confined space.

The following criteria define a hazardous atmosphere:

- Flammable gas, vapor, or mist greater than 10% of the lower flammable limit (LFL).
- Airborne combustible dust at a concentration that meets or exceeds its LFL.
- Oxygen concentration less than 19.5% or greater than 23.5%.

- Any airborne contaminant that may expose a worker above an acceptable dose or the permissible exposure limit.
- Any other condition recognized as immediately dangerous to life or health.

4.2 General Controls for Confined Space Entry

4.2.1 Low-Hazard Confined Spaces

Following are the requirements for low-hazard confined spaces:

- Barricades and isolation (if appropriate).
- Electrical equipment (e.g., ground fault circuit interrupters (GFCI) on power hand tools and other electrical equipment). Such equipment must be properly grounded and listed with Underwriters Laboratories.
- Proposed activities must not introduce hazards to the area thereby converting it into a high-hazard confined space. Contact the responsible ES&H team for guidance, if necessary.

4.2.2 High-Hazard Confined Spaces

In addition to the those for low-hazard confined spaces, the following requirements are applicable to high-hazard confined spaces:

- A written permit.
- Mechanical ventilation for actual or potential atmospheric hazards.
- Tests of the atmosphere before and during entry into a confined space by a health and safety technician or other trained person, that is, one who has completed course HS4152 (or equivalent).
- An attendant(s) at the entry point of the confined space.
- Two-way communication with entrants in confined spaces.
- Personal protective equipment deemed necessary by the ES&H team industrial hygienist.
- A harness retrieval system, unless it increases the risk of entry or will not contribute to rescue.
- Rescue team.
- Notification of the area ES&H team technician at least 4 hours before entry into a confined space, except in situations where there is a threat to life or property.

The responsible ES&H team may require notification of the Fire Department emergency dispatcher, including the location and duration of the entry.

If unexpected hazards arise, all employees within a confined space must immediately exit the space. The responsible health and safety technician must then be notified so that he/she can reevaluate the space before re-entry.

4.3 Requirements for Safe Entry into Confined Spaces

No entry will be permitted into a confined space until all precautions noted on the permit have been taken. Thus, the entry supervisor (i.e., the person who signs the permit and authorizes entry into a confined space) must brief entrants, supervisors, and ES&H team members on their responsibilities and the hazards and controls for safe entry. In addition, the proper use of emergency equipment should be demonstrated and the area ES&H technician should be contacted. Consult the ES&H team for guidance on the activities below that will be required for your particular area.

4.3.1 Controlling Ignition Sources

All ignition sources, including lit cigarettes, are prohibited in confined spaces. If sources such as welding or cutting equipment are required, a fire permit must be obtained. When open flames must be used in confined spaces, take extra precautions to ensure adequate ventilation. For a thorough evaluation of a confined space and to obtain a fire permit, call the Emergency Management Division (ext. 2-7595) of the Hazards Control Department.

4.3.2 Isolating the Area

Isolation is the process whereby a high-hazard confined space is removed from service and protected from the release of energy and material into that space.

Open chemical or gas lines within the permit space must be isolated by blanking or blinding (see Appendix A for definition); by misaligning or removing sections of lines, pipes, or ducts; or by using a double-block-and-bleed system. Before beginning work in these spaces, disconnect the lines that may allow hazardous materials to enter or take other precautions to prevent such materials from entering into these areas. For example, take the lines apart, cap the ends, and insert a blank between the flanged connections. Be sure that the blank is strong enough to handle the pressure buildup if a pump is accidentally turned on. As an added precaution, lock out the pumps before entry. Isolate and lock out or tag any other hazardous energy sources (e.g., electrical and mechanical hazards, water lines or pipes, and compressed air to prevent engulfment or injury from impact) to prevent possible injury to entrants. For more information, see Supplement 26.13 (General Lockout and Tagout Procedures) of the *Health & Safety Manual*.

4.3.3 Completing Entry Permits

Confined-space entry permits (see Appendix C) are required before entering a high-hazard confined space. A member of the ES&H team or a person authorized and trained in confined-space testing will complete the permit and conduct the necessary tests for oxygen deficiency, flammability, and toxicity. If a confined space is vacated for more than one hour before the job is completed, the air shall be re-tested to ensure that

conditions have not changed since the original entry. The results of the test shall be noted on the permit.

Once the entry supervisor and the ES&H team member have signed the permit, it should be posted in an easily visible location. The entry supervisor's signature on the permit, along with that of the person authorized to conduct atmospheric testing, is verification that the space is safe to enter. Therefore, he/she shall ensure that

- all appropriate entries are made on the permit;
- tests specified on the permit are conducted;
- all procedures and equipment specified on the permit are in place to permit safe entry into the confined space;
- rescue services and the means for summoning them are available.

Each permit will be valid for the duration of only one work shift unless otherwise noted on the permit. Copies of the permit shall be provided to the industrial hygienist and the ES&H team within five working days. Permits will be retained in the safety team's files for one year; thereafter, they may be destroyed.

4.3.4 Purging and Ventilating Confined Spaces

If a confined space contains sludge or other residue, tests positive for combustible or toxic elements, or indicates an oxygen deficiency or enrichment, purge the area with fresh air and provide positive ventilation both before and throughout entry into the space. Below are some precautions to observe when purging and ventilating a confined space.

- Remove any residue using proper flushing techniques. Starting at the top, flush the space with water or steam to ensure proper cleaning. If entry is required into the space, all personnel must wear suitable protective equipment (see Section 4.3.8).
- Provide a continuous supply of fresh air as close as possible to the work area before and while personnel are working in the confined space. Take care to place the inlet upwind and at least 25 ft away from the confined space and any other potential contaminant (e.g., vehicle exhaust).
- Retest the atmosphere for any hazard(s) in question upon completing the purging and ventilating procedures.
- Continuously perform subsequent tests for oxygen deficiency, flammability, and/or toxicity during entry into the confined space or at intervals frequent enough to ensure a safe atmosphere. Despite a purge, enough toxic substances may still remain in pores and may scale to recreate a hazardous atmosphere.

These precautions may not always be necessary, but purging with air is always mandatory whenever there is an atmospheric hazard or a potential atmospheric hazard.

4.3.5 Testing and Monitoring the Work Environment

Tests for oxygen deficiency or enrichment, flammability, and toxicity must be conducted by a qualified member of the ES&H team or by someone who has completed course HS4152, "Confined-Space Instruments" or equivalent. Because work in confined spaces can create hazardous atmosphere, these tests shall be performed before entry into a confined space, continuously during entry into a confined space, or at intervals frequent enough to ensure a safe atmosphere.

Atmospheric tests must be performed in the following order: oxygen deficiency, flammability and, if necessary, toxicity. Some flammability test instruments require an adequate amount of oxygen to work properly. Use of sampling lines or containers is required to avoid exposure to personnel during the initial testing operations. It is also important to ensure that sampling is representative of the total atmosphere in the space (e.g., sample at different levels within a deep tank). If the prescribed tests indicate a dangerous situation, follow the procedure in Section 4.3.4 and contact the area ES&H team before proceeding.

A variety of instruments is available for determining the oxygen levels and the presence of dangerous air contaminants, but only those approved by the Hazards Control Department may be used. These instruments must be inspected and calibrated by the Industrial Hygiene Laboratories Group (ext. 2-5197) at least every three months, and a sticker with the calibration and due dates for the next calibration should be affixed to the equipment. *Equipment that is out of calibration or that functions erratically shall not be used.*

4.3.6 Attendants

An attendant must be present whenever anyone enters into a high-hazard confined space. He/she must remain outside the entrance, be in communication with the person(s) entering the area, and be ready to summon for help in case of emergency. An effective means of communication between the attendant and the person(s) inside the confined space must be provided whenever the entrant is out of the attendant's sight.

Attendants must read and understand the instructions in Appendices D and E before beginning work in confined spaces.

4.3.7 Rescue Personnel

The Fire Department is the designated rescue team at LLNL. Each member of the team must receive training in the following:

- Rescue procedures for high-hazard confined spaces. Members must practice making rescues in confined spaces at least every 12 months. These drills should be representative of actual situations.
- The use of personal protective equipment. Mechanical retrieval devices shall be available to rescue personnel from vertical-type, high-hazard confined spaces that are more than 5 ft deep.

- The removal of dummies, mannequins, or persons from actual or simulated confined spaces.
- First aid and cardiopulmonary resuscitation.

Each rescue worker must wear a suitable harness attached to one end of a lifeline by a quick-release catch to permit escape if the lifeline breaks, provided that use of the harness will not increase the overall risk of the entry or hinder rescue. The other end of the lifeline shall be secured outside the entry opening to a retrieval system or another fixed point so that retrieval can begin as soon as the rescuer becomes aware that rescue is necessary. The harness and lifeline may also be required even when no respiratory equipment is needed. When entry is through an opening at the top of a confined space, rescue workers must wear a harness-type safety belt that suspends them upright.

Harnesses are available from Stores with approval from the Fire Safety Division of the Hazards Control Department.

If supplied air respiratory protective equipment is required for entry into a confined space, one standby person for every person entering the space must be immediately available outside the space. This person shall have an independent air supply (if applicable) and be fully suited with the required protective clothing, except for the respirator facepiece.

For additional guidance, see Appendix E, "Nonentry Rescue of Personnel in Confined Spaces."

4.3.8 Suitable Protective Equipment

Suitable protective equipment varies depending on the job. Such equipment may include respiratory protection; gloves specifically designed for the material being handled; and protection for the eyes, face, head, and feet. To obtain a respirator or for additional information, call Respirator Services (ext. 27910, Bldg. 324). All other equipment, including acid-resistant apparel, are available from Stores. An annual medical clearance is required for respirator use; call the Health Services Department to schedule an appointment. Contact your ES&H team for additional information, if necessary.

Adequate lighting is required when entering or servicing confined spaces, and flashlights and/or extension lamps approved for the environment must be provided. All portable power tools and lamps used inside confined spaces must be properly grounded and equipped with GFCIs, and electrical or air-operated equipment must be non-sparking. Footwear with exposed nails is prohibited.

4.3.9 Health and Safety Technician Notification

The health and safety technician must be notified at least 4 hours before entry into a high-hazard confined space unless specifically exempted by an operating procedure (OSP or FSP). Notification is not required for emergency situations involving personnel and property. The health and safety technician may audit the procedures for confined-space entry.

4.4 High-Hazard Confined Spaces with Special Circumstances

Some requirements may not be applicable to high-hazard confined spaces if

- the only hazard posed by the confined space is an actual or potential hazardous atmosphere, and
- forced air ventilation alone is sufficient to maintain the confined space safe for entry. An example of such areas is a degreaser maintenance pit—a high-hazard confined space in which forced air ventilation alone may be sufficient to control a potentially hazardous atmosphere.

Special circumstances for high-hazard confined spaces allow for less stringent controls, which can only be approved by the Hazards Control Department using an OSP or approved equivalent written material such as a contractor's operating procedure. A written certificate indicating that the space is safe to enter is required, and a "Certification of Safe Entry" (see example in Appendix F) shall be completed and signed by entrants for each space that qualifies under "special circumstances." See Appendix B for more information on how to qualify a confined space under special circumstances.

4.5 Telecommunication Spaces

Because of the general absence of significant hazards in most telecommunication spaces (vaults), the potential of an accident occurring in such areas is less than that for other types of confined spaces. If you have any question about safety in such areas, contact the area ES&H team or refer to OSP L-36 (Confined Space Entry—Communications Spaces).

4.6 Construction Sites

This supplement applies to construction sites that may have high-hazard confined spaces. Excavations (including trenches) at a construction site may be categorized as confined spaces depending on the depth and physical layout. The ES&H team must conduct an evaluation of such areas on a case-by-case basis to determine whether they are high-hazard confined spaces.

Excavations that are more than 4 ft deep usually qualify as confined spaces. Work within deep excavations may qualify those excavations as high-hazard confined spaces. A deep excavation with a connected sewer line in the space is usually evaluated as a high-hazard confined space because of the potential atmospheric hazard associated with the sewer system. An excavation that is more than 4 ft deep in which a gasoline-powered compactor is used is usually evaluated as a high-hazard confined space, even if ventilation controls are in place, because of the expected buildup of an atmospheric hazard (carbon monoxide) from the compactor exhaust.

Not all excavations (e.g., very shallow excavations, less than 4 ft; or excavations with sloping sides) meet the definition of a confined space and/or a high-hazard confined space. Entry into these spaces would not have to be in accordance with OSHA and LLNL confined space requirements.

5.0 Responsibilities

5.1 Hazards Control Department

The Hazards Control Department shall do the following with the space/equipment owner:

- Identify the hazards for each confined space by examining
  - — past and current uses of the area;
  - — the physical characteristics and configuration;
  - — the potential hazards in the area, including oxygen deficiency, flammability, or toxicity;
  - — the biological and mechanical hazards in the area.
- Perform an initial evaluation of the hazards associated with the confined space. Each hazard shall be examined with respect to the scope and magnitude of the hazard, the likelihood of the occurrence of the hazard and the related consequences, the potential for changing conditions/activities, strategies for hazard control, and the impact on the need for emergency response.
- Review pre-operational activities of confined spaces and discuss with entrants the potential hazards, the appropriate safeguards, and the personal protective equipment required.
- Re-evaluate the classifications of confined spaces annually or when changes in a work area may affect the space. The space/equipment owner shall be provided with documentation for any change.

The Hazards Control Department shall approve the confined-space entry permit with the entry supervisor. In addition, the Department shall do the following:

- Develop programmatic procedures and provide employees with regulatory interpretations relative to confined space entry.
- Provide technical guidance on the procurement and operation of confined-space equipment.
- Approve the procurement of equipment used to enter confined spaces.
- Assist in monitoring and evaluating airborne contaminants, particularly toxics.

- Evaluate physical hazards, including thermal effects (heat and cold), noise, and vibration.
- Develop special procedures for handling hazards created by unique operational activities, including procedures for
  — cleaning and decontaminating work areas and equipment;
  — performing hot-work operations in double-walled vessels;
  — inerting an atmosphere.
  Entrants and attendants must follow these procedures.
- Provide the space/equipment owner with specifications for posting the entrances to confined spaces.
- Assist with the development and performance of training courses.
- Maintain copies of all confined-space entry permits.
- Maintain a database of low- and high-hazard confined spaces, and provide the information in that database upon request.
- Regularly audit compliance with confined-space entry and testing procedures.
- Issue and monitor compliance with hot-work permits for operations performed in confined spaces, as appropriate.

5.2 Entry Supervisors

Entry supervisors are responsible for all personnel who enter or work in confined areas. In addition, they shall also do the following:

- Complete the appropriate training (see Section 6.0, Table 1).
- Ensure that individuals under their cognizance receive the proper training for confined space entry, including medical examinations when applicable.
- Provide the Hazards Control health and safety technician with advance notice of planned, confined-space entry work so that arrangements can be made for the necessary equipment and testing. Notification should be at least 4 hours in advance of the expected entry, except in situations where there is a threat to life or property.
- Perform pre-operational review activities in confined spaces and discuss with entrants the potential hazards, the appropriate safeguards, and the personal protective equipment required.
- Be knowledgeable of the hazards one may encounter upon entering a confined space, including the mode, signs, symptoms, and consequences of exposure.

- Check that the necessary procedures, practices, and equipment used for safe entry into confined spaces are in effect before authorizing entry or re-entry.
- Sign the confined-space entry permit after the Hazards Control Department has signed it. These signatures officially allow entry into confined spaces and verify that all actions and conditions necessary for safe entry are provided and will be maintained.
- Ensure that operations comply with the terms and conditions on the permit.
- Ensure that transfer is made to another authorized supervisor whenever the responsibility for a permit space entry changes, and that the terms and conditions of the permit are maintained.
- Take appropriate measures to remove unauthorized personnel who are in or about to enter confined spaces.
- Cancel the permit authorization whenever unacceptable conditions exist or upon completing permitted activities. If unexpected hazards arise, all employees must leave the area immediately and notify the responsible health and safety technician so that he/she can re-evaluate the space before re-entry.
- Provide copies of the permit upon completing the work to organizations listed on the permit.
- Maintain copies of all confined-space entry permits issued under their cognizance.
- Audit compliance with procedures for confined space before each entry.

5.3 Personnel Entering Confined Spaces (Entrants)

Individuals who work in confined spaces shall do the following before entering:

- Complete the appropriate training (see Section 6.0, Table 1).
- Confer with space/equipment owners to identify any modification to the space, and review the hazards and safeguards associated with confined-space entry to determine if additional evaluations are necessary.
- Ensure that the equipment used in confined spaces is properly isolated. With assistance from Plant Engineering and the Hazards Control Department, lock out equipment in accordance with lockout/tagout operating procedures. NOTE: Entrants may have to complete part or all of the isolation or equipment preparation procedures in cases where the individual responsible for the equipment is unable to do so.

- Be knowledgeable of the hazards associated with confined spaces; recognize the signs and symptoms of exposure, including behavioral effects; and understand the consequences of exposure to the hazards in these spaces.
- Maintain an awareness of the appropriate personal protective equipment and its proper application.
- Read the confined-space entry permit, if one is required, and agree to accept and abide by its conditions.
- Maintain contact with the attendant in charge of the confined space.
- Notify the attendant of a self-initiated evacuation of a confined space.
- Exit a confined space if
  - — instructed by an attendant;
  - — an alarm is activated;
  - — danger is perceived.
- Stop work if conditions can adversely affect entrants or if the equipment has been changed. Advise the entry supervisor of these conditions.
- Clean up the area upon completing work, and return any equipment that was checked out the same day.

5.4 Attendants

Attendants must comply with the requirements below for confined space entry. In cases where they may serve as atmospheric monitors, attendants shall adhere to the requirements in Section 5.5.

- Complete the appropriate training (see Section 6.0, Table 1).
- Follow the guidelines in Appendix D, "Primary Responsibilities for Attendants," and Appendix E, "Non-Entry Rescue of Personnel In Confined Spaces."
- Do not perform other tasks that might interfere with your primary duty of monitoring and protecting entrants.
- Provide standby assistance to entrants within confined spaces. *An attendant shall only leave the confined-space entry point if he/she is relieved by another attendant or to get help during an emergency.*
- Be knowledgeable of the hazards associated with confined spaces; recognize the signs and symptoms of exposure, including behavioral effects; and understand the consequences of exposure to the hazards of these spaces.
- Monitor inside and outside the area for any change or condition that could adversely affect entrants.

- Initiate evacuation and emergency procedures.
- Maintain continuous and effective contact with entrants.
- Direct occupants to leave a confined space when you observe irregularities.
- Provide rescue and/or medical personnel with information about the hazards in the confined space.
- Sign the confined-space entry permit, if one is required, and agree to accept and abide by its conditions.
- Take the necessary measures to remove unauthorized persons who are in or about to enter confined spaces.

5.5 Atmospheric Monitoring Personnel

Atmospheric monitoring personnel shall do the following:

- Complete the appropriate training (see Section 6.0, Table 1).
- Perform gas testing of equipment before each use in accordance with the manufacturer's recommendations for that equipment to ensure that it functions properly. This includes "field test."
- Perform the tests indicated on the confined-space entry permit, including any additional tests that may be necessary. Record the results on the confined-space entry permit.
- Ensure that the confined-space monitoring procedures test for atmospheric contaminants that are representative of all areas of confined spaces.
- Report to and work with the Hazards Control Department, entry supervisor, space/equipment owner, and entrants to resolve any issue pertaining to the gas-test results.
- Pay particular attention to contaminants that may be absorbed through the skin.

5.6 Space/Equipment Owner

With assistance from Plant Engineering and the Hazards Control Department, the space/equipment owner shall do the following:

- Shut down and prepare equipment that is used in confined spaces.

- Isolate and lock out or tag equipment in accordance with established operating procedures. If the space to be entered affects or can be affected by interconnecting or adjacent equipment or personnel, coordinate the equipment preparation and isolation with the owners and have them endorse (by signature) the confined-space entry permit.

In addition, the space/equipment owner shall do the following:

- Complete the appropriate training (see Section 6.0, Table 1).
- Maintain a list of low- and high-hazard confined spaces in the area.
- Review the confined space information provided by the ES&H team industrial hygienist; submit corrections for hazards not mentioned or accounted for in the identification and evaluation survey, as appropriate.
- Post confined spaces with the appropriate signs, as necessary. Consult the ES&H team industrial hygienist for sign specifications.
- Notify the ES&H team industrial hygienist about significant modifications to confined spaces that may impact classification and/or procedures for entry.
- Be apprised of and identify operations and activities in the area that may potentially impact entry into confined spaces.
- Consult with the requester of the confined-space entry permit to determine its current status and if any modification has been made to the confined space; sign the confined-space entry permit.
- Notify the ES&H team industrial hygienist if you have changed responsibilities.
- Monitor operational conditions and revoke permits if unsafe conditions or practices arise.
- Take appropriate measures to remove unauthorized personnel who are in or about to enter confined spaces.

5.7 LLNL Fire Department Personnel

The Fire Department shall do the following:

- Complete the appropriate training for rescue/recovery personnel (see Section 6.0, Table 1).
- Assist in the development and implementation of rescue/recovery procedures for confined-space entry.
- Conduct rescue drills with LLNL personnel on a scheduled basis but not less than once per year.

- Tour LLNL as appropriate to maintain continued familiarity with the premises; review confined spaces with emphasis on size and configuration.

5.8 Health Services Department

The Health Services Department shall provide the following:

- Medical care during emergency response, as appropriate.
- Pre-placement examinations. A pre-placement exam is required for employment at LLNL. This examination will evaluate physical capabilities in relation to the prospective job. The Department shall be notified of all job transfers to determine if further medical evaluation is needed.

5.9 Plant Engineering

Plant Engineering shall do the following with assistance from the Engineering and Construction Department, construction inspectors, and LLNL-designated representatives monitoring contract personnel:

- Complete the appropriate training (see Section 6.0, Table 1).
- Contact the ES&H team industrial hygienist for a pre-operational review of contractor activities before initiating confined-space operations.
- Review the information on the contractor's confined-space entry permit and sign the "Approval" section. A signature officially allows issue of the permit and verifies that all actions and conditions necessary for safe entry into a confined space are provided and will be maintained.
- Debrief contractors regarding any hazard that was encountered or created during the operation and of the appropriate corrective action upon concluding the entry.

5.10 Procurement Department

The Procurement Department shall do the following with assistance from Plant Engineering, the Engineering and Construction Department, LLNL-delegated representative, and the ES&H team industrial hygienist:

- Ensure that prospective contractors bidding on LLNL contracts are informed that confined-space operations are involved in the scope of the work. Contractor work practices and procedures shall incorporate all applicable regulatory requirements. Knowledge of the content of applicable regulatory standards should be considered fundamental for any contractor who proposes to engage in confined-space operations at LLNL.
- Ensure that procurement requisitions for confined-space safety equipment are approved by the ES&H team industrial hygienist.

6.0 Training

All personnel (e.g., workers, attendants, or emergency services personnel) involved in confined-space activities must complete the required training in Table 1, including course HS4150 (Confined-Space Entry) before entering a confined space. Contractor personnel must complete equivalent training and provide evidence of the training upon request. Retraining is required every two years and must be documented in the Laboratory Repository of Completed Courses (LROCC). Atmospheric monitors must complete course HS4152 (Confined-Space Instruments).

Depending on the nature of the entry into a confined space, other required training may include courses HS1620 (Standard First Aid), HS4610 (Air-Purifying Respirators—General Training), HS4620 (Air-Line Respirators—General Training), and HS4630 (Self-Contained Breathing Apparatus). Additional training needs are identified by the area ES&H team.

Employees who fail to follow or are unfamiliar with confined-space entry procedures shall have their confined space authorization immediately suspended. These employees will require retraining before any entry into a confined space is allowed.

Table 1. Training requirements for high-hazard confined space work*

Responsible person	HS4150	HS4152	HS5245	HS1620 and HS1640	HS4610/11 HS4620/21 HS4630/31
Managers/Supervisors of Personnel entering confined spaces	o	o	o		
Space/Equipment Owner where confined space is located	o	o	o		
Atmospheric Monitoring Personnel	X	X			o
Entry Supervisors	X	X	o	o	o
Entrants	X	X	o	o	o
Attendants	X	X	o	o	o
Rescue/Recovery Personnel	X	X	X	X	X

* See the current *LLNL Course Catalog* for complete course descriptions of the following:

HS1620, "Medic First Aid"
HS1640, Cardiopulmonary Resuscitation (CPR)"
HS4150, "Confined-Space Entry" (Biennial refresher training required)
HS4152, "Confined-Space Instruments" (Biennial refresher training required)
HS4610, "Basic Respirator Training"
HS4611, "Air-Purifying Respirators—Specific Training"
HS4620/21, "Air-Line Respirators—Specific Training"
HS4630/31, "Self-Contained Breathing Apparatus"
HS5245, "Lock and Tag Procedure"

o = Recommended
X = Required

7.0. Supporting References and Standards

American National Standards Institute (1989), "Safety Requirements for Confined Spaces," ANSI Z117.1-1989, ANSI, New York.

California Code of Regulations, Title 8, *Industrial Relations Safety Orders.*

Code of Federal Regulations, Title 29, Section 1910.146, *Permit Required Confined Spaces for General Industry; Final Rule,* Occupational Safety and Health Administration, U.S. Government Printing Office, Washington, DC.

Code of Federal Regulations, Title 29, Section 1910.268(o), *Telecommunications; Underground lines,* Occupational Safety and Health Administration, U.S. Government Printing Office, Washington, DC.

Code of Federal Regulations, Title 29, Section 1926.21(b), *Safety Training and Education,* Occupational Safety and Health Administration, U.S. Government Printing Office, Washington, DC.

Code of Federal Regulations, Title 29, Section 1926.21(6)(i), *Safety Training and Education,* Occupational Safety and Health Administration, U.S. Government Printing Office, Washington, DC.

Code of Federal Regulations, Title 29, Subpart P (Excavations), Section 1926.651, *General Requirements,* Occupational Safety and Health Administration, U.S. Government Printing Office, Washington, DC.

Operational Safety Procedure L-36, *Confined Space Entry—Communication Spaces,* Lawrence Livermore National Laboratory, 1993.

Procedures for Confined Space Entry, Sandia National Laboratory, Livermore, California, 1993.

Appendix A

Terms and Definitions

acceptable entry conditions	The conditions that must exist in a permit space to allow entry and ensure that employees involved with a high-hazard confined space entry can safely enter into and work within the space.
attendant	An individual stationed outside one or more permit spaces to monitor authorized entrants. He/she performs all attendant's duties assigned in the employer's permit space program.
authorized entrant	An employee authorized by the employer to enter a permit space.
blanking or blinding	The absolute closure of a pipe, line, or duct by fastening a solid plate (e.g., a spectacle blind or skillet blind) that completely covers the bore and is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.
confined space	A space that (1) is large enough and so configured that an employee can bodily enter and perform assigned work; (2) has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and (3) is not designed for continuous employee occupancy.
confined space program	The overall program for controlling and, where appropriate, protecting employees from permit space hazards and for regulating employee entry into permit spaces.
double block and bleed	The closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.
emergency	Any occurrence (including any failure of hazard control or monitoring of equipment) or internal or external event to the permit space that could endanger entrants.

engulfment	The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.
entry	The action by which a person passes through an opening into a high-hazard confined space. Entry includes ensuing work activities in that space, and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.
entry permit	The written or printed document that is provided by the employer to allow and control entry into a permit space.
entry supervisor	The person (e.g., the employer, foreman, or crew chief) responsible for • determining if acceptable entry conditions are present in a permit space where entry is planned; • authorizing entry and overseeing entry operations; • terminating entry. An entry supervisor also may serve as an attendant or authorized entrant, as long as that person is trained and equipped for each role he/she fills as required by this supplement. Also, the duties of the entry supervisor may be passed from one individual to another during an entry operation.
hazardous atmosphere	An atmosphere that may expose employees to the risk of death, incapacitation, impairment of the ability to self-rescue (i.e., escape unaided from a permit space), injury, or acute illness from one or more of the following causes: • Flammable gas, vapor, or mist exceeding 10% of its lower flammable limit (LFL). • Airborne combustible dust at a concentration that meets or exceeds its LFL. NOTE: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 ft or less. • Atmospheric oxygen concentration below 19.5% or above 23.5%.

- Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in a DOE-mandated health and safety standard. NOTE: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.
- Any other atmospheric condition that is immediately dangerous to life or health. Other sources of information (e.g., material safety data sheets that comply with the Hazard Communication Standard, 29 CFR 1910.1200, published information, and internal documents) can provide guidance on establishing acceptable atmospheric conditions for air contaminants that OSHA has not yet determined a dose or the permissible exposure limit.

high-hazard confined space (permit space)

A confined space that has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section.
- Contains any other recognized serious safety or health hazard.

hot-work permit

The employer's written authorization to perform operations capable of providing a source of ignition (e.g., riveting, welding, cutting, burning, and heating).

immediately dangerous to life or health

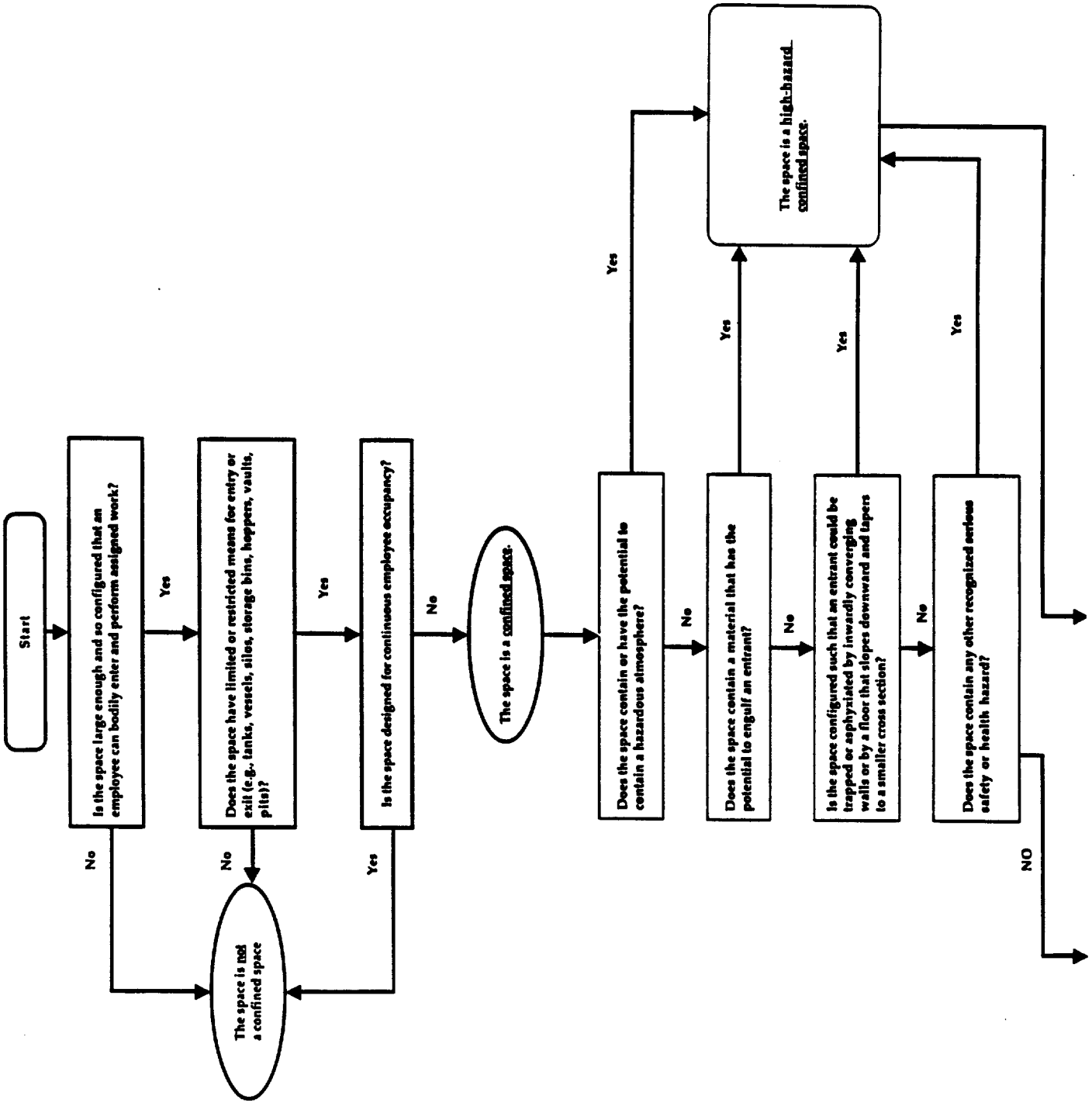
Any condition that poses an immediate or delayed threat to life, or that would cause irreversible adverse health effects, or that would interfere with an individual's ability to escape unaided from a permit space. NOTE: Some materials (e.g., hydrogen fluoride gas and cadmium vapor) may produce immediate transient effects that, even if severe, may pass without medical attention but are followed by sudden, possibly fatal, collapse 12–72 hours after

	exposure. The victim "feels normal" from recovery from transient effects until he/she collapses. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.
inerting	Displacement of the atmosphere in a permit space by a noncombustible gas (e.g., nitrogen) to such an extent that the resulting atmosphere is noncombustible. NOTE: This procedure produces an oxygen-deficient atmosphere that is immediately dangerous to life or health.
isolation	The process by which a permit space is removed from service and completely protected against the release of energy and material into that space by means such as • blanking or blinding; • misaligning or removing sections of lines, pipes, or duct; • using a double-block-and-bleed system; • locking or tagging out all sources of energy; • blocking or disconnecting all mechanical linkages.
line breaking	The intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.
low-hazard confined space	A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.
oxygen-deficient atmosphere	An atmosphere containing less than 19.5% oxygen by volume.
oxygen-enriched atmosphere	An atmosphere containing more than 23.5% oxygen by volume.
permit system	The written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.
prohibited condition	Any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

rescue service or team	Personnel designated to enter confined spaces to rescue employees from permit spaces. At the Laboratory this is the LLNL Fire Department.
retrieval system	The equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.
testing	The process of identifying and evaluating the hazards of a permit space that entrants may encounter. Testing includes specifying the tests to be performed on the permit space. NOTE: Testing enables employers to devise and implement adequate control measures for protecting authorized entrants and for determining if acceptable entry conditions are present immediately before and during entry.

Appendix B

Evaluation Guide for Confined Spaces



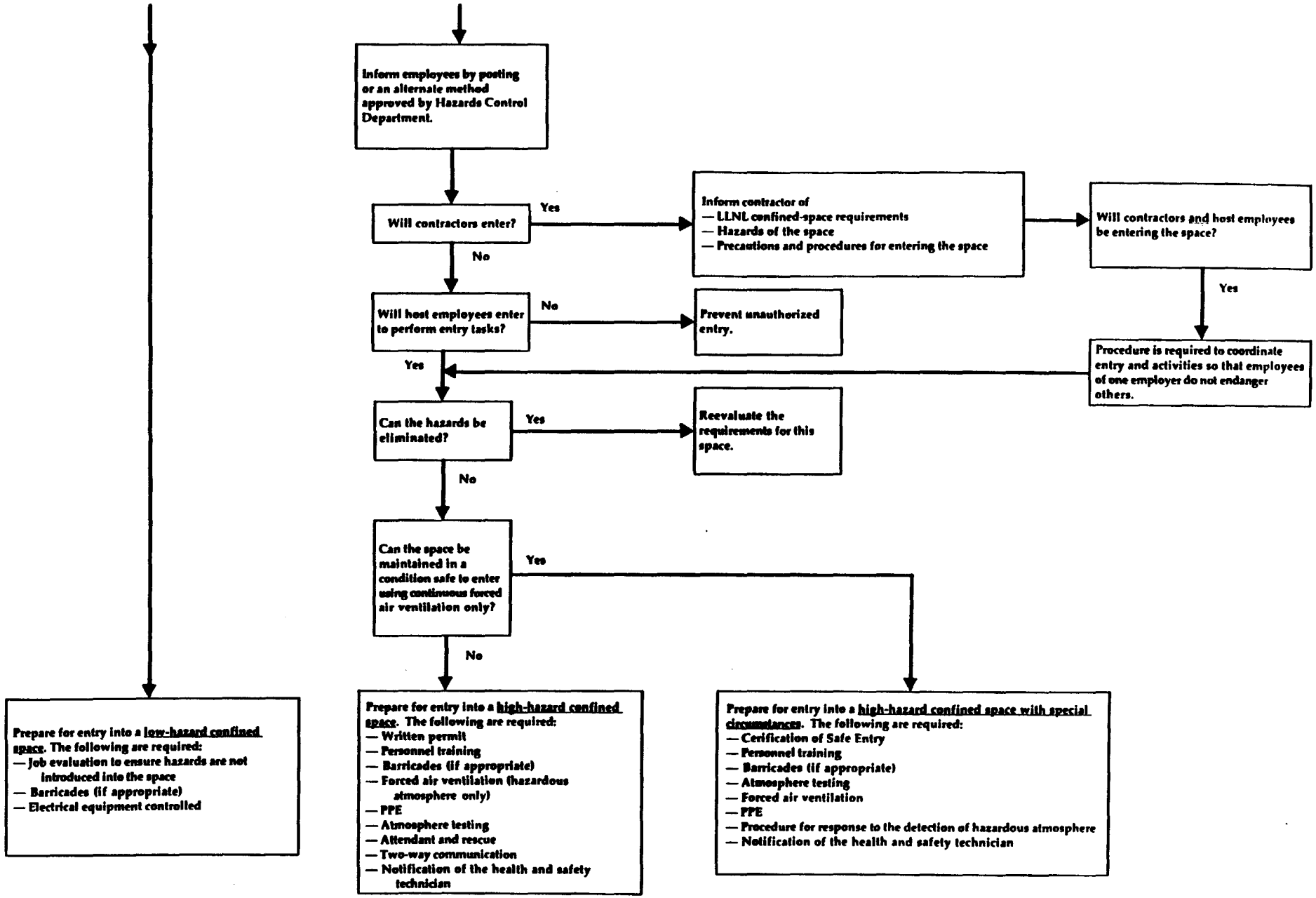


Figure B-1. Confined space decision flowchart.

Appendix C

Confined Space Entry Permit

Appendix C

CONFINED SPACE ENTRY PERMIT
LAWRENCE LIVERMORE NATIONAL LABORATORY

REASON FOR ENTRY:

LOCATION:

DATE/TIME:

PERMIT VALID ONE SHIFT UNLESS OTHERWISE SPECIFIED:
☐ DAY ☐ SWING ☐ OWL

NAME OF ENTRANT(S):

NAME OF ATTENDANT(S):

HAVE THE FOLLOWING PRECAUTIONS BEEN TAKEN?

	YES	NO	NA
1. HAS ENTRANT AND ATTENDANT BEEN TRAINED AND QUALIFIED?	☐	☐	
2. WERE HAZARDS, TESTING, AND EMERGENCY PROCEDURES EXPLAINED?	☐	☐	
3. WERE THE FOLLOWING SYSTEMS ISOLATED, LOCKED, TAGGED, AND TESTED?			
ELECTRICAL CIRCUITS	☐	☐	☐
MECHANICAL EQUIPMENT	☐	☐	☐
VALVES AND PIPE LINES	☐	☐	☐
GAS LINES	☐	☐	☐
4. HAVE BARRICADES BEEN PLACED AROUND WORKING AREA?	☐	☐	☐
5. WILL ANY HOT WORK BE REQUIRED? (IF YES, HOT WORK PERMIT MUST BE ISSUED)	☐	☐	

	YES	NO	NA
6. ARE ALL TOOLS EXPLOSION PROOF OR NOT ACTUATED BY EXPLOSIVE CHARGES?	☐	☐	☐
7. WILL ANY TOXIC MATERIALS BE USED? (E.G., PAINT, EPOXY, GLUES, ETC.)	☐	☐	
8. IS PURGING OR VENTILATION REQUIRED?	☐	☐	
9. IS QUALIFIED RESCUE PERSONNEL AND EQUIPMENT AVAILABLE ?	☐	☐	☐
10. HAS HEALTH AND SAFETY TECHNICIAN BEEN NOTIFIED?	☐	☐	
11. IS PROTECTIVE EQUIPMENT REQUIRED?	☐	☐	

PLEASE SPECIFY: ☐ HARDHAT ☐ GLASSES/GOGGLES
☐ CLOTHING ☐ RESPIRATORY PROTECTION
☐ SAFETY HARNESS/LIFE LINE ☐ FIRE EXTINGUISHER

SAMPLING EQUIPMENT USED

MODEL NUMBER	HAZARDS CONTROL NUMBER	CALIBRATION DATE

TESTS CONDUCTED

	RANGE	RESULTS	BY WHOM	RESULTS	BY WHOM
OXYGEN LEVEL	(19.5 %-23.5 %)				
COMBUSTIBILITY	(10 % OR LESS)				
TOXICITY - CARBON MONOXIDE	(35 PPM OR LESS)				
TOXICITY - HYDROGEN SULFIDE	(10 PPM OR LESS)				
TOXICITY - _____ (Indicate Material of Concern)					
TOXICITY - _____ (Indicate Material of Concern)					

POTENTIAL HAZARDS ASSOCIATED WITH CONFINED SPACE:

ADDITIONAL COMMENTS:

APPROVALS:

ENTRY SUPERVISOR

HAZARDS CONTROL REPRESENTATIVE

TO BE KEPT POSTED ON JOB SITE UNTIL WORK IS COMPLETED OR PERMIT EXPIRES OR IS REVOKED

DISTRIBUTION: WHITE–JOB SITE COPY CANARY–INDUSTRIAL HYGIENIST'S COPY PINK–SAFETY TEAM'S COPY

Appendix D

Primary Responsibilities for Attendants

Attendants must carefully read, understand, and be thoroughly familiar with the instructions in this appendix before beginning work in confined spaces.

Following are the primary responsibilities for attendants:

1. Ensure the safety of personnel working in vessels or confined spaces.
2. Maintain an accurate count of all persons working in confined spaces.
3. Maintain the conditions and requirements listed on the confined-space entry permit.
4. Notify everyone to evacuate the confined space if you observe a hazardous condition.
5. Dial 911 for both the Livermore site and Site 300 to obtain help if an emergency arises. Do not attempt to enter the confined space during an emergency. If possible, an attendant may rescue a victim from a confined space using a retrieval system and without additional help if such rescue does not require entering the space.
6. Provide the rescue team incident commander with the confined-space entry permit, including any information on the events leading up to the emergency.

> NOTE: The circumstances and conditions of the job will determine the safety requirements. However, the steps below are basic to all jobs.

7. Maintain effective and continuous contact with entrants.
8. Do not leave your assignment while personnel are inside the confined space, except to get help in an emergency. If other duties require you to leave your assignment, have all personnel evacuate the space.
9. Consult your supervisor if you have any questions regarding the job.
10. Be alert. Try to anticipate and prevent any condition that would be hazardous.
11. Prevent the fouling of air lines and/or lifelines.
12. Make sure that you have been trained in the proper use of respiratory equipment or lifelines if required use them.
13. Clean and return special equipment to its original location upon completing the job.

Appendix E

Nonentry Rescue of Personnel in Confined Spaces

Persons who have tried to rescue individuals from confined spaces have themselves become victims because of failure to follow proper procedures. Thus, it is essential that all persons involved with the rescue of personnel from confined spaces know exactly what to do in such situations. If possible, an attendant may rescue a victim from a confined space using a retrieval system and without additional help if the rescue does not require the attendant to enter the space.

A person who has collapsed or appears to be having difficulty while working in a confined space could be experiencing a heart attack or other illness. In such instances,

1. Dial 911 for both the Livermore site and Site 300 to obtain help. Do not attempt to enter the confined space during an emergency.
2. Attempt to retrieve the person(s) from outside the confined space using a harness retrieval system or other equipment. Do not enter the confined space or attempt a rescue unless designated by the incident commander.
3. Using the retrieval system, remove the victim from the area immediately.
4. Render whatever first aid you are qualified to provide once the victim is outside the space until medical help arrives. Immediately check for injuries and treat lifethreatening conditions.

   NOTE: The attendant shall assist the Fire Department rescue team upon arrival.

Appendix F

Example of Certification of Safe Entry Form

All answers to the following questions must be "Yes" to allow entry. A completed copy of this sheet must be sent to the ES&H team industrial hygienist.

Date: _____

Confined space number/Location: _____

	Yes
1. Has the ES&H technician been notified at least 4 h in advance (unless exempted by written procedure)?	____
2. Is it safe to remove the entrance cover?	____
3. Is a temporary barrier in place to protect the opening?	____
4. Is the confined space atmosphere for the following tested in the order listed and found to be safe:	
• Oxygen level (approximately 21%)?	____
• Lower flammable limit (LFL) of flammable gases or vapors (less than 10%)?	____
• Carbon monoxide level (less than 5 ppm)?	____
• Toxic air contaminants (approximately background or zero)?	____
If any level or oxygen deficiency is measured, entry is not allowed. Contact the health and safety technician for assistance.	
5. Do the work areas where employees will be within the space have direct, forced ventilation?	____
6. Was the air supply for the forced air ventilation obtained from a clean source?	____
7. Will the atmosphere within the confined space be tested continuously or periodically (at least every hour) to ensure that hazardous atmosphere is not developing? (Does the personal gas-alarm monitor meet established requirements?)	____
8. Does the employee entering the space have a certificate?	____

I certify that this confined space is safe for entry.

_____	_____
Entrant's Signature	Entrant's Signature
_____	_____
Print name	Print name

Chapter 35

Vehicle Operations and Traffic

January 1997

Approved by the ES&H Working Group

Robert W. Kuckuck date 1-16-97

Robert Kuckuck
Deputy Director for Operations

35

Vehicle Operations and Traffic*

Contents

* Major revision

Vehicle Operations and Traffic

35.1 Introduction

The use of vehicles, including motorized carts and bicycles, presents potential hazards around the LLNL-Livermore site and Site 300. Thus, LLNL has instituted policies to protect vehicle occupants and pedestrians. All employees (motor vehicle operators, bicycle riders, and pedestrians) must comply with these policies and the California Vehicle Code (CVC) when operating Laboratory-owned vehicles as well as privately owned or rented vehicles in order to make the roadways and pathways safe. In addition, drivers must *always* wear seat belts and operate vehicles at a speed that is reasonable, safe, and proper for the weather, traffic, and road conditions. The maximum speed limit at the LLNL-Livermore site is 25 miles per hour (mph) and 35 mph at Site 300, unless otherwise posted. The maximum speed limit in parking lots and alleys is 15 mph.

Speeding and moving traffic infractions are serious safety concerns. Anyone who violates either the CVC or Laboratory policies while onsite is subject to citation by the Protective Force Division as well as corrective action by LLNL management. Drivers who are cited for traffic violations offsite while on official business will be held personally responsible for the citation and may also be subject to disciplinary action by LLNL management.

35.2 Applicability

The provisions of the CVC and the Laboratory's policies for pedestrians, traffic safety, and parking apply to all employees, contractors, visitors, vendors, and guests who use Laboratory, private, or rented vehicles at the LLNL-Livermore site and Site 300.

35.3 Policy and Regulatory Summary

The requirements for all vehicles are based on the CVC, while those for commercial vehicles are based on the Department of Transportation (DOT) *Code of Federal Regulation*, Title 49, "Federal Motor Carrier Safety Regulations." These requirements are further supplemented by the Laboratory's traffic policies.

The Traffic Safety Committee prepares draft policies for approval and reviews onsite traffic safety issues and all citation appeals.

Offsite Use. Government vehicles authorized for offsite use must have

- Government license plates.
- A spare tire and tools to change the tire.
- Emergency flares or reflective devices.
- A telephone number to call in case the vehicle breaks down during normal business hours or after hours.
- Fire extinguishers, if required for the commodity being transported.
- Appropriate inspection forms and shipping documentation, if required.

Carts, Gas or Electric. *Carts are vehicles licensed for onsite use only.* When provided, seat belts shall be used by the driver and all occupants of a cart.

35.4.3 Commercial Motor Vehicles

Vehicles are classified as commercial motor vehicles (CMVs) because of their weight, configuration, or the materials they are used to transport.

Personnel Requirements. Individuals who operate (or those required to be ready to operate) CMVs for LLNL must

- Have a valid commercial driver's license (CDL) issued by their State of residence, with the appropriate endorsements for the class of vehicle to be operated and the type of cargo to be carried.
- Pass a DOT pre-assignment drug test (if hired after 1 January 1995).
- Take course PA0005 (Alcohol and Drug Testing for CDL Holders) and sign a receipt indicating that they have received the booklet entitled "LLNL Informational Materials" upon completing the course. Other training for CDL holders and their supervisors are specified in Section 35.6.

Commercial driver's license holders employed by LLNL must enroll in the Laboratory's Controlled Substance and Alcohol Testing Program, as required by federal regulations, and have a Driver's Qualification File (DQF) on record with Business Services. Business Services publishes an up-to-date list of personnel authorized to operate CMVs. Individuals who are not on this list shall not operate CMVs.

For more information on personnel requirements, contact the Hazardous Materials Packaging and Transportation Safety Assurance Office.

Procurement. Prior to placing an order, Fleet Management should coordinate the purchase of all CMVs with the Hazardous Materials Packaging and Transportation Safety Office to ensure compliance with applicable DOT regulatory requirements.

Inspections. All CMVs operated by or for LLNL shall be inspected in accordance with the requirements in 49 CFR 396. Before operating a CMV, the driver shall

- *Six or seven points within a 12-month period.* The employee, his/her AD, and Staff Relations will receive a letter from the Protective Force Division informing them that six or seven points have been accumulated. The AD will initiate action to suspend the person's onsite driving privileges for three months (or more) and have his/her badge marked accordingly. The employee then must complete course HS5600 (Defensive Driving) to earn reinstatement of onsite driving privileges by the end of the suspension period.
- *Eight or nine points within a 12-month period.* The employee, his/her AD, and Staff Relations will receive a letter from the Protective Force Division informing them that eight or nine points have been accumulated. The AD will initiate action to suspend the person's onsite driving privileges for 12 months (or more) and have his/her badge marked accordingly.

35.4.6 Onsite Parking

All non-government vehicles must be parked in designated parking spaces. Parking is permitted in other areas for government vehicles, LLNL service vehicles, and private vehicles that have special parking permits. All other vehicles must park in designated areas only, and should not overlap adjacent spaces or block the flow of traffic. Backing into diagonal spaces is prohibited, and backing into perpendicular spaces is not recommended. No vehicle shall park within 10 ft. of the low-security side of a security fence. Individuals who violate onsite parking policies are subject to citation based on the provisions of the CVC.

Restricted Parking Zones. Restricted parking zones are designated as follows:

- *Blue Curb*—Parking for only the physically challenged with permanent or Laboratory-issued placard.
- *Carpool*—Carpool parking stalls are reserved Monday through Friday from 6:45 a.m. to 1:30 p.m. for permit holders only. Parking permits for carpools are issued by the Transportation Systems Management (TSM) Program (ext. 2-RIDE) and shall be attached to the rear-view mirror.
- *Vanpool*—Vanpool parking stalls are reserved between 6:45 a.m. and 1:30 p.m. daily. Vanpools may park in specifically designated parking stalls. Vanpool stall designations and permits may also be obtained from the TSM Program (ext. 2-RIDE).

No parking stalls onsite are assigned specifically to individuals. Functional group stalls may be designated when there is a compelling, demonstrated business need.

In addition, bicycle riders shall

- Make sure bicycles have brakes that can make one wheel (the rear wheel, if there is only one brake) skid on a dry, level, clean pavement.
- Ride bicycles as close to the right of the roadway as possible.
- Exercise care when passing a parked vehicle or one that is moving in the same direction.
- Not hitch a ride or be towed by an attachment to another vehicle, or allow a second person to ride on a bicycle designed for a single rider.
- Not carry packages, bundles, or other articles that would prevent them from keeping at least one hand on the handlebars; nor should they carry items in the basket that could slip through the wire webbing and catch in the bicycle wheel.
- Use conventional hand signals to signal their intent before turning.
- Observe all traffic control signs and use caution when crossing intersections.
- Ride as close as possible to the right side of pathways when passing oncoming pedestrians and alert them of your presence in a non-alarming fashion. Cyclists are encouraged to use bicycle pathways or ride in single file near the side of the road.
- Avoid riding bicycles in areas with uneven surfaces.

LLNL and personal bicycles should not be operated at night unless equipped with lights. LLNL bicycles that are not functional or unsafe to ride shall not be ridden. They shall be turned upside down in a traffic-free area for pickup by the Bicycle Maintenance Shop for repair. A courtesy note describing the problem should be attached.

All bicycles should be parked in designated bike racks (or other locations), away from the line of traffic. LLNL bicycles are not to be taken into uncontrolled areas either onsite or offsite. Personal bicycles may be parked inside buildings, at the discretion of the building management, provided they are restrained in such a manner that proper access and egress are maintained. Bicycles parked inside buildings are to be left behind during emergency evacuations.

35.4.9 Vehicle and Pedestrian Safety

Pedestrians are subject to the provisions of the CVC. Pedestrians have the right-of-way at marked crosswalks and unmarked intersections, but must give way to vehicles at all other points on roadways. Pedestrians must not move into the paths of moving vehicles so suddenly so as to create a hazard. They should walk to the right side of pathways used by bicycle riders.

35.5.2 Supervisors

Both the supervisors of Laboratory employees and Laboratory contacts for non-LLNL employees are responsible for

- Ensuring that the appropriate notifications are made to Laboratory organizations.
- Contacting their directorate's assurance manager about serious accidents that may require an Occurrence Report.
- Making arrangements for individuals in testing-designated positions who are involved in occurrences requiring immediate DOE notification to be drug tested.
- Analyzing the accident using the procedures described in Chapter 4 of this Manual.
- Developing and implementing the appropriate corrective action.
- Completing accident or injury reports as necessary and returning them to the appropriate Laboratory organization.

In addition, supervisors must assure that CDL drivers involved in accidents with CMVs are subject to the controlled substance and alcohol testing requirements in 49 CFR 382 when such accidents result in a human fatality or citation for a moving violation, and either medical treatment is received away from the scene or the vehicle is towed from the scene. Contact the Hazardous Material packaging and Transportation Safety Assurance Office for further information.

35.5.3 Protective Force Division

The Protective Force Division is responsible for

- Coordinating the investigation of onsite and offsite traffic accidents involving LLNL vehicles.
- Requesting assistance from the California Highway Patrol, if necessary, for unusual circumstances associated with an incident.
- Completing, reviewing, and distributing vehicle accident reports (CHP-555).
- Sending copies of traffic collision reports to Industrial Safety (L-383), the Legal Liaison Office, and the Fleet Management Group, and to the Supplemental Labor Office, if appropriate.

35.5.4 Fleet Management Group

The Fleet Management Group is responsible for obtaining a repair estimate and for performing a safety inspection of damaged vehicles.

35.7 LLNL Contacts

Contact the following for further information, as necessary:

- Civil Planning (Office of Space and Site Planning), ext. 2-9490.
- Driver's Qualification File Administration (Business Services), ext. 2-1876.
- Fleet Management Group (Business Services), ext. 2-7474.
- Education, Training, and Safety Analysis (Hazards Control), ext. 2-1217.
- Hazardous Materials Packaging and Transportation Safety Assurance Office, ext. 3-9594.
- Health Services, ext. 2-7459.
- Industrial Safety (Hazard Control), ext. 2-0964.
- Protective Force Division (Safeguards and Security), ext. 3-3680.
- Quality Assurance Support Office, ext. 3-6984.
- Risk Management Office (Human Resources), ext. 2-7442.
- Traffic Managers Office, ext. 2-7492.
- Transportation Systems Management Program (Plant Engineering, Energy Management), ext. 4-4042.
- Traffic Safety Committee (Directors Office), ext. 3-6391.

35.8 Supporting References and Standards

California Vehicle Code.

Code of Federal Regulations, Title 49, "Federal Motor Carrier Safety Regulation" (various parts).

Onsite Hazardous Materials Packaging and Transportation Safety Manual, URL-MA-108269, Lawrence Livermore National Laboratory, Livermore, CA.

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