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Environmental Protection Department
Operations and Regulatory Affairs Division

Closure Plan for the Building 233 Container Storage Unit

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Lawrence Livermore National Laboratory
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CLOSURE PLAN FOR THE BUILDING 233 CONTAINER STORAGE UNIT

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EXECUTIVE SUMMARY

Lawrence Livermore National Laboratory (LLNL) is a U.S. Department of Energy (DOE) research facility located in Livermore, California. LLNL Building 233 Container Storage Unit (B233 CSU) is a structural-steel-frame building with a metal roof and chain-link-type metal-mesh walls. It is approximately 15 feet by 90 feet. The unit consists of two cells. The concrete floor of each cell is sloped towards the west towards a cinder block wall shared with Building 233. The CSU was used to store mixed waste containing hazardous and radioactive constituents. It is not a part of LLNL's permitted waste management facilities and is being closed under interim status.

In May 2000, LLNL submitted an initial closure plan detailing proposed activities for the closure of the B233 CSU. Subsequent to that, the California Department of Toxic Substances Control (DTSC) directed LLNL to implement a part (Phase I) of the sampling plan to characterize the facility so that a more complete initial study could be conducted before the DTSC approved the closure plan. In October 2004 LLNL implemented the Phase I activities according to a DTSC-approved Work Plan. LLNL submitted the Phase I results in March 2005. The DTSC then directed LLNL to conduct Phase II in order to explain the Phase I findings. Phase II was conducted in October 2005 in accordance with a DTSC-approved Work Plan. The DTSC directed LLNL to conduct Phase III to clean the pesticide contamination found as a result of previous phase activities and to resample the cinder block wall of the CSU. LLNL conducted Phase III in October 2006.

The closure plan includes the following:

- A list of Constituents Of Concern (COC) based on the waste that was stored in the CSU (Appendix A and Appendix D).
- Steps to characterize the site.
- Closure performance standards.
- Results of Phases I, II, and III activities (Appendix D).

The results of Phases I, II, and III activities showed above-background concentrations of metals in soil and concrete, and pesticides on the cinder block wall. The radioactive materials found are below the action limits for the site. An analysis of the phase activities and further investigation results show that the concentrations of the constituents detected in the soil, concrete, and the walls of the CSU are below health-based Environmental Protection Agency (EPA) Region 9 Preliminary Remediation Goals (PRGs) and the Office of Environmental Health Hazard Assessment (OEHHA) California Human Health Screening Levels (CHHSLs) for residential land use, where available, except for dieldrin in the cinder block wall. However, because of the activities and the use of the site, there are no human exposure pathways. Also, groundwater is not threatened by the presence of relatively low levels of constituents detected for the following reasons:

- The depth to groundwater is about 80 feet deep in the area.
- The CSU and the surroundings areas are covered with concrete and asphalt.

CLOSURE PLAN FOR THE BUILDING 233 CONTAINER STORAGE UNIT

1.0 CLOSURE PLAN

1.1 Introduction

This Closure Plan has been prepared for the Building 233 (B233) Container Storage Unit (CSU) at Lawrence Livermore National Laboratory (LLNL) and is a detailed strategy of procedures to be implemented in closing the facility. LLNL is owned by the U.S. Department of Energy (DOE) and operated jointly by DOE and its LLNL contractor. The U.S. Environmental Protection Agency (EPA) identification number for LLNL is CA 2890012584.

This Closure Plan is submitted to the Department of Toxic Substances Control (DTSC) in compliance with the Special Condition as outlined in Part IV, item number 4, of the Hazardous Waste Facility permit (DTSC, 1999). The special condition requires LLNL to submit this Closure Plan no later than 180 days after the date that the LLNL Hazardous Waste Permit became effective. LLNL's hazardous waste management operations permit became effective on November 19, 1999 (DTSC, 1999).

The B233 CSU is regulated under the Resource Conservation and Recovery Act (RCRA) and operates as an interim status storage area. The unit is also used to manage waste containing radioactive constituents. This Closure Plan addresses closure of RCRA interim status units in accordance with the requirements of Title 40 of the Code of Federal Regulations, Part 265.111 (40 CRF 265.111), and Title 22 of the California Code of Regulations, Part 66265.111 (22 CCR 66265.111).

The steps outlined in this Plan will insure that hazardous waste generated during closure activities does not escape or will not be released to the environment or present a harmful condition to public health or the environment. Waste generated during closure activities will be placed in separate containers depending on waste compatibility; and all waste streams generated during closure activities will be collected, sampled, and disposed of in accordance with applicable regulations. The Plan also insures that all hazardous waste present at the B233 CSU prior to the time of closure will be shipped to authorized off-site facilities by authorized haulers, using uniform hazardous waste manifests, or to other LLNL hazardous waste management facilities for treatment or storage.

This Plan is subject to the approval of the California Environmental Protection Agency, DTSC.

1.2 Closure Plan Amendments

This Closure Plan will be amended whenever:

- ♦ Unexpected events occur during closure activities that require modification of the approved Plan.
- ♦ Changes in state or federal law or regulations affect the Plan.

If an unexpected event that will affect the Plan occurs before closure has begun, an amendment will be submitted no later than 60 days after the event.

If, during final closure activities, an unexpected event that affects the Plan occurs, DTSC will be notified immediately, and an amendment will be submitted within 30 days.

1.3 Organization of the Closure Plan

Section 2 of this Closure Plan describes the B233 CSU, including its location, the type of construction materials, and the uses of the unit. **Section 3** describes the implementation of the Closure Plan. **Section 4** outlines:

- ♦ Procedures for decontaminating the B233 CSU; and disposition of the unit's structures and any materials generated during closure.
- ♦ Disposal activities for hazardous and mixed waste generated during closure.

Section 5 references the *Sampling and Analysis Plan for the Building 233 Container Storage Unit Closure (SAP).* The actual SAP is included as **Appendix A**.

Section 6 documents Closure Performance Standards for the B233 CSU**.**

Section 7 provides an overview of the Health and Safety Plan, and is included as **Appendix B**. **Section 8** provides the training that will be required of workers involved in closure activities.

Section 9 states the conditions for considering the B233 CSU closed. It also states that an independent, California-registered, professional engineer will oversee all closure activities. **Section 10** lists the documents that will be maintained during closure activities. **Section 11** provides references to the milestone chart for closure activities. The methods that LLNL will use to monitor closure activities are provided in **Section 12**. **Section 13** and **Section 14** provide LLNL's exemption from providing cost estimates for closures activities. **Section 15** is LLNL's commitment to notify DTSC as required by law. **Section 16** provides LLNL's approach to post-closure management of residual contamination. **Section 16** also states LLNL's intention to prepare a Post-closure Report for the B233 CSU. **Section 17** describes the process that LLNL has followed to ensure that it meets requirements to protect cultural, archeological, and paleontological resources. **Section 18** contains the reference list, and **Section 19** provides the acronyms used in this Plan. **Appendix B** contains the B233 Closure Plan Health and Safety Plan (HASP), and **Appendix C** contains a memorandum on the site hydrogeology. **Appendix D** contains the Phases I, II, and III work plans and discusses the results of characterization activities. In the Closure Plan and the Appendices, tables and figures follow the text

2.0 DESCRIPTION OF THE BUILDING 233 CONTAINER STORAGE UNIT

LLNL is a multidisciplinary research and development facility that generates hazardous, radioactive, and mixed waste. It is located about 40 miles east of San Francisco, California, in the Livermore Valley. Its Main Site occupies an area of approximately 821 acres in eastern Alameda County, adjacent to the City of Livermore. **Figure 1** shows the location of the Main Site and the hazardous waste management facilities within it. The B233 CSU is located in the southwest quadrant of the Main Site.

The B233 CSU (**Figure 2)** is a structural-steel-frame building with a metal roof and chain-link-type metal-mesh walls. It is approximately 15 feet by 90 feet. The unit contains two cells, each approximately 15 feet by 40 feet. The floor plan provides aisles ranging in width from 2.5 feet to 4 feet. All wastes are stored within the perimeter limits of each cell. The surface of the concrete base is free of gaps or cracks. The concrete floor of each cell is sloped from the unit's east exterior barrier to the west interior cinder block wall shared with Building 233.

Section IV.1 in the SAP (**Appendix A**) provides unit-specific information regarding the potential contaminants based on the type of waste stored or treated.

Ancillary equipment includes the following: eyewash and safety shower station, fire extinguisher, telephone, fluorescent lighting, automatic sprinkler wet-pipe fire suppression system, spill kit box, and personal protective equipment (PPE) storage box. Portable emergency back-up generator power and light units are available in the Area 612 Facility. Speakers, connected to the LLNL-wide emergency public address system, are mounted to the wall located between the north and south cells of the B233 CSU.

Run-on and run-off are controlled by the structure itself. The units are steel-framed and are enclosed by chain-link-type metal-mesh walls. A metal roof protects the interior from precipitation. Run-on is prevented by an exterior grade that slopes away from the facility and gutters and downspouts that direct rainwater to nearby storm drains.

Contamination and secondary containment controls include the epoxy-coated, reinforced concrete floor and curbing. Secondary containment pallets or skids provide additional protection against potential spills and contamination of the unit. Secondary containment structures consist of curbing on the sides of both units and a common rear wall to B233. The concrete floor of each cell is sloped from the unit's east exterior barrier to the west interior cinder block wall shared with B233. In addition to the unit's built-in secondary containment design, four 750-gallon tanks provide additional containment for sprinkler water and any significant liquid waste release to the south cell (only). This containment system has never been activated.

2.1 Maximum Inventory in Storage

The waste inventory in the B233 CSU is limited to the maximum stated in the Part A permit application (LLNL, 1998a). The storage capacity of the unit is 14,960 gallons.

The hazardous and mixed waste remaining in the storage area at time of closure will either be transferred to an appropriate hazardous waste management facility on site or will be sent off site to an authorized facility using a uniform hazardous waste manifest.

2.2 Potential Historical Contaminants

The potential historical contaminants associated with the unit are summarized in Section IV.1 of the SAP (**Appendix A**). These potential contaminants are identified based on the operational history of the area and each unit and on the range of waste types that could be accepted in accordance with the Part A permit application (LLNL, 1998a). To determine the Constituents Of Concern (COC) at the B233 CSU site, LLNL's waste database was searched going back to 1986. LLNL personnel familiar with the operations of the CSU were also interviewed. **Table 1** lists the parameters for analysis and analytical methods for bulk samples, swipes, and wastewater generated from decontamination activities.

2.3 Historical Releases from the B233 Container Storage Unit

A review of historical incident reports for the B233 CSU has shown no documented releases.

2.4 Meteorology

Meteorological data (including wind speed, wind direction, rainfall, humidity, solar radiation, and air temperature) are continuously gathered at LLNL. Mild, rainy winters and warm, dry summers characterize the climate. The mean annual temperature for the Livermore site in 2001 was 14.7°C (58.5°F). Temperatures range from –5°C (23°F) during some predawn winter mornings to 40°C (104°F) during some summer afternoons.

Both rainfall and wind exhibit strong seasonal patterns. These wind patterns tend to be dominated by the thermal draw of the warm San Joaquin Valley that results in wind blowing from the cool ocean toward the warm valley, increasing in intensity as the valley heats up. The wind blows from the northeast primarily during the winter storm season. Most precipitation occurs between October and April with very little rainfall during the warmer months.

Annual wind data for the Livermore site indicates about 50 percent of the wind comes from the southwest to westerly direction. This prevailing pattern occurs primarily during the summer. During the winter, the wind often blows from the northeast. Based on a ten-year record, the highest and lowest annual rainfalls were 541 and

211millimeters (21.3 and 8.3 inches), and the average annual rainfall was 360 millimeters (14.2 inches). In 2001, the Livermore site received 339 millimeters (13.4 inches) of rain.

Based on recent and historical weather data, closure operations should not be affected by weather conditions. However, any activity (e.g., drilling with a drill rig or sampling on the roof) that could be dangerous to the worker or compromise the integrity of the sample due to rainfall, wind, or temperature extremes will be postponed to a later date.

3.0 IMPLEMENTATION OF THE CLOSURE PLAN

This Closure Plan will be implemented upon approval by DTSC. LLNL will notify DTSC at least 60 days prior to the implementation of this Closure Plan.

LLNL will provide a copy of this Plan to contractors who will be hired to implement this Closure Plan.

4.0 CLOSURE PROCEDURES

4.1 Decontamination Procedures

Structures and surfaces will be decontaminated by using appropriate methods and procedures. **Table 2** describes decontamination approaches that may be used, and decontamination methods are explained in the SAP (**Appendix A**). The decontamination method selected from **Table 2** will be based on the type of contaminants anticipated.

All decontamination activities will occur in secondarily contained areas. The decontamination process is described below:

1. The B233 CSU will be decontaminated using the decontamination methods described in Table A-5 of the SAP (**Appendix A**).
2. All wastewater generated from decontamination activities will be collected. The wastewater will be pumped from the secondary-containment structures into a portable tank using an auxiliary pumping system. Any residual liquid will be removed with absorbent material that will then be collected in a 55-gallon drum. This absorbent material will be handled as appropriate, based on the analytical results of the wastewater generated during decontamination.
3. Decontamination will be verified in accordance with the criteria specified in Section 6.0 of this closure plan, "Closure Performance Standards," and the Sampling and Analysis Plan (Appendix A). After decontamination has been verified, all decontamination solutions will be sampled and analyzed. Depending upon sample results, a determination will be made on follow-up treatment or disposal options. If analytical results are above the sewer discharge limits of the Livermore Water Reclamation Plant (LWRP), the decontamination solutions will be treated on site at the newly activated Decontamination and Waste Treatment Facility (DWTF). **Table 3** provides an

estimate of quantities of waste to be generated during decontamination activities.

The specific sampling and analysis methodology is described in the SAP (**Appendix A**), including quality assurance and quality control.

4.2 Disposition of Structures and Materials

- Non-contaminated materials will be disposed of as scrap material or non-hazardous waste.
- If decontamination of structures is cost effective and feasible, decontamination procedures will be implemented. Otherwise, equipment and structures will be disposed of as hazardous or mixed waste.
- Debris waste will be identified according to 22 CCR 66260.10 and handled as outlined in 22 CCR 66268.45. 22 CCR 66260.10 defines debris as manufactured objects greater than 60 mm in size that are intended for disposal. 22 CCR 66268.45 enables debris to be treated using specified methods. The treated debris is excluded from the definition of hazardous waste. Regulations further state that this exclusion requires that the debris not exhibit a characteristic of hazardous waste after treatment. Persons claiming this conditioned exclusion of treated debris will have the burden of proving by clear and convincing evidence that the material meets all the exclusion requirements (22 CCR 66261.3[e]).
- Wastes that contain radioactive constituents above background will be shipped to an off-site facility, like the Nevada Test Site, that is appropriately authorized/licensed to accept such wastes.

Decontamination Techniques Applied to (used) Sampling Equipment:

Except where otherwise specified (in a task-specific Health and Safety Plan [HASP]), decontamination shall be performed in the same level of PPE used during sampling activities.

Equipment and supplies used for equipment decontamination may include (but are not limited to) the following:

- De-ionized (DI), distilled or (otherwise) analyte-free water.
- Soap and/or detergent solutions.
- Trisodium phosphate (TSP).
- Isopropyl alcohol (IsOH).
- Nitric acid (dilute HNO_3).
- Cleaning brushes.
- Chemical-free cloths or paper towels.

- ♦ Plastic buckets, galvanized steel pans.
- ♦ Steam cleaner.

There are four basic techniques employed at LLNL for removing contaminants from sampling equipment:

1. Rinsing thoroughly with analyte-free water (used for cleaning small items, lightly contaminated with polar compounds).

2. Hand-washing with a suitable detergent, e.g., “Alconox” (used when contaminant types are known or suspected, particularly when organic constituents are involved).

3. Systematically applying the following cleaning agents (used primarily when sampling concentrated chemical waste):

    a. Clean equipment with tap water and a TSP/water solution using a brush over a tub to remove particulate matter.

    b. Rinse with distilled water.

    c. Rinse with a 5% nitric acid solution.

    d. Rinse with distilled water.

    e. Rinse with pesticide-grade isopropanol.

    f. Rinse with distilled water and collect rinsate in a sample collection container for equipment blank analyses.

    g. Allow equipment to air dry.

    h. Collect decontamination liquids and properly dispose of as waste.

4. Steam cleaning (performed when equipment is too large to wash by hand).

In all cases, rinsate from decontamination activities is collected, analyzed, and compliantly dispositioned.

The procedures, described above, are followed when the decontamination activities involve non-disposable sampling equipment, used in bulk and soil sampling operations. Swipe sampling involves the use of disposable collection media; therefore, decontamination techniques do not apply.

4.3 Unit Structure

The unit structure will be sampled and analyzed as outlined in the SAP (**Appendix A, Section III.5.1**). Construction waste will be evaluated against the definition of hazardous waste, including debris waste, and handled as stated above.

4.4 Containers Used for Management of Hazardous Waste Generated during Closure Activities.

Waste containers used to manage waste generated during closure activities will be the same type of containers used during the active life of the facility. The container types and sizes are listed in **Table 4** and are the same as those described in the Waste Analysis Plan included in the Part B permit application (LLNL, 1998b). Containers are selected to ensure compatibility with the waste to be contained.

4.5 Disposition of Materials Generated during Closure Activities

Equipment that may have come into contact with hazardous waste in the implementation of this Closure Plan will be decontaminated by suitable washing and/or wiping as a part of this closure operation or disposed of as hazardous or mixed waste per appropriate regulations.

All expendable solid materials (wipes, rags, etc.) which are used in the above decontamination steps and which come in contact with hazardous wastes will be collected in containers and disposed of as hazardous waste or, if indicated, mixed waste.

Representative samples will be obtained from all containers of washing liquids that are collected during the implementation of the closure. These samples will be analyzed in order to characterize the contents as hazardous, mixed, or non-hazardous waste. All samples will be collected as per the SAP (**Appendix A**). In all cases where analysis is necessary, a Department of Health Services (DHS)-certified laboratory will perform the analysis. Sample chain-of-custody procedures will be documented.

No wastes will be chemically treated in the B233 CSU during the closure activity. Wastes will be managed (removed, transported, stored, or disposed of) in accordance with the Radioactive and Hazardous Waste Management (RHWM) Division's Waste Acceptance Criteria (WAC). Wastes that are identified as hazardous or mixed—based on the SAP in **Appendix A**—will be treated or stored at LLNL hazardous waste management facilities or shipped to an authorized, off-site treatment, storage, and disposal facility (TSDF) using hazardous waste manifests.

4.6 Off-site Treatment and/or Disposal

LLNL ships hazardous waste to offsite authorized facilities including, but not limited to, the following:

Name of the Off-site Authorized Facility	Facility Address	Distance to the Facility from LLNL (miles)
Advanced Environmental Technical Services, Inc.	4227 Technology Dr., Fremont, CA 94538	21.3
Teris West	1737 E. Denni St., Wilmington, CA 90744	359.2
Envirosafe Services of Idaho	10.5 miles on highway at 78 Missile Base Rd., Grandview, ID 83624	665
Heritage Environmental Services, Inc.	5122 E. Storey Rd., Coolidge, AZ 85228	771
Safety Kleen	2500 West Lokern Rd. Buttonwillow, CA 93206	222
Trade Waste/Chemical Waste Management	7 Mobile Ave., Sauget, IL 62201	2070.2
Envirocare	Salt Lake City, UT	742

LLNL may use these facilities or other authorized facilities as they become available. All waste to be transported off site will be packaged and labeled in accordance with applicable state and federal regulations, including U.S. Department of Transportation (DOT), EPA, and DTSC requirements.

Hazardous waste manifests, land disposal restrictions (LDR) certification, and any other pertinent documentation will be maintained and provided in the B233 Container Storage Unit Closure Report for all hazardous waste generated during closure activities.

4.7 Transportation Distances to Off-site Facilities

The approximate transportation distances to the off-site treatment and disposal facilities from the LLNL Main Site are shown in the table in **Section 4.6**.

5.0 SAMPLING AND ANALYSIS PLAN FOR THE B233 CONTAINER STORAGE UNIT STRUCTURE, SECONDARY CONTAINMENT, AND SOIL

All sampling and analyses for the B233 CSU, structures, and foundations will be conducted in accordance with the SAP (**Appendix A**).

A sampling plan has been developed to verify the integrity of the B233 CSU secondary containment systems and to characterize the area. This sampling plan is also included in **Appendix A**. Soil samples will be taken from selected locations as shown in the sampling plan. In addition, if inspection of the containment area were to reveal any cracks in the secondary containment pad, a sample will be taken from the soil beneath the crack to determine if contamination exists. The sampling methods used are found in EPA-600/2-80-018, *Samplers and Sampling Procedures for Hazardous Waste Streams* (EPA, 1980).

6. 0 CLOSURE PERFORMANCE STANDARDS

The intent of this closure is to eliminate, to the extent necessary to protect human health and the environment, the potential post-closure escape of residual contaminants or the migration of waste decomposition products to the ground, surface water, or atmosphere.

LLNL intends to clean-close the CSU. Clean-closure will be demonstrated as follows:

1. Characterizing the facility, including the structure and the soil, and

2. Comparing the results of the characterization to background and to regulatory agency health-based concentration levels.

LLNL will demonstrate clean closure by comparing the analytical results with LLNL background levels for metals, and health-based screening standards, OEHHA CHHSLs, and EPA Region 9 Preliminary Remediation Goals (PRGs) for volatiles.

If clean closure cannot be demonstrated through the comparison with the screening standards, and if there are human exposure pathways, LLNL will conduct a risk assessment with site-specific conditions.

All closure activities will be conducted in such a way as to minimize threats to human health and the environment. These activities include implementation of the sampling plans described in **Sections 5** to verify closure and to verify that further maintenance and control are not required.

Decontamination procedures and selection of appropriate decontamination solutions are described further in **Table 2** and the SAP (**Appendix A**). Verification sampling will be performed as needed for the potential contaminants listed in Table A-1 of the SAP **(Appendix A)**, and any other contaminants suspected at the time of closure.

Wastes will be evaluated against the definitions of “hazardous waste” and “debris waste” and will be handled accordingly.

All decontamination debris and solutions will be collected, analyzed, and disposed of appropriately, based on waste classification and in accordance with applicable requirements. If hazardous waste contamination of components were detected through the closure sampling process, and if decontamination were not effective, the contaminated equipment and structural components will be removed and managed either as hazardous or mixed waste. The contaminated material will be properly packaged and stored prior to ultimate disposal at an authorized off-site facility.

If it is determined during closure that soil contamination is there, and presents a risk to human health or the environment, a Post-closure Plan will be written to address the contamination in a way that is protective of human health and the environment.

Table 5 contains values for maximum allowable concentrations for metals in soil for clean closure. The site background levels for different constituents for soil were developed by using methods outlined in Attachment 7 of **Appendix D**.

Table 6 provides action limits/release limits for naturally occurring radioactive materials in soils and soil analogues for alpha and beta. If there is a positive response above the action limits from the alpha or beta analysis, a follow-up with alpha and gamma analysis for identification of related isotopes will be performed.

Table 7 provides clean closure levels for total metals in concrete. The background for concrete were developed by using the following references:

- ♦ U.S. EPA, *ProUCL Version 4.0 Technical Guide*, U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC, 20460, EPA/600/R-07/041, April 2007, and
- ♦ R.O. Gilbert, *Statistical Methods for Environmental Pollution Monitoring,* Van Nostrand Reinhold, New York, 1987.

The concrete samples used to develop the background values were obtained from several onsite locations without any known history of contamination.

Performance standards to be met in conducting closure of the B233 CSU are achieved through the following processes:

- ♦ Sampling procedures will follow the sampling frequency and selection requirements outlined in Section III of the SAP (**Appendix A**).
- ♦ Swipe samples will be collected from equipment destined for disposal at off-site disposal facilities. Based on analytical results, the equipment will be evaluated for land disposal restrictions and the off-site facility's WAC.
- ♦ Samples will be collected from concrete and asphalt surfaces, bulk paint chips, and bulk concrete chips from the structural components in accordance with Section III.5, Sampling Methodology, of the SAP. The methodology for acquiring swipes or paint chips will include bulk scrapings following a quadrate system as described in the Section III.1 of the SAP (**Appendix A**).
- ♦ Samples will be collected from areas of suspected contamination, such as surface cracks or obvious stains.

- Decontamination procedures for cement and asphalt surfaces will be implemented so that no residues resulting from hazardous waste operations will remain.
- Decontamination verification sampling will be conducted of the asphalt and concrete surfaces.
- Decontamination procedures will be repeated when analytical data indicate that hazardous waste constituents are still present on cement and asphalt surfaces. If hazardous waste constituents cannot be removed, the cement or asphalt will be removed and disposed of appropriately.
- Decontamination solutions, debris, and wastes will be collected and characterized for hazardous waste and radioactive constituents for disposal or storage at an approved, authorized, on-site or off-site TSDF.
- Soil and groundwater samples (if available and required to evaluate groundwater contamination) will be collected from under the B233 CSU as described in the SAP (Appendix A).
- Clean-up levels for concrete and soil are provided in the Sampling and Analysis Plan, Appendix A, as well as this Closure Plan.

7.0 HEALTH AND SAFETY PLAN

A Health and Safety Plan (HASP) covers activities implemented to protect workers and the environment during closure activities. Contractors hired to perform the B233 CSU closure activity will be required to follow LLNL's general health and safety requirements and will provide a safety plan for their specific activities. These requirements are documented in **Appendix B**, which details the health and safety precautions to be taken during the initial phase of the B233 CSU closure activity, i.e., site characterization.

Health and safety issues and standard operating procedures for the specific closure will be addressed, as described in **Appendix B**. LLNL's closure project leader and the Site Safety Officer (SSO) will monitor closure activities.

8.0 TRAINING FOR PERFORMING CLOSURE TASKS

All personnel who participate in closure activities at the B233 CSU will have appropriate training to perform the assigned tasks. Appropriate training for LLNL personnel is conducted through the RHWM Division training program, which is designed to meet regulatory requirements and provide personnel with knowledge on how to safely operate the LLNL waste management facilities.

Any contractors or their subcontractors, as part of the contract requirements, must also provide evidence of employee training to perform hazardous and mixed waste management activities. Contractors who implement decontamination, sampling, and/or demolition procedures associated with this Closure Plan will be trained to follow LLNL's waste acceptance criteria.

All employees, contractors, and subcontractors conducting closure activities will be provided with and briefed on this Closure Plan.

9.0 CLOSURE CERTIFICATION

If sample analyses verify that contamination from the B233 CSU operations did not enter the soil, and if verification sampling demonstrates that all components of the unit have been decontaminated (or removed for disposal), the facility will be considered closed. LLNL will provide a final Closure Report and certification of closure to DTSC within 60 days of completion of the closure activities described in this Plan.

An independent, California-registered, professional engineer will oversee all closure activities to certify that these activities have been performed by qualified individuals and were completed in accordance with this Closure Plan. This engineer will monitor closure activities, review logbooks, sampling and analytical data, and other closure records to certify that all activities have been properly completed. The independent engineer will not be from the owner or operator organizations. The independent engineer will maintain documentation of his/her closure inspections and reviews of all analytical and other data generated during closure. The final closure certification will be submitted within 60 days after the completion of closure.

10.0 DOCUMENT MAINTENANCE

The following documentation will be maintained during closure activities and will be provided in the final Closure Report:

- ♦ Daily activity logs.
- ♦ Contractor safety documentation.
- ♦ Sampling and analytical data.
- ♦ Records of type and quantity of hazardous and mixed waste generated during closure activities.
- ♦ Disposition of hazardous and mixed waste generated during closure activities, including transfer/shipping documents.

11.0 CLOSURE MILESTONES

A milestone chart for closure activity is included in **Figure 3.**

12.0 CLOSURE MONITORING

LLNL representatives will monitor all closure activities described in **Sections 4, 5,** and **6** to verify that the activities are being conducted in accordance with this Closure Plan.

An independent, California-registered, professional engineer as described in **Section 9** of this Plan will also monitor closure activity.

13.0 CLOSURE COST ESTIMATES

Under 40 CFR 265.140(c) and 22 CCR 66265.140(c), the federal government as the owner and operator of LLNL is exempt from the requirements to provide cost estimates and financial assurance mechanisms for closure actions.

14.0 POST-CLOSURE COST ESTIMATES

Under 40 CFR 265.140(c) and 22 CCR 66265.140(c), the federal government as the owner and operator of LLNL is exempt from the requirements to provide cost estimates and financial assurance mechanisms for post-closure actions.

15.0 REGULATORY AGENCY NOTIFICATION

Notification will be given to DTSC 60 days before closure activities begin. DTSC will also be notified in the event that any unexpected events require an extension of the time permitted to conclude closure activities.

16.0 POST CLOSURE/POST-CLOSURE PLAN

If it is determined that hazardous waste was released to soil or groundwater during the active life of the B233 CSU, LLNL's intent is to manage any contamination pursuant to the post-closure regulations if clean closure is not achieved. A post-closure plan, including a section on groundwater sampling, will be submitted to the DTSC in the event that contamination from the B233 CSU operations is discovered in soil or groundwater, and the area cannot be "clean closed."

17.0 CULTURAL, ARCHEOLOGICAL, AND PALEONTOLOGICAL CONSIDERATIONS

The closure of B233 CSU was evaluated by a State-qualified historic preservation professional. Based on the closure activities in this Plan, it was determined that the project does not require additional archeological review.

LLNL has a programmatic agreement, effective July 11, 2003, with the State Historic Preservation Office (SHPO) that provides National Historic Preservation Act (NHPA) coverage for activities at LLNL until that time when evaluations of buildings and archeological sites and plans for management of significant properties are finalized. Under the terms of this agreement, LLNL is authorized to proceed with actions short of demolition of buildings or destruction of archeological sites. By the agreement, it may do so without additional coordination with the SHPO.

The agreement with SHPO also defines a threshold-based process to coordinate with an archeologist concerning archeological and paleontological surveys. It is not likely that the agreed-upon threshold for consideration of a survey would be met for closure of the B233 CSU. Whether or not under the protocol, a survey is determined necessary, it is LLNL's policy and the Laboratory's agreement with the state that work would stop, and an archeologist would be contacted if cultural or paleontological resources, such as ground or flaked stone tools, shell, bone, beads, trash areas, weathered boards, glass (especially colored), pottery, or square nails are discovered during ground-disturbing activities.

18.0 REFERENCES

California Code of Regulations (CCR), Title 22, Chapter 11, Section 66260.10, Definitions (22 CCR 66260.10).

California Code of Regulations (CCR), Title 22, Chapter 11, Identification and Listing of Hazardous Waste, Section 66261.3, Definition of Hazardous Waste (22 CCR 66261.3).

California Code of Regulations (CCR), Title 22, Chapter 15, Interim Status Standards for Owners and Operators of Hazardous Waste Transfer, Treatment, Storage, and Disposal Facilities, Sections 66265.111, Closure Performance (40 CCR 66265.111).

California Code of Regulations (CCR), Title 22, Chapter 15, Interim Status Standards for Owners and Operators of Hazardous Waste Transfer, Treatment, Storage, and Disposal Facilities, Section 66265.140, Applicability (40 CCR 66265.140).

California Code of Regulations (CCR), Title 22, Section 66268.45, Treatment Standards (22 CCR 66268.45).

California Code of Regulations (CCR), Title 22, Section 66700, Zero Headspace Extraction (22 CCR 66700).

Code of Federal Regulations (CFR), Title 10, Part 830, Nuclear Safety Management. Office of the Federal Register, Washington, D.C. (10 CFR 830).

Code of Federal Regulations (CFR), Title 10, Part 835. Occupational Radiation Protection. Office of the Federal Register, Washington, D.C. (10 CFR 835).

Code of Federal Regulations (CFR), Title 40, Part 265.111, Closure Performance Standard. Office of the Federal Register, Washington, D.C. (40 CFR 265.111).

Code of Federal Regulations (CFR), Title 40, Part 265.140, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities. Office of the Federal Register, Washington, D.C. (40 CFR 265.140).

Department of Toxic Substances Control (DTSC). (1999). Hazardous Waste Facility Permit. Department of Toxic Substances Control, Sacramento, CA.

Office of Environmental Health Hazard Assessment (OEHHA). 2005. *Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties.* Department of Toxic Substances Control, Sacramento, CA. January.

Esposito, M. P. et al. (1987). *Decontamination Techniques for Buildings, Structures, and Equipment*. Noyes Data Corporation, Park Ridge, NJ.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring.* Van Nostrand Reinhold, New York.

Lawrence Livermore National Laboratory. (1998a). *Part A Permit Application for Hazardous Waste Treatment and Storage Facilities, Livermore Site.* Lawrence Livermore National Laboratory, Livermore, CA. October. (UCAR-10275-98).

Lawrence Livermore National Laboratory. (1998b). *Part B Permit Application for Hazardous Waste Treatment and Storage Facilities, Livermore Site.* Lawrence Livermore National Laboratory, Livermore, CA. October (UCAR-10275-98).

Lawrence Livermore National Laboratory. (2003). *LLNL Environmental, Safety, and Health Manual.* Lawrence Livermore National Laboratory, Livermore, CA (UCRL-AR-119618).

Unterberg, W., and R. W. Melvoid et al. (1989). *Reference Manual of Countermeasures for Hazardous Substance Release,* Hemisphere Publishing Corporation.

U.S. Environmental Protection Agency (EPA). (1980). *Samplers and Sampling Procedures for Hazardous Waste Streams.* U.S. Environmental Protection Agency, Research Triangle Park, NC (EPA 600/2-80-018).

U.S. Environmental Protection Agency. (1986). *Test Methods for Evaluating Solid Waste.* 3rd Edition. U.S. Environmental Protection Agency, Research Triangle Park, NC (EPA SW-846).

U.S. Environmental Protection Agency. (2007a). *ProUCL Version 4.0 Technical Guide.* U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC, 20460 (EPA/600/R-07/041) April.

U.S. Environmental Protection Agency. (2007b). *Users' Guide and Background Technical Document For US EPA Region 9's Preliminary Remediation Goals (PRG) Table.* U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC, 20460

19.0 ACRONYMS

ASTM	American Society for Testing and Materials
B233	Building 233
CCR	California Code of Regulations
CHHSL	California Human Health Screening Level
CFR	Code of Federal Regulations
CSU	Container Storage Unit
CP	Closure Plan
DHS	(California) Department of Health Services
DI	De-ionized
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DTSC	California Department of Toxic Substances
DWTF	Decontamination and Waste Treatment Facility
EPA	U.S. Environmental Protection Agency
HASP	Health and Safety Plan
HNO_3	Nitric acid
IsOH	Isopropyl alcohol
LDRs	Land disposal restrictions
LLNL	Lawrence Livermore National Laboratory
LWRP	Livermore Water Reclamation Plant
NHPA	National Historic Preservation Act
OEHHA	Office of Environmental Health Hazard Assessment

PPE	Personal protective equipment
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RHWM	Radioactive and Hazardous Waste Management Division
RWQCB	Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SSO	Site Safety Officer
SHPO	State Historic Preservation Office
TSDF	Treatment, storage, and disposal
TSP	Trisodium phosphate
U.S.	United
WAC	Waste Acceptance Criteria
WET	Waste Extraction Test
XRF	X-ray fluorescence
ZHE	Zero headspace extraction

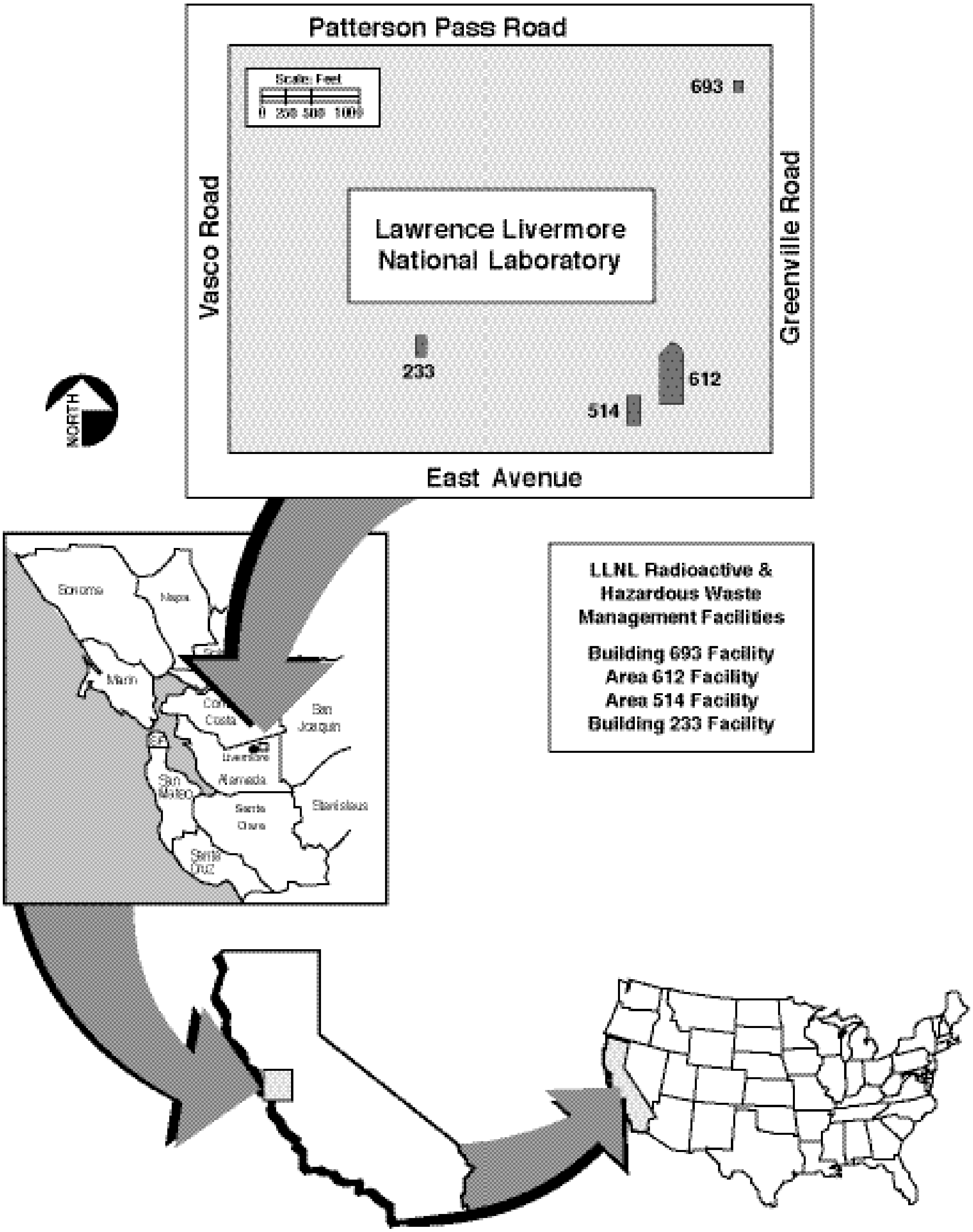

Figure 1. Location of Lawrence Livermore National Laboratory

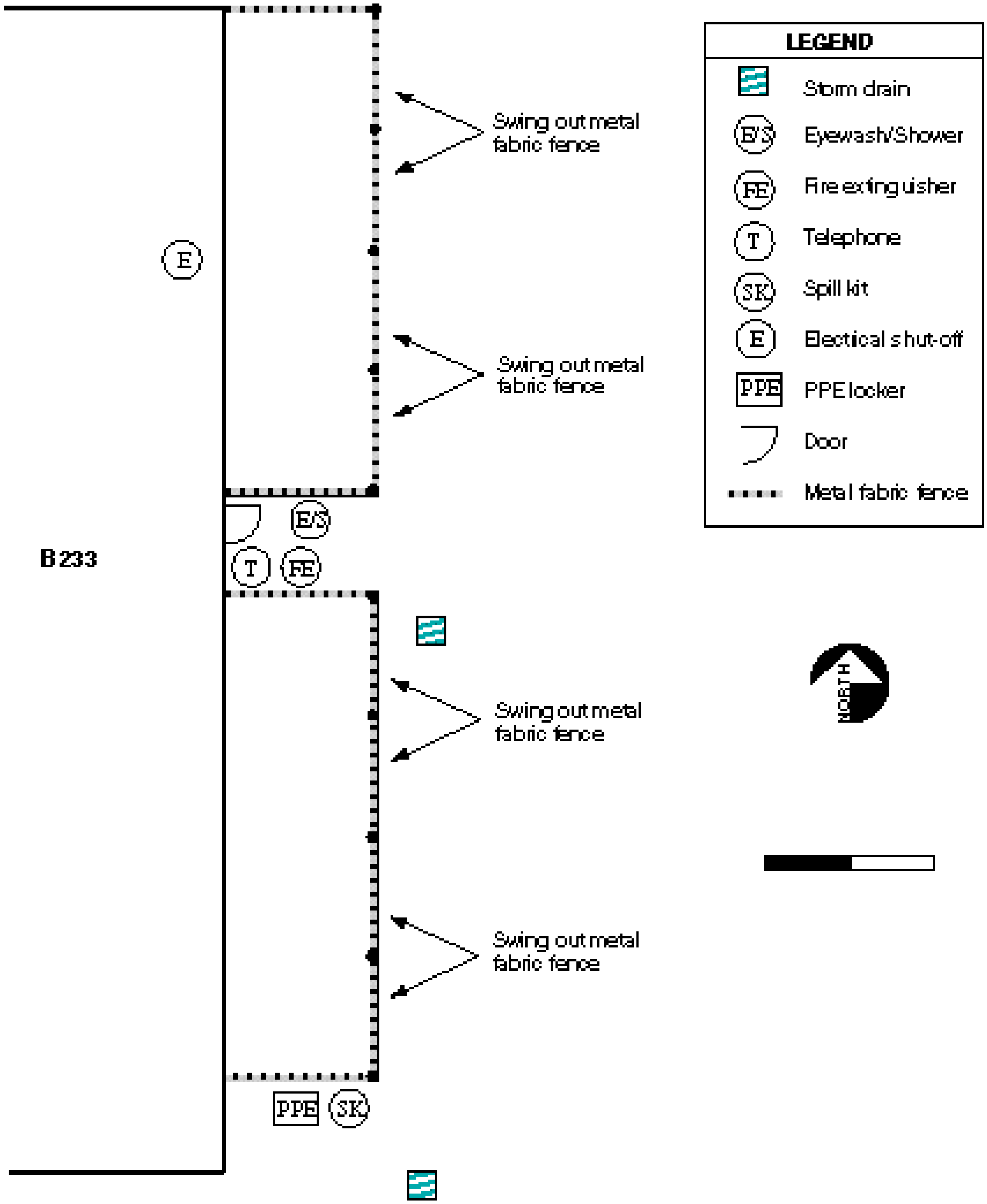

Figure 2. Schematic of the Building 233 Container Storage Unit

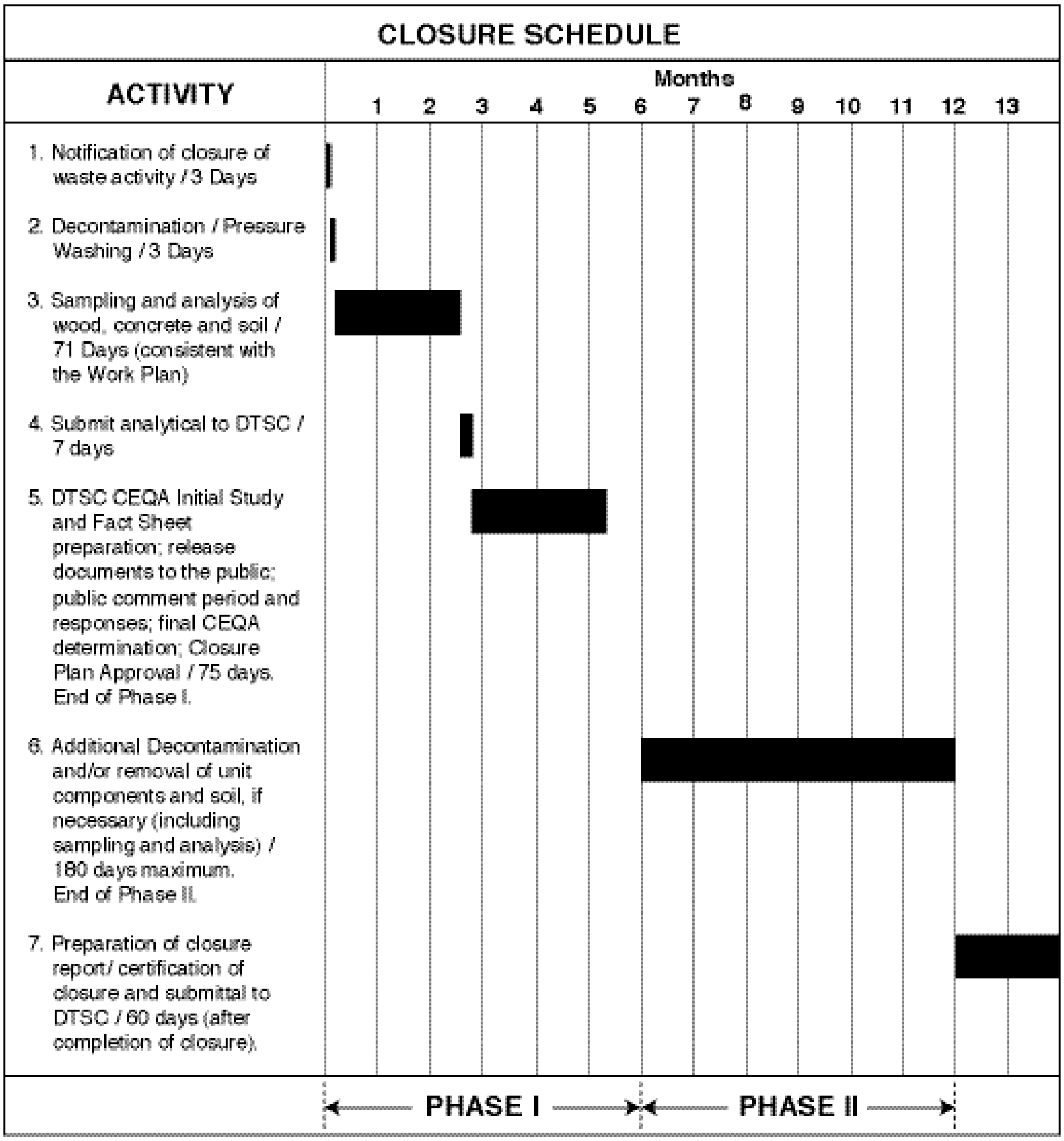

Figure 3. Closure Plan Milestone Chart for the B233 Container Storage Unit

Table 1. Parameters for Analysis and Analytical Methods for Bulk Samples, Swipes, and Wastewater Generated from Decontamination Activities

Parameter/Constituent	Method[b]	EPA Hazardous Waste Numbers[c]	California Waste Code[c]
Hazardous metals preparation[a]	California Waste Extraction Test (WET), 1310	N/A	N/A
Volatile organic compounds preparation[a]	1310	N/A	N/A
Volatile organic compound soil matrix sampling	5035	N/A	N/A
Asbestos	OSHA ID-191 or NIOSH 9002	N/A	151
Antimony	6010	N/A	181
Arsenic	6010 or7061	D004	181
Barium	6010	D005	181
Beryllium	6010	N/A	181
Cadmium	6010	D006	181
Chromium (total)	6010	D007	181
Chromium VI	7199	D007	181
Copper	6010	N/A	181
Total Cyanide	9010	N/A	181
Lead	6010	D008	181
Mercury	7470 or 7471	D009	181
Nickel	6010	N/A	181
Selenium	7740 or 7741	D010	181
Silver	6010	D011	181
Thallium	6010	N/A	181
Vanadium	6010	N/A	181
Zinc	6010	N/A	181
Acetone	8260	D001	212
Volatile halogenated organics [d]	8260	D019, D035, D039, D040	351
Volatile aromatics[e]	8260	D018,	352

Table 1. Continued

Parameter/Constituent	Method[b]	EPA Hazardous Waste Numbers[c]	California Waste Code[c]
Semi volatiles[f]	8270	N/A	352
Pesticides[g]	8081	N/A	N/A
PCBs	8082	TSCA	261
pH[h]	9095	N/A	352
Gross alpha	9310	N/A	N/A
Gross beta	9310	N/A	N/A
Tritium	ASTM D-2476	N/A	N/A
Oil and grease	9070	N/A	352

[a] Parameters based on 22 CCR 66700, Zero Headspace Extraction (ZHE).

[b] Refers to EPA, 1983, unless otherwise noted.

[c] Parameters based on 22 CCR Section 66700. Codes applicable to solids, liquids with higher values may qualify for restricted California codes. If soil contamination is found in the soil, then cleanup California DTSC codes will be applied (611).

[d] Includes carbon tetrachloride, chloromethane, ethylene dichloride, methyl ethyl ketone, methylene chloride, tetrachloroethylene, trichloroethane, trichloroethene, trichlorofluoromethane, and trichloromethane.

[e] Includes benzene, hexachlorophenol, toluene, and xylene.

[f] Includes dichlorophenoxyacetic acid and pentachlorophenol.

[g] Includes endrin, heptachlor.

[h] If pH is less than or equal to 2, an anion test will be performed to test for acetic acid hydrochloric acid, nitric acid, phosphoric acid, and sulfuric acid. If the pH is greater than or equal to 12, the material will be characterized as containing Sodium hydroxide based on generator knowledge.

ASTM = American Society for Testing and Materials.

N/A = Not applicable.

Table 2. Decontamination Approaches

Contaminant	Localized Area	Widespread Area
Radioactive materials	1. Cloth wipes and detergent[a] 2. Mild acid solution[b] 3. Top layer removal[b]	1. High-pressure steam and water 2. Mild acid solution[b] 3. Top layer removal[b]
Metals	1. Cloth wipes and detergent[a] 2. Chelating agent (EDTA disodium salt) 3. Top layer removal	1. High-pressure steam and water 2. Chelating agent (EDTA disodium salt) [b] 3. Top layer removal[b]
Oil and grease	1. Cloth wipes and detergent[a] 2. High-pressure steam and water[b] 3. High-pressure steam with trisodium phosphate[b]	1. High-pressure steam and water 2. High-pressure steam with trisodium phosphate[b] 3. Top layer removal[b]

[a] Detergent to be used must contain trisodium phosphate.

[b] Used only if first procedural step fails to remove contamination.

References: Unterberg and Melvoid et al (1980); Esposito (1987).

Table 3. Estimates of Quantities of Waste to Be Generated during Decontamination Activities

Waste Type	Estimated Quantity to Be Generated	Decontamination or Disposition Method
Disposable rubber gloves, boots, and other personnel protective gear	15 ft^3	Containerize for off-site disposal.
Miscellaneous rags, paper, and disposable sampling materials	5 ft^3	Containerize for off-site disposal.
Spent decontamination liquids	1500 gal	Store for on-site treatment or containerize for off-site treatment and/or disposal.

Table 4. Containers Used to Manage Waste Generated during Closure Activities

Container Type	UN Specifications	Lining	Waste Type
55-gal steel drum	UN 1A1, UN1A2 (with inner containers)	Appropriate liner, if required	Waste oils, photochemicals, halogenated solvents, flammable solvents, waste paints
5-gal polyethylene and Nalgene carboys	UN 1H1	None	Waste acids, photochemicals
55-gal steel drum	UN 6HA1	Polyethylene bladder	Waste acids, photochemicals
30-gal steel drum	UN 1A2	Appropriate liner, if required	Ash, dirt, miscellaneous dry waste
Various sizes (>119-gal capacity), wooden or steel boxes	UN 11G, Non-DOT spec	Appropriate liner, if required	Asbestos, miscellaneous equipment, solid waste
5-gal steel can	UN 1A2	Appropriate liner, if required	Solid and liquid waste, aerosols, miscellaneous small items to be overpacked in container
55-gal steel drum	UN 1A2	Appropriate liner, if required	Ash, solid waste, miscellaneous equipment
5-gal, polyethylene container with cap	UN 1H1	None	Aqueous/organic solutions
5-gal, metal can with screw cap	UN 1A1	None	Aqueous/organic solutions, halogenated and flammable solvents
5-gal can with lid	UN 1A2	Appropriate liner, if required	Solid and liquid waste, aerosols, miscellaneous small items to be overpacked in container
85-gal steel overpack drum	UN 1A2	Appropriate liner, if required	Overpack for leaky, bulging, or damaged 55-gal drums
110-gal, steel overpack drum	UN 1A2	Appropriate liner, if required	Overpack for leaky, bulging, or damaged 55-gal drums
330-gal, polyethylene portable tank	UN 31H, Non-DOT spec	None	Aqueous solutions of: waste acids, photochemicals, caustic waste, organic/inorganic solutions
600-gal, polyethylene portable tank	UN 31H, Non-DOT spec	None	Aqueous solutions of: waste acids, photochemicals, caustic waste, organic/inorganic solutions, oil, halogenated solvents, flammable solvents

Table 4. Continued

Container Type	UN Specifications	Lining	Waste Type
625-gal, stainless-steel portable tank	UN 31A, Non-DOT spec	None	Aqueous solutions of: waste acids (no HCl), photochemicals, caustic waste, organic/inorganic solutions, oil, halogenated solvents, flammable solvents
Seamless steel cylinder	DOT specification 3A and 3AX	None	Compressed gas
Seamless steel cylinder	DOT specification 3AA and 3AAX	None	Compressed gas
Seamless steel cylinder	DOT specification 3B	None	Compressed gas
Seamless nickel cylinder	DOT specification 3BN	None	Compressed gas
Steel cylinder with porous fillings	DOT specification 8	None	Compressed gas; acetylene
Steel cylinder with porous fillings	DOT specification 8AL	None	Compressed gas; acetylene
Non-reusable (non-refillable) cylinder	DOT specification 39	None	Compressed gas
Lecture bottles and other small non-spec cylinders and spheres	None	None	Compressed gas

Table 5. Maximum Allowable Concentrations for Metals in Soil Calculated at the 99.5% Confidence Level

Metal	Maximum Total Concentration (mg/kg)
Antimony	1.12
Arsenic	8.51
Barium	308
Beryllium	0.62
Cadmium	1.59
Chromium	72.4
Chromium VI	NA[a]
Cobalt	14.6
Copper	62.5
Lead	43.7
Mercury	0.14
Molybdenum	2.5
Nickel	82.8
Selenium	0.4
Silver	2.5
Thallium	0.5
Vanadium	65.2
Zinc	75.3

[a] Any detection of Chromium VI is considered above background.

Source: Folks, 1997.

Table 6. Action Limits/Release Limits for Naturally Occurring Radioactive Material in Soils and Soil Analogues (Volumetric)

Criteria	Action Limit/Release Limit
Alpha	<15 pCi/g
Beta	<25 pCi/g

pCi/g = picocuries per gram

Table 7. Total Metals Concentrations for Metals in Uncontaminated Concrete

Metal	Number of Samples	Mean Concentration (mg/kg)	Minimum Level Detected	Maximum Level Detected	Calculated Background Levels
Antimony	–	–	–	–	–
Arsenic	38	3.68	1.49	8.5	6.8
Barium	37	281.79	39	420	428
Beryllium	–	–	–	–	–
Cadmium	38	2.65	1	2.9	2.4
Chromium	38	42.10	13.1	60.7	59
Cobalt	38	7.97	1.5	13.3	12.5
Copper	38	38.34	12.2	55.4	51.2
Lead	37	14.55	5.7	45.4	31.6
Manganese	37	380.60	91	626	567
Mercury	34	1.70	0.016	0.41	0.30
Molybdenum	37	5.20	0.29	1.6	1.5
Nickel	38	41.62	6.1	64.7	61.5
Potassium	38	1485.98	710	2540	2160
Selenium	–	–	–	–	–
Silver	35	1.88	0.29	1.4	1.3
Strontium	38	122.92	48.9	187	169
Thallium	–	–	–	–	–
Vanadium	38	38.43	9.7	54.6	56.4
Zinc	37	87.47	29.8	269	153

Appendix A
Sampling and Analysis Plan
for the Final Closure of the
Building 233 Container Storage Unit

Appendix A. Sampling and Analysis Plan for the Final Closure of the Building 233 Container Storage Unit

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Appendix A. Sampling and Analysis Plan for the Final Closure of the Building 233 Container Storage Unit

I. Introduction

I.1 Purpose

This document establishes the plan and procedures for the sampling and the analyses of the Building 233 (B233) Container Storage Unit (CSU) at Lawrence Livermore National Laboratory (LLNL) in conjunction with its Resource Conservation Recovery Act (RCRA) closure.

Building 233 is a structural-steel-frame building with a metal roof, slab floor, and wood-slatted chain-link fence for side walls (see Figure A-2). The B233 CSU is a 1350-square-foot structure that consists of two storage cells, each measuring 15 feet by 40 feet.

I.2 Objective

The objective of this Sampling and Analysis Plan (SAP) is to ensure that the B233 CSU structures and soils are adequately characterized for final closure and proper disposal. The Debris Rule will be utilized as a characterization and disposal option when applicable. When appropriate, structures, roofing, and non-contaminated items will be disposed of as scrap.

II. Scope of Work for Closure

The overall scope of work for closure is discussed in the main portion of this closure document. Sampling and analysis results and generator knowledge will be used to characterize the hazardous nature of the main structures, concrete, and soil. Items will be managed according to the levels of hazardous constituents remaining, as determined by the results of the sampling and analysis activities and data. Sampling and analysis activities for B233 CSU will be divided into two stages:

- Samples will be taken and analyzed of the structure of the B233 CSU.
- Concrete, and soil samples will be taken at the surface and at the incremental depths of 2, 5, 10, 15, and 20 feet and analyzed.

The two activities above will occur in two phases. In general, Phase I activities will include initial decontamination and characterization of the unit, concrete, and underlying soil. Phase II activities will consist of remediation and verification activities if analytical results exceed clean-up levels for the project.

III. Sampling

III.1 Sampling and Analysis Procedures

Sampling and analysis will be performed using California-certified laboratory procedures and Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846, U.S. Environmental Protection Agency [EPA], 1986). The applicable SW-846 method will be selected based on the constituent(s) suspected from a specific waste stream. Table A-1 lists the SW-846 test method for various constituents. Sampling frequencies have been determined using rationale provided in SW-846 (EPA, 1986).

Swipe sample locations will use the following sampling quadrate (**Figure A-1**) for sample acquisition. Each section is 100 square centimeters and will be sampled in a stratified sequential format. The sequential format is to survey and swipe followed by bulk acquisitions as appropriate.

III.2 Pre-sampling Requirements

During the release activities for RCRA closure, the LLNL Radioactive and Hazardous Waste Management (RHWM) Division will decontaminate B233 CSU items to remove radiological residues. However, if decontamination is not successful, items will be disposed of as radioactive; as radioactive-containing, California-regulated components or as RCRA mixed waste. The LLNL Hazards Control Department will evaluate the analytical results and release the Unit or Items for closure.

III.3 Sample Control, Sample Tracking, and Data Control

Analytical sample custody and the analytical sample custody logbooks are to be handled and preserved as described in this section. Additional standard operating procedures will be provided by the contractor.

III.3.1 Sample Control and Documentation

III.3.1.1 Field Logbooks

A complete record of all samples and sampling events will be maintained by making entries into field logbook(s). Field logbooks are bound volumes with consecutively numbered pages. The sampling team leader assigns each logbook a unique code and issues the logbooks upon request. A list of issued logbooks and their locations is maintained by the sampling team leader. Completed logbooks are returned to sampling team leader.

Entries in the sampling field logbooks reflect the sampling event and include the following information:

- Date and time of sampling.
- Sample identification (ID) code.

- Method of sample collection, including preservation techniques, size or volume, description of the matrix of the sample, and any deviations or anomalies noted.
- Requested analysis and analytical laboratory performing the analysis.
- Condition of sampling site relevant to sample validity when applicable.
- Results of associated field measurements.
- Calibration information pertaining to field instruments used for the sampling event.
- ID of field personnel performing the work.
- ID of field equipment (model number, serial number).
- Special notes of other activities in the area that may have an impact on analytical results.

Specific field data collection forms might be used during sampling activities. Each data collection form initiated during sampling becomes a controlled document and receives a document control number. The document control number is derived from the logbook code and the logbook page number that was used to document that sampling event.

III.3.1.2 Chain-of-Custody (CoC) Records

The primary objective of using CoC documents is to create an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and receipt of data.

Issuance and Archival of CoC Records

- CoC forms are provided by the sampling team leader.
- Completed CoC records are archived by the sampling team leader.

Required Documentation

Each CoC document will be completed using waterproof ink and contain the following information:

- Document control number.
- Sample matrix code.
- Name of sampler and employer.
- Requested analysis code.

- Number and type of container(s).
- Sample ID and sample date/time.
- Area from which the sample originated.
- Name of the analytical laboratory name where the samples are to be sent as designated by the Sampling Plan.
- Requester name. This is the organization for which the samples are being collected.
- Additional information/instructions or remarks. The remarks section should also indicate whether field filtration and preservation has been performed, or if it is required upon receipt at the lab.

III.3.1.3 Sample Identification Labels

ID labels are to be used when tagging or labeling sample containers. The sampling personnel may fill out sample container labels after collecting samples or prior to collecting samples at each location. Waterproof ink will be used on the label.

Issuance and archival

Sample labels may be obtained from the analytical laboratory where the samples are to be sent. The field personnel will have a small stock on hand at all times. Labels are not archived and are destroyed with sample disposal at the laboratory.

Required Documentation

The Sample ID Label will include the following information:

- Sample ID. The sample ID can be made up from the combination of various factors such as location, sample type, etc. If a new location is to be sampled or an experiment is to be conducted, the Project Leader will approve all new sample IDs.
- Project name.
- Sample date. The date when the sample was collected.
- Sample time. Time is recorded according to the 24-hour clock (e.g., 1:00 a.m. = 0100 hours, 3:00 p.m. = 1500 hours).
- Samplers' initials. The initials of personnel conducting the sampling.
- Preservation method. Any preservative added to the sample should be indicated.

- Comments. Any additional information should be provided in the Comments section.

- Requested analysis. The type of analysis to be performed on the sample.

III.3.2 Sample Container and Preservation

Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing. Methods of preservation are intended to retard biological action and hydrolysis of chemical compounds and complexes, and to reduce the volatility of analytes and adsorption effects.

Containers can introduce positive or negative errors by contributing contaminants through leaching or surface desorption, and depleting concentrations through adsorption. Therefore, containers such as Borosilicate glass, linear polyethylene, polypropylene, or Teflon will be used for collecting environmental media.

All sample containers will be pre-cleaned. Volatile Organic Analysis (VOA) vials will be certified clean by the vendor. Using this Sampling Plan, sampling personnel will determine the type of bottles, preservatives, holding times, and filtering requirements. Sample containers will be filled so that the sample does not come into contact with the sampler's gloves, thus potentially causing contamination.

If the samples are to be preserved, sampling personnel will consult a Quality Control Chemist to determine the approximate volume of acid (or base) needed to preserve a sample and then use the pre-determined amount of acid (or base).

If samples that require preservation at the time of collection cannot be preserved in the field or upon returning from the field, samples will be preserved by the laboratory immediately upon receipt. This will be clearly noted on the CoC document. In all cases, samples are to be preserved within 12 hours from the time of collection except in the instances where the samples can be analyzed within their unpreserved holding time.

Samples requiring refrigeration of 4˚C will be protected from getting wet. Samples will be immediately placed in an ice chest containing either Blue Ice packs (in air-tight plastic bags), or bagged or loose ice cubes. A temperature blank will always be included in the ice chests so that the laboratory can check the temperature of the cooler at time of sample receipt. If samples are not submitted to the laboratory daily, ice chests will be checked periodically and thawed ice replaced.

Sample preservation methods will be noted in the sampling logbook, on the sample label, and on the CoC form, as appropriate.

III.3.3 Shipping

All samples will be shipped off site according to the U.S. Department of Transportation regulations.

Properly identified sample containers will be placed inside Ziploc®-type storage bags, sealed, and then placed in picnic-cooler-type containers. Samples to be shipped will be packed with sufficient incombustible, absorbent cushioning material to minimize the possibility of sample container breakage. Samples that require refrigeration during shipping should be packed with a sufficient number of Blue Ice packs or bagged ice cubes to keep the samples preserved. Temperature blanks will accompany all samples that require temperature preservation (4°C). They consist of a 250-milliliter poly container or equivalent filled with water. The receiving analytical laboratory will be instructed to measure these blanks to ensure sample integrity.

III.4 Component Characterization

Generator knowledge, swipe, and bulk-sampling will be used to characterize wastes for proper disposal. **Table A-2** summarizes how Unit components will be characterized.

III.5 Sampling Methodology

Sampling methodology is discussed in this section and in **Section III.6**. This section focuses on sampling activities that will occur above ground: the supporting structures, beams, and roofing; dry wastes from decontamination activities; and the surface and below-surface concrete-asphalt[1]-soil (CAS) layer. Any above-surface sampling activities can be done simultaneously or in any convenient sequence as long as all controls and procedures are followed. **Section III.6** focuses on sampling activities at below-surface levels.

III.5.1 Structures and Roofing

The B233 CSU is a 1350-square-foot structure consisting of two storage cells, each measuring 15 feet by 40 feet. B233 is a structural-steel-frame building with a metal roof, slab floor, and wood-slatted, chain-link fence for side walls (see **Figure A-2**). The concrete floor of each cell is sloped from the unit's east exterior barrier to the west interior cinder block wall, which is shared with B233. The back wall and the side walls measure approximately 14 feet and 12 feet respectively. See the reference photographs included as **Attachment A to this appendix**.

The ceiling, floor, and the walls will be surveyed and swiped sampled using the quadrate format (**Figure A-1**) prior to removal. The swiped samples will be collected using swipe tabs. The following sampling frequency and selection criteria will be followed:

- Ceiling—Swipe one sample from the center of the ceiling. One swipe sample will be obtained from each cell. A total of two swipes will be obtained for analysis.

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[1] Asphalt sampling will be conducted if applicable.

- Floor—Three sample locations from the floor of each cell will be identified for concrete and soil sampling. Two low areas and one cracked concrete area or an area with damaged epoxy coating will be identified per cell. Bulk concrete and soil samples (not swipes) will be obtained for analysis. A total of 12 soil samples (three per cell, two samples from each borehole) and a total of six concrete samples will be obtained for analysis.

- Back wall— Three bulk samples will be obtained from each cell. A total of six samples from each cell will be obtained for analysis.

- Side walls and front gates—Three bulk samples of the slats from each cell will be sampled. A total of six bulk samples will be obtained.

In addition, any areas with visual signs of staining will be sampled.

III.5.2 Supplies and Supporting Equipment

All supplies not removed from the B233 CSU during the implementation of this Closure Plan will be surveyed and swiped before they are released and disposed of. This sampling will also include such items as the electrical control board, lighting, and any other supporting materials that are in the facility but that are not necessarily in direct contact with the treatment or storage activities.

III.5.3 Dry Wastes from Decontamination

Resulting dry wastes (e.g., chemwipes and rags) from decontamination and sampling efforts will be sampled and characterized by the analysis results.

III.5.4 Soil Sampling

Soil, asphalt, and concrete will be sampled and analyzed to determine the presence of contamination.

To fully characterize the components of the B233 CSU, the unit will be sampled as described in this SAP. See **Figure A-3** for sample locations and the reference photographs included as **Attachment A**.

Accepted drilling methods will be used to obtain a core sample of concrete, followed by taking samples of soil underlying the concrete at the surface and at incremental depths of 2, 5, 10, 15, and 20 feet.

The concrete and soil samples taken at the surface and at the 2-foot depth at each location will be analyzed first. Should analytical results indicate contamination in these samples, analysis will be performed on the samples taken at the 5-foot and 10-foot depths. If contamination is not found in two consecutive depths, the deeper samples will not be analyzed, and the area will be considered "clean."

The concrete and soil samples will be analyzed for organic, inorganic, and radiological parameters, as described in **Section IV.4**, Subsurface Sample Acquisition.

If a crack in the secondary containment floor areas penetrates the depth of the concrete, additional soil samples will be obtained to determine the possible nature and extent of contamination. The depth of a crack will be determined by visual examination with the aid of a 7–10 times, handheld magnification lens. For reference purposes, sample locations will be documented on a map of the area, which is maintained in field logs.

IV. Analysis Criteria

The structure and the below-ground-level soils will be sampled and analyzed for radioactive and hazardous contaminates. Radioactive and hazardous analysis will be performed by a California-certified laboratory. Hazardous constituents are analyzed per SW-846 (EPA, 1986). Components and wastes are characterized, as described in **Table A-2**.

IV.1 Hazardous Constituents

To determine the Constituents Of Concern (COC) at the B233 CSU site, LLNL's waste database was searched going back to 1986. Personnel who are familiar with the operations of the CSU were also interviewed. The following were identified as constituents of concern. To fully characterize the site, however, LLNL included other constituents.

Constituents Of Concern

Chemical Constituents	Radioactive Constituents
Acetic Acid	Americium-241*
Acetone	Americium-242*
Arsenic	Americium-242m*
Asbestos*	Americium-243*
Barium	Californium-249*
Benzene	Californium-252*
Beryllium*	Curium-243*
Cadmium*	Curium-244*
Carbon tetrachloride	Cobalt-60*
Chloromethane	Depleted Uranium*
Cyanide	Europium-152*
Dichlorophenoxyacetic acid	Naturally Occurring Uranium*
Endrin	Neptunium-237*
Ethylene dichloride	Plutonium-238*
Freon TF*	Plutonium-239*
Heptachlor	Plutonium-240*
Hexavalent chromium	Plutonium-241*

Hydrochloric acid	Plutonium-242*
Lead*	Thorium-228*
Mercury	Uranium-233*
Methyl ethyl ketone	Uranium-235*
Methylene chloride	Uranium-238*
Nitric acid	
Oil*	
Polychlorinated biphenyls (PCBs)	
Pentachlorophenol	
Phosphoric acid	
Potassium hydroxide	
Selenium	
Silver*	
Sodium hydroxide	
Sulfuric acid	
Tetrachloroethylene	
Toluene	
Trichloroethane	
Trichloroethylene*	
Trichlorofluoromethane	
Trichloromethane	
Xylene	

* denotes constituents of concern for the CSU

Metal swipe samples will be analyzed using Total Threshold Limit Concentration (TTLC) methodology.

Any bulk sample will be characterized in accordance with hazardous waste criteria for inorganic substances, as specified in Title 22 of the *California Code of Regulations* (CCR), Section 66261.24(a)(2) Table II. The test methods used are based on Soluble Threshold Limit Concentration (STLC) and TTLC parameters. The STLC analysis employs the California Waste Extraction Test (WET). If the STLC or TTLC limits are equaled or exceeded, the waste is considered hazardous waste. The STLC/WET analysis will be conducted if the total concentration of the waste constituent is equal to or greater than 10 times the STLC hazardous waste threshold.

Bulk samples will also be analyzed using toxicity-characteristic leaching procedure (TCLP) for metals and organics using the Zero Headspace Extraction (ZHE) method (22 CCR 66700), (as well as STLC and TTLC metals, and cyanide). The resulting TCLP extract will be analyzed for Volatile Organic Compounds, volatile aromatics, semi-volatiles, and PCBs. These analyses give speciated organic substances, whose TCLP values are presented in **Table A-3**. If the TCLP, STLC, or TTLC values are equaled or exceeded in the waste, the waste is considered hazardous waste. The TCLP will be conducted if the total concentration of the waste constituent is equal to or greater than 20 times the TCLP hazardous waste threshold.

Bulk and swipe samples will undergo the following analyses by a California-certified laboratory using the methods listed in **Table A-1** and in accordance with the Sampling Plan Summary in **Table A-4**:

- STLC procedure for metals using the California WET.
- TTLC procedure for metals using methods listed in **Table A-1.**
- TCLP procedure for metals using the SW-846 (EPA, 1986).
- TCLP for organics. The sample will be extracted using ZHE. The resulting extract will be analyzed for VOCs, volatile aromatics, semivolatiles, and petroleum hydrocarbons.
- PCB analysis by EPA Method 8082 (**Table A-1**).
- Cyanides determination using a method listed in **Table A-1.**

IV.2 Decontamination Wastewater Analysis

Decontamination activities will be performed using the methods described in **Table A-5** of this SAP. Collected aqueous waste generated during decontamination activities will be treated and analyzed in accordance with **Table A-2**, and the data compared to the City of Livermore Water Reclamation Plant (LWRP) sewer discharge requirements and limits in effect at the time of closure.

IV.3 Rain Water

Rain water that enters the secondary containment system during these activities will be sampled and analyzed in accordance to the Waste Analysis Plan (WAP) in the 1998 Part B Permit Application (LLNL, 1998).

IV.4 Subsurface Sample Acquisition

Subsurface sampling locations are identified as indicated in **Figure A-3** for matching locations. See also the reference photographs included as **Attachment A**.

All subsurface sampling and analysis locations are referred to as Concrete-Asphalt-Soil (CAS). All samples depth locations will be analyzed for any radiological contamination (that is, alpha, beta, and tritium). If there were a positive response from the alpha or the beta analysis, a follow-up with alpha and gamma analysis for identification of related isotopes will be performed.

CAS samples will be analyzed for radiological, organic, and inorganic parameters as indicated in **Tables A-1** and **A-2.** CAS samples will be taken at incremental depths of surface, 2, 5, 10, 15 and 20 feet. Samples will be taken and evaluated in decreasing depth, starting with a surface soil sample and a second sample at 2 feet. If the results of two consecutive depth locations do not show contamination, that sample location zone will be considered clean. Analytical results of the concrete sample will be compared with treatment standards (i.e., clean close limits in **Table A-6** for metals) to determine whether any residual contamination that might be detected is from waste management activities in the unit or is an artifact of the concrete itself. The concrete total metals concentrations shown in **Table A-6** were obtained by sampling several onsite areas without any known history of contamination.

IV.4.1 Radiological Constituents

Swipe results will be evaluated and compared to DOE release levels. Soil and concrete samples will be analyzed for radioactivity by means of a bulk radiochemical analysis for alpha, beta, and tritium radioactivity.

V. Data Evaluation

The resulting data will be evaluated according to the following:

- Metal swipe will be analyzed by TTLC methodology.
- Core samples and concrete samples will be analyzed in accordance with SW-846 (EPA, 1986) to test for respective contaminants.
- The acquired CAS samples will be analyzed for radioactivity using the methods listed in **Table A-1**. **Table A-7** lists the action limits/release limits for naturally occurring radioactive materials in soil and soil analogues for alpha and beta. Results for metal analyses will be compared to the clean closure levels in **Table** A-8 for soil and **Table A-6** for concrete. Analysis results will be compared with regulatory agency health-based standards for other hazardous constitutents.

VI. Quality Assurance/Quality Control

Quality assurance (QA) is a management system for ensuring that all information, data, and decisions are technically sound and properly documented. This SAP contains guidance for the parameters in the following list:

- Sampling and decontamination.
- Sample custody.
- Calibration procedures and frequency.
- Analytical procedures.

- Data reduction, validation, and reporting.
- Internal quality control checks.
- Frequency, performance, and system audits.
- Specific routine procedures used to assess data precision, accuracy, and completeness.
- Corrective actions.
- QA reports to management.

This section provides information on QA objectives for the procedures and the data relevant to this SAP. QA considerations for procedures include field and laboratory techniques. Data quality is assessed by determining the precision, accuracy, representivity, comparability, and completeness (PARCC) parameters.

VI.1 Quality Assurance Chain-of-Custody Practices

For each sample collected in the field, sampling personnel will follow the practices described in **Section III.3.1**, including the use of field logbooks and a CoC document and a standard identification label to accompany each sample at all times. The CoC form will accompany the samples through the sampling and analysis process. When samples change custody, the relinquishing and the receiving parties sign the CoC document.

VI.2 Quality Assurance Performance Criteria

All sampling and analysis activities will be performed in accordance with the QA/quality control (QC) practices described in this SAP and according to the *Laboratory Quality Assurance Plan* (LLNL, 1992) and related procedures. Contract laboratories selected to perform any of the analytical tests will possess a laboratory certification from the California Department of Toxic Substances Control (DTSC) and will conform to the related certification QA/QC requirements.

VI.3 Quality Assurance /Quality Control Practices

The QA/QC practices to be followed during the execution of this plan are summarized in this section. Adherence to these practices will produce data capable of withstanding scientific and legal evaluation.

VI.3.1 Field QA/QC

Field QA/QC is ensured by uniform procedures for sample collection, handling, CoC, and shipping and by evaluation of QC samples collected in the field. Field samples used to assess QA/QC are the following:

- Field blanks.

- Trip blanks.
- Rinsates (equipment blanks).
- Swipe blanks.
- Field replicates.

All samples are collected in accordance with EPA SW-846-approved procedures. For the B233 Closure Plan, one replicate sample will be taken for each matrix at the time of sampling (i.e., soil, swipe, concrete chips). Samplers will choose the most likely contaminated spot to collect the replicate samples, and they will document the location of the sampling event. One trip blank will be taken for each day of sampling in which volatile analyses are requested. If swipes are taken, a clean swipe tab will be submitted. For other bulk samples, distilled water in a VOA vial will be submitted.

VI.3.2 Laboratory QA/QC

This section summarizes laboratory practices that ensure analytical QA/QC.

VI.3.2.1 General Laboratory Controls

In addition to instrument calibration and the analysis of QC samples, the California-certified laboratory that performs the analyses must implement the following analytical controls:

- Reagents and solvents will have certified compositions.
- Reagent storage environment and duration will meet the manufacturers' guidelines.
- Laboratory equipment will be calibrated/standardized following the referenced procedures for the methods used and shall be documented.
- Volumetric measurements will be made with certified glassware.
- Data reduction computations will be independently checked.
- Qualified personnel will perform laboratory analyses.
- QA/QC requirements and guidelines specified in the selected analytical methods will be followed.

These requirements are standard in a certified laboratory and will be verified during the laboratory inspection and validation process.

VI.3.2.2 Laboratory QA/QC

The laboratory performing the analysis will spike samples with a known concentration of an analyte and analyze the sample to determine the accuracy as percent recovery. The percent recovery will be recorded on the analytical QC forms. If the results fall outside internal limits, the samples will be reanalyzed. Examples of laboratory QC samples are the following:

- Method blanks.
- Method blank spike.
- Laboratory control sample for inorganics.
- Matrix spikes.
- Laboratory duplicate samples.
- Known laboratory QC check sample.

VI.4 Precision, Accuracy, Representivity, Comparability, and Completeness (PARCC)

Data will be evaluated according to the PARCC parameters in order to have a level of assurance of the quality of the measurement data. These characteristics are necessary when considering the usefulness of a set of data for interpretation.

VI.4.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. It is a quantitative measure of the variability of a group of measurements compared to their average value. Precision is assessed by means of laboratory duplicate or field replicate sample analysis and is usually stated in terms of standard deviation or relative standard deviation (coefficient of variation). Field precision will be assessed by replicate samples, field audits, and checklists performed on a routine basis. These audits will document the use (or nonuse) of uniform sampling methods and of handling and shipping procedures. Laboratory precision is assessed by duplicate samples and laboratory splits.

VI.4.2 Accuracy

Accuracy refers to the nearness of a result, or the mean of a set of results, to the true or accepted value. Accuracy measures the average or systematic error of a method. Accuracy may be determined by the evaluation of the results of field/trip blanks, field replicates, check samples, and matrix spikes. Accuracy is most often expressed as the percent recovery of the measurement of a sample with known concentration of the analyte of interest. Field accuracy will be evaluated from the results of field audits, including on-site assessment of sample-collection procedures, instrument performance, and calibration procedures. Sampling accuracy will also be assessed through the use of trip blanks and field blanks and replicates. These blanks will identify compounds inadvertently introduced into the samples during shipment or from contaminated sampling equipment.

VI.4.3 Representivity

Representivity expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. The representivity of a sample is a qualitative parameter mainly concerned with sample-collection design. Representivity is best satisfied by making sure that the sampling locations are selected properly (representative of a given point in space and time) and that a sufficient number of samples is collected. The following criteria must be met to provide evidence of representivity:

- Material content of sampling equipment and sampling containers meet criteria for acceptability of parameters to be analyzed.
- Sampling procedure does not alter samples regarding parameters of concern.
- Sample preservation procedures meet criteria for acceptability of parameters and media to be analyzed.
- Contamination of field blanks is not evident.
- Decontamination of sampling equipment between samples reveals no apparent cross-contamination.
- Collection of samples in space and time is adequate to represent the condition of concern.
- The actual measurement result represents the concept or parameter that is of interest.

VI.4.4 Comparability

Comparability refers to the qualitative parameter expressing the confidence with which different data sets can be compared. Sample data should be comparable with other measurement data for similar samples and sample conditions. Standard techniques are used to collect and analyze representative samples in order to ensure comparable results. Analytical results will be reported in appropriate units for convenient comparison to historical data.

VI.4.5 Completeness

Completeness is the percentage of measurements made that are judged to be valid. The criteria specified for precision, accuracy, representivity, and comparability for each analytical method used must be validated in order to fulfill the completeness goals. Completeness of the data is the amount of valid data obtained from a measurement system versus the amount of planned data.

VI.5 Data Evaluation

The resulting data will be evaluated according to the following:

- Core samples, swipe samples, and concrete samples are to be analyzed in accordance with SW-846 (EPA, 1986) to test for respective contaminants. Analytical results from this testing will be compared to RCRA and California hazardous regulatory limits where appropriate.
- Samples that identify hazardous constituents that do not have regulatory waste limits will be evaluated in accordance with 22 CCR 66261.24(b) and 22 CCR 66261.24(c) for toxicity characteristics.
- Swipe data from the radiological analysis will be evaluated in accordance with U.S. Department of Energy (DOE) Orders 5400.5 and 5480.11.

VI.6 Reports

At the completion of the sampling and analysis effort, a report will be generated by summarizing the analytical results.

VII. References

American Public Health Association, American Water Works Association, and Water Environment Federation (ASTM). 1993. *Standard Methods for the Examination of Water and Wastewater*, 18th edition, American Public Health Association, Washington, D. C.

California Code of Regulations (CCR), Title 22, Chapter 11, Section 66261.24, Characteristics of Toxicity (22 CCR 66261.24).

California Code of Regulations (CCR), Title 22, Section 66700, Zero Headspace Extraction (22 CCR 66700).

Esposito, M. P. et al. 1987. *Decontamination Techniques for Buildings, Structures, and Equipment.* Park Ridge, NJ, Noyes Data Corporation.

Folks, Karen. (1997). *LLNL Report of Waste Discharge for Beneficial Reuse of Soil at the Livermore Site: Technical Report 1997.* Lawrence Livermore National Laboratory, Livermore, CA (UCRL-AR-126943).

Lawrence Livermore National Laboratory. 1998. *Part B Permit Application for Hazardous Waste Treatment and Storage Facilities, Livermore Site.* Lawrence Livermore National Laboratory, Livermore, CA. October. (UCAR-10275-98).

Lawrence Livermore National Laboratory (LLNL). 1992 or latest revision. *Quality Assurance Plan.* Lawrence Livermore National Laboratory, Livermore, CA. Manual M-078-92.

U.S. Department of Energy (DOE) (1993). Order 5400.5, *Radiation Protection of the Public and the Environment.* U.S. Department of Energy, Washington, D.C. January.

U.S. Department of Energy (DOE) Order 5480.11

U.S. Environmental Protection Agency. 1986. *Test Methods for Evaluating Solid Waste.* 3rd Edition. U.S. Environmental Protection Agency, Research Triangle Park, NC (EPA SW-846).

VIII. Acronyms

ASTM	American Society of Testing and Materials
B233	Building 233
CAS	Concrete, asphalt, and soil
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chain of custody
CSU	Container Storage Unit
DOE	U.S. Department of Energy
DTSC	California Department of Toxic Substances Control
EPA	Environmental Protection Agency
ID	Identification
LLNL	Lawrence Livermore National Laboratory
LWRP	Livermore Water Reclamation Plant
PARCC	precision, accuracy, representivity, comparability, and completeness

PCB	Polychlorinated biphenyls
pCi/g	picoCuries per gram
QA	Quality assurance
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RHWM	Radioactive and Hazardous Waste Management (Division)
SAP	Sampling and Analysis Plan
STLC	Soluble Threshold Limit Concentration
TCLP	Toxicity-characteristic leaching procedure
TTLC	Total Threshold Limit Concentration
VOA	Volatile organic analysis
VOCs	Volatile organic compounds
WAP	Waste Analysis Plan
WET	Waste Extraction Test
ZHE	Zero Headspace Extraction

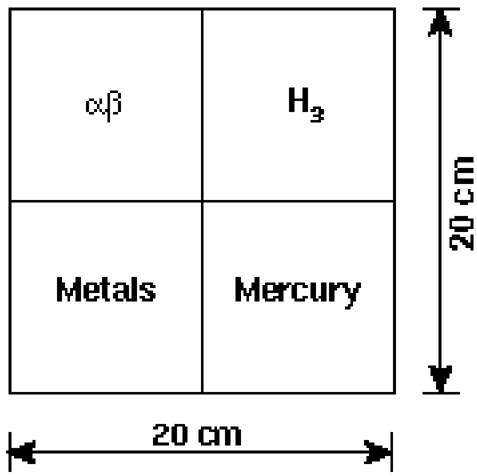

Figure A-1. Sampling Quadrate

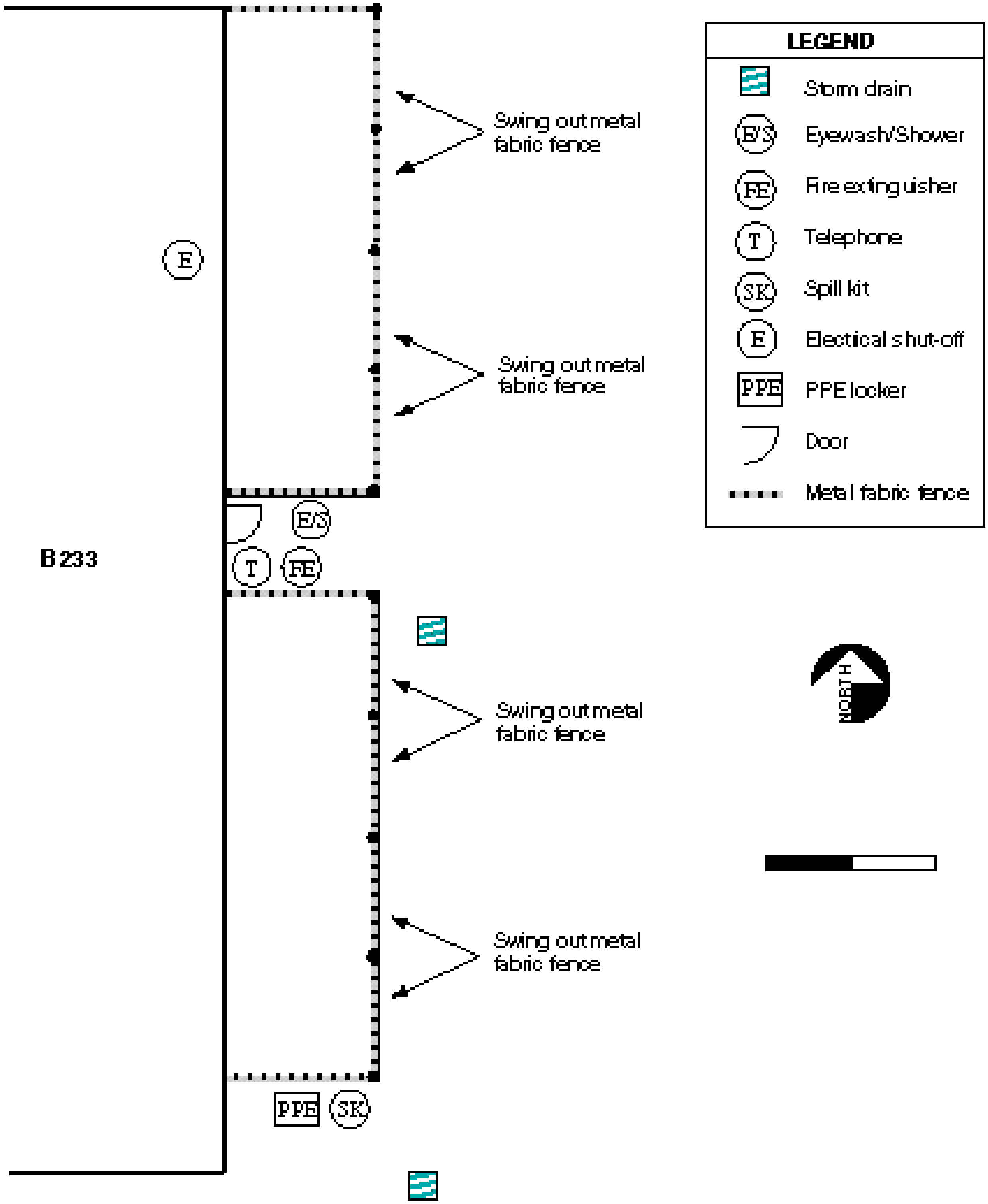

Figure A-2. Schematic of the Building 233 Container Storage Unit

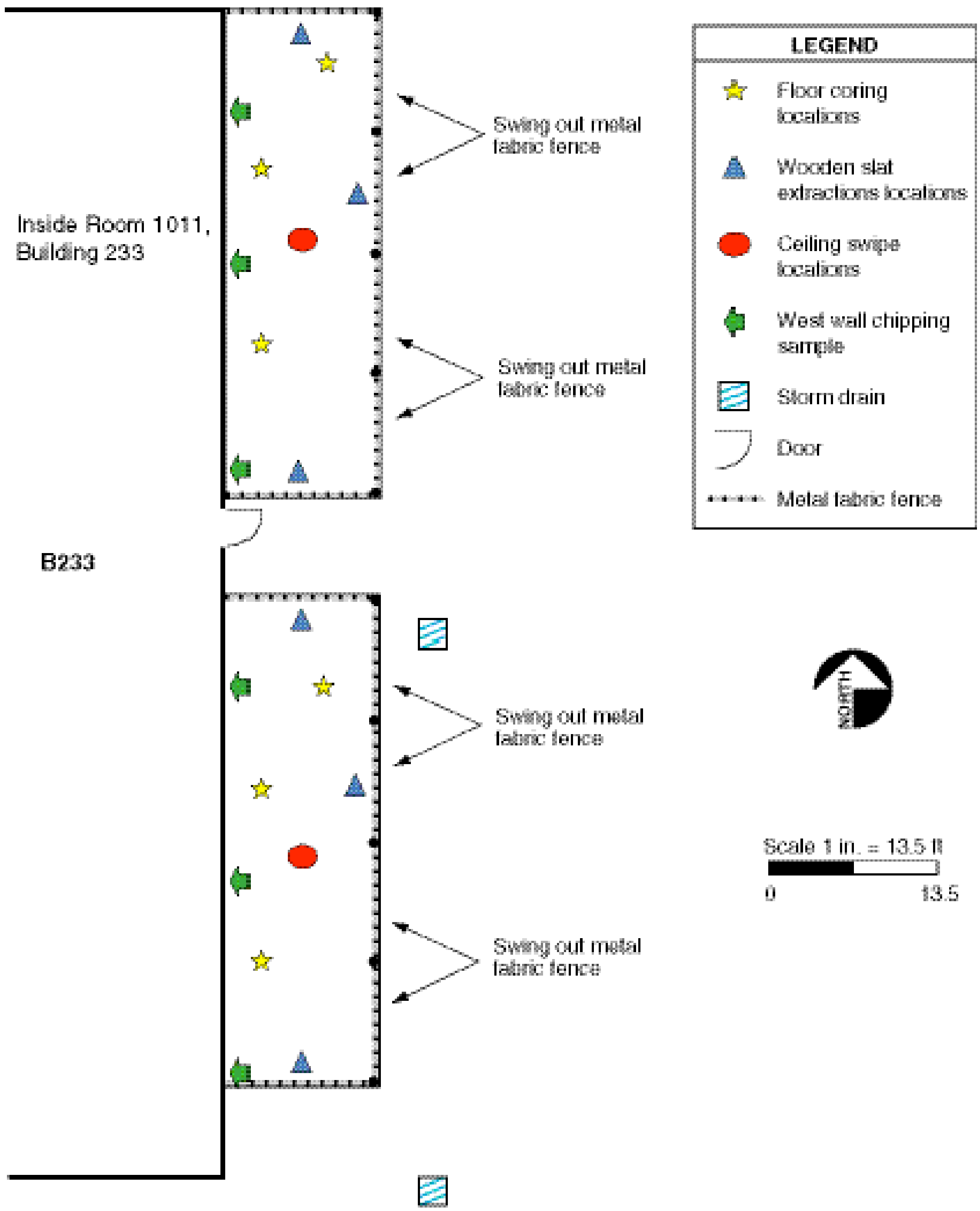

Figure A-3. Sample Locations for the Building 233 Container Storage Unit Closure

Table A-1. Parameters for Analysis and Analytical Methods for Bulk Samples, Swipes, and Wastewater Generated from Decontamination Activities

Parameter/Constituent	Method[b]	EPA Hazardous Waste Numbers[c]	California Waste Code[c]
Hazardous metals preparation[a]	California Waste Extraction Test (WET), 1310	N/A	N/A
Volatile organic compounds preparation[a]	1310 or	N/A	N/A
Volatile organic compound soil matrix sampling	5035	N/A	N/A
Asbestos	OSHA ID-191 or NIOSH 9002	N/A	151
Antimony	6010	N/A	181
Arsenic	6010 or 7061	D004	181
Barium	6010	D005	181
Beryllium	6010	N/A	181
Cadmium	6010	D006	181
Chromium (total)	6010	D007	181
Chromium VI	7199	D007	181
Copper	6010	N/A	181
Total Cyanide	9010	N/A	181
Lead	6010	D008	181
Mercury	7470 or 7471	D009	181
Nickel	6010	N/A	181
Selenium	7740 or 7741	D010	181
Silver	6010	D011	181
Thallium	6010	N/A	181
Vanadium	6010	N/A	181
Zinc	6010	N/A	181
Acetone	8260	D001	212
Volatile halogenated organics [d]	8260	D019, D035, D039, D040	352
Volatile aromatics[e]	8260	D018,	352
Semi volatiles[f]	8270	N/A	352
Pesticides[g]	8081	N/A	N/A
PCBs	8082	TSCA	261
pH[h]	9095	N/A	352

Table A-1. Continued

Parameter/Constituent	Method[b]	EPA Hazardous Waste Numbers[c]	California Waste Code[c]
Gross alpha	9310	N/A	N/A
Gross beta	9310	N/A	N/A
Tritium	ASTM D-2476	N/A	N/A
Oil and grease	9070	N/A	352
TCLP	SW846	N/A	N/A
TTLC	Title 22 CCR § 66700	N/A	N/A

[a] Parameters based on 22 CCR 66700, Zero Headspace Extraction (ZHE).

[b] Refers to EPA, 1983, unless otherwise noted.

[c] Parameters based on 22 CCR Section 66700. Codes applicable to solids, liquids with higher values may qualify for restricted California codes. If soil contamination is found in the soil, then clean-up California DTSC codes will be applied (611).

[d] Includes carbon tetrachloride, chloromethane, ethylene dichloride, methyl ethyl ketone, methylene chloride, tetrachloroethylene, trichloroethane, trichloroethene, trichlorofluoromethane, and trichloromethane.

[e] Includes benzene, hexachlorophenol, toluene, and xylene.

[f] Includes dichlorophenoxyacetic acid, and pentachlorophenol.

[g] Includes endrinand heptachlor.

[h] If pH is less than or equal to 2, an anion test will be performed to test for acetic acid, hydrochloric acid, nitric acid, phosphoric acid, sulfuric acid. If the pH is greater than or equal to 12, the material will be characterized as containing Sodium hydroxide based on generator knowledge.

ASTM = American Society for Testing and Materials.
N/A = Not applicable.

Table A-2. Building 233 Container Storage Unit Component and Waste Characterization[a]

Unit Component or Waste	Radiological Constituent	Metals Residue	Organic Residue	Other
Concrete wall/floorand soil samples	Bulk analysis	Bulk analysis—STLC, TTLC, TCLP metals	TTLC, STLC, TCLP organics using ZHE: volatile halogenated organics, volatile aromatics, semivolatiles, oil and grease, and PCBs	Generator knowledge
Decontamination wastewater	Bulk radiochemical analysis	Bulk analysis—STLC, TCLP,, TTLC	8010, 8020, 8240 or 8260, 8082	pH, cyanide
Decontamination sludges and residues	Bulk radiochemical analysis	Bulk analysis—STLC, TCLP,, TTLC metals	TTLC, STLC, TCLP organics using ZHE: volatile halogenated organics, volatile aromatics, and semivolatiles, PCBs	Generator knowledge
Selected slats	Bulk radiochemical analysis	Bulk analysis-STLC metals including Hg, TCLP, TTLC metals	TTLC, STLC, TCLP organics using ZHE: volatile halogenated organics, volatile aromatics, and semivolatiles, PCBs	Generator knowledge
Ceiling, floor, and back walls	Bulk radiochemical analysis	Bulk analysis-TTLC metals, including Hg, STLC, TCLP metals	TTLC, STLC, TCLP organics using ZHE: volatile halogenated organics, volatile aromatics, and semivolatiles, PCBs	Generator knowledge
Roof and support structure	Bulk radiochemical analysis	Bulk analysis—TTLC, STLC, TCLP metals	TTLC, STLC, TCLP organics using ZHE: volatile halogenated organics, volatile aromatics, and semivolatiles, PCBs	Generator knowledge

Table A-2. Continued

Unit Component or Waste	Radiological Constituent	Metals Residue	Organic Residue	Other
Decontamination rags and wipes	Bulk radiochemical analysis	Bulk analysis—TTLC, STLC , TCLP metals	TTLC, STLC, TCLP organics using ZHE: volatile halogenated organics, volatile aromatics, and semivolatiles, PCBs	Generator knowledge
Rain water	See *Waste Analysis Plan* (LLNL, 1998).			

[a] See Table A-4 for specific analyses for each sample type.

Table A-3. List of Organic Toxicity Characteristic Leaching Procedure (TCLP) Regulatory Limit Values[a]

Substance	TCLP (mg/L)
Benzene	5.0
Carbon tetrachloride	0.5
Chlordane	0.03
Chlorobenzene	100.0
Chloroform	6.0
Cresols	200.0
1,4-Dichlorobenzene	7.5
1,2-Dichloroethane	0.5
1,1 Dichloroethylene	0.7
2,4-Dichlorophenoxyacetic acid	10.0
2,4 Dinitrotoluene	0.13
Endrin	0.02
Heptachlor	0.008
Hexachlorethane	3.0
Hexachlorobenzene	0.13
Hexachlorobutadiene	0.5
Lindane	0.4
Methoxychlor	10.0
Methyl ethyl ketone	200.0
Nitrobenzene	2.0
Pentachlorophenol	100.0
Pyridine	5.0
Tetrachloroethylene	0.7
Toxaphene	0.5
Trichloroethylene	0.5
2,4,5-Trichlorophenol	400.0
2,4,6-Trichlorophenol	2.0
2,4,5-Trichlorophenoxypropionic acid (Silvex)	1.0
2,4, 5-Trichlorophenol	400.0
Vinyl chloride	0.2

[a] From 22 CCR 66261.24(a)(2) Table II.

Table A-4. B233 Sample Plan Summary—Number of Samples per Analytical Test/Sample Media

	Number of Samples per Sample Medium								
	Soil [5]	Concrete Surface Floor	Concrete Wall	Decon Rinse-water	Wood Slats	Ceiling Swipes	Floor Swipes [6]	Back-wall Swipes [6]	Total No. of Samples per test
Analytical Method	12	6	6	2	6	2	0	0	34
TTLC Metals w/ Hg	12	0	0	0	0	0	0	0	12
STLC Metals w/ Hg [1]	12	0	0	0	0	0	0	0	12
TCLP Metals w/ Hg [2]	12	0	0	0	0	0	0	0	12
STLC Organics (8260B/8270C/8081A) [1]	12	0	0	0	0	0	0	0	12
TCLP Organics (1311/8260B/8270C/8081A) [2]	12	0	0	0	6	0	0	0	34
8260 (Totals)	12	6	6	2	6	2	0	0	34
8270 (Totals)	12	6	6	2	6	2	0	0	34
GAB	12	6	6	2	6	2	0	0	34
Tritium	12	6	6	2	6	2	0	0	14
PCB (Method 8081) [3]	12	0	0	2	0	0	0	0	34
pH	12	0	0	2	0	0	0	0	14
Cyanide (Method 9012)	12	6	6	2	6	0	0	0	32
Oil and Grease	12	0	0	2	0	0	0	0	14
Asbestos [4]	12	0	0	0	6	2	0	0	18
Hexavalent Chromium on STLC extract [1]	12	0	0	0	0	0	0	0	12
Hexavelent Chromium	12	6	6	2	6	0	0	0	32
Total No. of Analyses	204	48	48	22	54	12	0	0	0

Notes:

1. The STLC will be run if the total waste constituent concentration is equal to or greater than 10 times the STLC hazardous waste threshold.
2. The TCLP will be run if the total waste constituent concentration is equal to or greater than 20 times the TCLP hazardous waste threshold.
   The sampling strategy described in notes 1 and 2 allow a staged approach based on the initial total constituent concentration.

3. A review of the waste inventory indicates PCBs have never been stored in B233. PCBs, however, will be analyzed for in the soil as a conservative soil characterization measure.
4. Hazardous waste limit for asbestos applies to friable, powdered or finely divided substances only. The concrete bulk samples are not friable; therefore, the test is not applicable.
5. Twelve soil samples total: 3 sample locations per cell, 2 soil samples at each location (minimum). Two low areas in each cell plus one damaged epoxy location will be the criteria to determine sample locations. Bulk concrete floor and wall samples will be analyzed; therefore, swipes are not necessary.

Table A-5. Methods for Decontamination of the Building 233 Container Storage Unit

Method	Cleaning materials	Cleaning Solution	Post-decontamination activity
Wet wipe	Cloth	Water	N/A
Detergent wash with cloth or brush	Cloth or brush	Detergent	Rinse with water.
Acid wash	Brush or other scrubbing material	Hydrochloric, nitric, sulfuric or phosphoric acid, depending on type of contaminant	Ensure that pH of surfaces cleaned are between 6 to 8. Dry the equipment by wiping down with proper absorbent.
Caustic wash	Cloth or brush	Caustic materials compatible with suspected contaminant(s)	Ensure that pH of surfaces cleaned are between 6 to 8. Dry the equipment by wiping down with proper absorbent.
Hydro blast washing	Hydroblaster	Clean water and caustic/detergent solution	Rinse with clean water and dry.
Steam cleaning	Steam cleaner	Steam	Dry with proper absorbent.

Notes:
The spread of contamination will be minimized by using a fresh, unused surface of the cloth each time the surface of the equipment is wiped.

Esposito et al. (1987) presents a general historical overview of decontamination methods associated with different classes of waste, i.e., how to clean metal bearing or oily waste.

Table A-6. Total Metals Concentrations in Uncontaminated Concrete

Metal	Number of Samples	Mean Concentration (mg/kg)	Minimum Level Detected	Maximum Level Detected	Calculated Background Levels
Antimony	_	_	_	_	-
Arsenic	38	3.68	1.49	8.5	6.8
Barium	37	281.79	39	420	428
Beryllium	_	_	_	_	-
Cadmium	38	2.65	1	2.9	2.4
Chromium	38	42.10	13.1	60.7	59
Cobalt	38	7.97	1.5	13.3	12.5
Copper	38	38.34	12.2	55.4	51.2
Lead	37	14.55	5.7	45.4	31.6
Manganese	37	380.60	91	626	567
Mercury	34	1.70	0.016	0.41	0.30
Molybdenum	37	5.20	0.29	1.6	1.5
Nickel	38	41.62	6.1	64.7	61.5
Potassium	38	1485.98	710	2540	2160
Selenium	_	_	_	_	-
Silver	35	1.88	0.29	1.4	1.3
Strontium	38	122.92	48.9	187	169
Thallium	_	_	_	_	_
Vanadium	38	38.43	9.7	54.6	56.4
Zinc	37	87.47	29.8	269	153

Table A-7 Action Limits/Release Limits for Naturally Occurring Radioactive Material in Soils and Soil Analogues (Volumetric)

Criteria	Action Limit/Release Limit
Alpha	<15 pCi/g
Beta	<25 pCi/g

pCi/g = picocuries per gram

Table A-8. Maximum Allowable Concentrations for Metals in Soil Calculated at the 99.5% Confidence Level

Metal	Maximum Total Concentration (mg/kg)
Antimony	1.12
Arsenic	8.51
Barium	308
Beryllium	0.62
Cadmium	1.59
Chromium	72.4
Chromium VI	NA[a]
Cobalt	14.6
Copper	62.5
Lead	43.7
Mercury	0.14
Molybdenum	2.5
Nickel	82.8
Selenium	0.4
Silver	2.5
Thallium	0.5
Vanadium	65.2
Zinc	75.3

[a] Any detection of Chromium VI is considered above background.

Attachment A.
Reference Photographs of the Building 233 Container Storage Unit

Figure 1. Exterior view of the Building 233 Container Storage Unit

Figure 2. Building 233 Container Storage Unit North Cell

Figure 3. Building 233 Container Storage Unit South Cell

Appendix B. B233 CSU Closure Plan
Health and Safety Plan (HASP)

Appendix B. B233 CSU Closure Plan
Health and Safety Plan (HASP)

General Scope

The B233 CSU is a structural-steel-framed building with a metal roof and metal walls of chain-link mesh. The unit contains two cells (which are kept locked when unattended), each spanning an area of approximately 15 feet by 40 feet. These cells were used to store containers of solid (form) radioactive waste. No spills are noted as having occurred in this unit over the course of its history. No hazardous or radioactive waste is currently being stored in the B233 CSU cells. Maximum contamination levels in the B233 CSU, if detected, are anticipated to be in the "trace-quantity" realm; employee exposure to significant levels of radioactive or hazardous constituents is, therefore, not anticipated. The B233 Container Storage Unit (CSU) closure will be accomplished in two phases:

- Phase I consisting of site characterization activities.
- Phase II, addressing required remedial actions, as necessitated by "Phase I" analytical yields.

Personnel meeting the training requirements specified in Section 8 of the B233 CSU Closure Plan will perform the work. Further, an independent, California-registered, professional engineer will oversee the project.

This Health and Safety Plan (HASP) identifies the basic hazards that could be encountered by technical personnel performing duties associated with the B233 CSU closure. Additionally, this document prescribes the control measures to be employed (by all participants) to prevent and avert personnel injury, environmental degradation, and property damage. The tasks associated with Phase I may include, but are not limited to the following:

- Pressure washing.
- (Other) preliminary decontamination methods.
- Waste container handling.
- Working from elevations.
- Sample collection (which may include area-swiping, coring, drilling and the use of radiation-detection instrumentation).
- Emergency management.

The Phase II job specifics will be defined subsequent to the site characterization phase (as mentioned above). Phase II operations may include concrete, asphalt, and soil (CAS) removal operations. A separate hazard assessment, addressing operational specifics, will be conducted prior to the commencement of Phase II work.

Pressure Washing Activities

Prior to extracting samples, the two 15 feet by 40 feet storage cells will be steam-cleaned and pressure-washed. This cleaning measure will be accomplished working down gradient (from east to west). The rinsate generated as a result of this step will be collected, analyzed, and disposed of in accordance with applicable federal, state and local regulations. Technicians[1] assigned to pressure washing duties will wear Level D personal protective equipment (PPE). This PPE will include, at a minimum:

Eye Protection	Safety glasses (with side shields) and Splash Shield
Hand Protection	Medium-to heavyweight latex, nitrile, neoprene, polyvinyl chloride (PVC) or equivalent, moisture-resistant gloves / taped at the wrists
Full-body Protection	Disposable poly-coated tyvek coveralls, rain gear, or equivalent moisture-resistant suit)
Foot Protection	Steel-toed boots (composed of PVC, neoprene, or equivalent, moisture-resistant material) / taped at ankles.

Personnel operating the pressure-washing unit[2] will be trained in its safe operation. All workers involved with this cleaning activity will take the necessary safety precautions to guard against hydro-injection, thermal burns, and slip, trip and fall injuries.

Preliminary Decontamination Methodologies

Additional Phase I decontamination activities may involve such basic cleaning methodologies as wiping, mopping, and (dry and wet) vacuuming. Adherence to safe work practices (e.g., wearing prescribed PPE, taking cognizance of the hazards posed by applied cleaning agents, maintaining a neat work environment, utilizing "wet area" caution signs, employing good hygiene practices, following applicable standard operating procedures) will minimize the potential for work-related injuries.

Waste Container Handling

Heavy containers, holding accumulated rinsate, soil, and drilling mud, may be generated during the initial phase of the B233 CSU closure process. Forklifts and drum dollies are the primary pieces of equipment used to handle heavy containers. Notwithstanding, care shall be taken by all participants to avoid back injuries, pinch points, container ruptures and equipment recoil[3] when opening,

[1] Subcontractors participating in closure activities will wear PPE in accordance with the subcontractor's Site-specific HASP. The requirements specified in the subcontractor's HASP will be at least as stringent as those outlined in this document.

[2] The noise produced by the pressure washer does not exceed the American Conference of Governmental Industrial Hygienist (ACGIH) action level of 85 decibels; hearing protection is, therefore, not required.

[3] Loaded drum dollies subjected to sudden releases can snap back with violent force against the torso of the equipment handler.

closing, palletizing, loading, unloading or otherwise handling heavy containers of waste materials. Moreover, only employees possessing a current LLNL forklift license will be allowed to operate industrial lift trucks. Personnel performing container-handling duties will wear Level D PPE:

Eye Protection	Safety Glasses (with side shields)
Hand Protection	Leather, or cloth gloves (or other hand protection of equal durability and strength)
Full-body Protection	Lab-issued uniform or coveralls
Foot Protection	Steel-toed boots.

Working from Elevations

It is not anticipated that B233 CSU site characterization activities will involve working from elevations. Notwithstanding, work performed from elevated surfaces raises a number of significant safety concerns. If work assignments require personnel to access heights in excess of 6 feet, such work will be conducted in accordance with the following:

Topic	Environment, Safety and Health (ES&H) Manual Reference	Work Smart Standard
Fall Protection	Document 11.1, "*Personal Protective Equipment*," Section 3.12, "*Fall Protection*"	DOE Order 440.1A, "*Worker Protection Management for DOE Federal and Contractor Employees*" Public Law 91-596 (5)(a)(1), Occupational Health and Safety Administration (OSHA)
Ladders	Document 11.2," *Hazards-General and Miscellaneous*," Section 6.0, "*Ladders and Step Stools*"	DOE Order 440.1A ,"*Worker Protection Management for DOE Federal and Contractor Employees*" Public Law 91-596 (5)(a)(1), OSHA
Roof Access	Document 15.1, "*Roof Access*"	29 CFR 1910, Subpart D "*Walking/Working Surfaces*" 29 Code of Federal Regualtions (CFR) 1926, Subpart X, "*Stairways and Ladders*" and American National Standards Institute (ANSI) 14.1 through 14.5

In addition to complying with the requirements contained in the above listed safety documents, personnel performing work from elevated surfaces will be made cognizant of the proximity of overhead power lines and shall maintain a safe distance from the same.

Sample Collection

Sampling activities could include area swipes, coring, drilling and surveying (with radiation detection devices). Prerequisite to conducting concrete penetration or soil excavation activities; however, a permit must be obtained from the LLNL Plant Engineering group. Plant Engineering is responsible for ensuring that areas designated for penetration or excavation are clear of buried utilities, e.g., electrical conduits, gas, water, and air lines. Additionally, the permit-acquisition process requires that a review be conducted (by LLNL wildlife biologist and the LLNL archaeologist) that assesses the proposed activity's potential impact to sensitive ecological systems and cultural resources. Guidance for these activities are listed below:

Topic	**ES&H Manual Reference**	**Work Smart Standard**
Coring and drilling	Document 11.2,"*Hazards – General and Miscellaneous,*" Section 18.0, "*Concrete Penetration and Soil Excavation*"	29 CFR 1926, Subpart K, "*Electrical*" 29 CFR 1926, Subpart P, "*Excavation*"

Emergency Procedures

Radiological or hazardous chemical emergencies stemming from employee contact with or exposure to dangerous quantities of radioactive or hazardous materials are highly improbable. On the other hand, serious industrial injury could occur while performing a number of the planned operations.

LLNL implements its Contingency Plan whenever an employee sustains an injury that requires treatment beyond basic first aid. In such an instance, calling 911 (when using a site phone) or 925-447-6880 (from a cell phone) is dialed, summoning the site paramedics to the scene of the incident.

In the event of an earthquake or major fire, the LLNL area Self-Help Plan will be invoked. The Self-Help Plan calls out Assembly Point Leader, and First Aid and Sweep Team Leaders. Said plan empowers satellite groups to self-administer [4] needed emergency services during sitewide occurrences, the magnitudes of which extend beyond the response capabilities of LLNL emergency crews.

The B233 CSU contains the following emergency supplies and equipment (see Appendix A, Figure A-2):

- Emergency eyewash/shower.

[4] During major emergencies, the onsite emergency staff may be unable to respond expeditiously to each summons for assistance.

- Fire extinguisher.
- Telephone.
- Spill kit.
- Electrical shut-off.
- PPE locker.

Appendix C
Hydrogeology Memorandum

MEMO

To: Stan Terusaki

July 30, 2003

From: Rick Blake, Environmental Restoration Division, EPD/ LLNL,
Geologist/Environmental Scientist
(925) 422-9910

Re: Building 233 Closure Plan Input: Hydrogeology: DTSC-Comment #3

LLLL is located in the southern portion of the Livermore Valley. The valley is filled with alluvial sediments called the Upper and Lower Livermore Gravels. The Lab is positioned on the southeastern edge of the basin, where the Livermore Gravels are 400-600 ft thick. This section of gravel thickens to the west, and reaches a thickness of approximately 2000-3000 ft in the Pleasanton area to the west.

The aquifers that underlie the Lab are composed of a complex network of alluvial silts, clays, sands, and gravels that are tens to hundreds of feet thick. The sand and gravel formations within these formations serves as migration pathways for groundwater flow, and where present, contaminated groundwater.

LLNL is currently conducting an extensive groundwater cleanup project under the CERCLA Federal Superfund program. The site was added to the National Priority List in 1987 and since then, over 1000 wells have been drilled here at Livermore to characterize, monitor, and remediate the groundwater below the site (Dibley, 2003).

The alluvial sediments below the Lab have been subdivided into seven hydrostratigraphic units (HSU's), (Blake, et al, 1996). This approach was undertaken for purposes of mapping the stratigraphy, characterizing contaminant plumes, and optimizing cleanup efforts. The HSU's were identified based on borehole lithology, geophysical logs, hydraulic tests, soil chemistry, and groundwater chemistry. Flow is laminar within each HSU, and horizontal or later flow is identified in the dense network of monitoring wells by conducting a series of hydraulic tests. HSU's are 1A, 1B, 2, 3A, 3B, 4, 5, 6, and 7. Vertical flow or connection between HSU's is normally not present or very minimal. Therefore, for mapping purposes, contaminants can be mapped out within each unit, and traced upward to the unsaturated portion of the HSU and commonly traced to the source area, either a building, land fill, or chemical storage area. Often times however, no source area can be detected.

In the Building 233 area, the HSU's that are contaminated are HSU 1B and 2. The first water bearing zone below B-233 is HSU-1B, so any contaminant that is discharged from the building would impact the 1B saturated sediments. The depth to water at the building is approximately 80 ft and only about15 ft of the 75 ft of HSU=1B is saturated. The well that is closest to B-233 is W-147, which is approximately 400 ft to the west, and is down gradient from the building. Recent chemical analysis of water taken from this well indicates that the well water contains a small amount of TCE (4.8 ppb, August 2002), and Tritium (472 piC/L, June 2003). Both of these values are below MCL standards.

Well W-147 is located approximately 400 ft east of the building, in an up-gradient position. This well is also screened in HSU-1B, and is the first water bearing unit at this location. Recent analytical data from the well indicates that the water from this location is ND for TCE (Dec. 2002), and has an activity level of 3360 piC/L for Tritium (June 2003).

There is no information suggesting that any of the contaminants in these wells are coming from operations at the B-233 complex. Current Environmental Restoration plans for the area is to build a Treatment Facility just south of the B-233 area to remediate the groundwater. The facility will be called TFG-North, and start-up is due at the end of this month, July 31, 2003. The Treatment Facility will consist of an air stripper and a granular activated carbon treatment system. It will be located about 300 ft to the south, just east of B-223. Recent wells (W-1806, 1807, and 1901) have been drilled in this area and have shown the presence of contaminants in the HSU-1B and HSU-2 zones. It has been determined that the contamination in this area in HSU-1B is due to contamination from operations at the B-321 complex, not from operations at either B-233, or B-223. The contamination in HSU-2 as mentioned earlier is deeper than HSU-B and is related to contamination that originated from the Treatment Facility E area located several hundred feet hydraulically up gradient to the east. Since the wells screened in HSU-2 are much deeper than HSU-1B, they would not be impacted by operations in the B-233 complex, and therefore will not be addressed in this report.

Analytical data from W-1806 indicate that minor contamination is present, 4.2 ppb TCE, and 160piC/L tritium. W-1807 contains 30 ppb TCE and 195 piC/L Tritium, while W-1901 was analyzed at 11 ppb TCE, and tritium was not analyzed. The most recent chemical analyses for all the wells mentioned in this report can me seen on Table 1.

Table 1. Chemical analyses for ground water wells in the B-233 area.
All wells screened in HSU-1B.

Well	TCE, ug/L	Tritium, pCi/L
W-147	4.8 (8/02)	472 (6/03)
W-148	< 0.5 (12/02)	3,360 (6/03)
W-1806	4.2 (4/03)	160 (4/03)
W-1807	13 (4/03)	195 (4/03)
W-1901	11(11/02)	N/A

N/A = compound not analyzed

In conclusion, it is determined that the low level of contamination in the wells closest to B-233 is due to operations at the B321 complex, not Building 233.

Sample #CSU-233 Decontamination Rinsewater

Sample Matrix - Decontamination rinsewater

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Rinsewater			
	Gross alpha	24	N/A	pCi/L	(1)
	Gross beta	33	N/A	pCi/L	(1)
	Tritium	350	N/A	pCi/L	(1)

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Rinsewater			
	Bis(2-ethylhexyl)phthalate	51	N/A	ug/L	(1)
	Chloroform	9	N/A	ug/L	(1)
	Oil and Grease	16.7	N/A	mg/L	(1)

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Rinsewater			
	Arsenic	0.038	N/A	mg/L	(1)
	Barium	3.8	N/A	mg/L	(1)
	Cadmium	0.037	N/A	mg/L	(1)
	Chromium	0.21	N/A	mg/L	(1)
	Cobalt	0.037	N/A	mg/L	(1)
	Copper	0.82	N/A	mg/L	(1)
	Lead	0.67	N/A	mg/L	(1)
	Manganese	1.6	N/A	mg/L	(1)
	Mercury	0.0026	N/A	mg/L	(1)
	Molybdenum	0.052	N/A	mg/L	(1)
	Nickel	0.23	N/A	mg/L	(1)
	Potassium	18.7	N/A	mg/L	(1)
	Selenium	0.026	N/A	mg/L	(1)
	Silver	0.011	N/A	mg/L	(1)
	Strontium	0.35	N/A	mg/L	(1)
	Vanadium	0.089	N/A	mg/L	(1)
	Zinc	27.8	N/A	mg/L	(1)

All metals over the detection limit reported.

pH Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Rinsewater			
	pH	7.2	N/A	Units	(1)

(1) Decontamination rinsewater met sanitary sewer discharge limits and was authorized for release to sewer. However, waste operations personnel shipped the rinsewater for off-site disposal on 9-22-04 after bulking with similar wastewaters. One sample, instead of two, was obtained because the first sample met sanitary sewer discharge limits.

Sample #CSU-233N-C-1 (north cell, ceiling swipe location #1)

Sample Type - Swipe

Radioactivity Summary	Analyte	Sample Type	LOS	Units	Comments
		Swipe			
	Gross alpha	2.8	2.8	dpm	
	Gross beta	3.5	3.5	dpm	
	Tritium	22	22.0	dpm	

Volatile Organic Compounds Summary	Analyte	Sample Type	Clean Up Level	Concentration	Comments
		Swipe		(ng/kg)	
		(ng/swipe)			
	BHC, alpha isomer	5.1	(1)	20.4622	(2)

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Type	Clean Up Level	Concentration	Comments
		Swipe		(mg/kg)	
		(mg/swipe)			
	Barium	0.00098	(1)	0.00393	(2)
	Cadmium	0.00013	(1)	0.00052	(2)
	Chromium	0.00270	(1)	0.01083	(2)
	Cobalt	0.00022	(1)	0.00088	(2)
	Copper	0.00120	(1)	0.00481	(2)
	Manganese	0.00110	(1)	0.00441	(2)
	Molybdenum	0.00047	(1)	0.00189	(2)
	Potassium	0.02100	(1)	0.08426	(2)
	Silver	0.00043	(1)	0.00173	(2)
	Strontium	0.00054	(1)	0.00217	(2)
	Zinc	0.01400	(1)	0.05617	(2)

All metals over the detection limit reported.

(1) All residue resulting from the handling of hazardous waste in the facility will be removed and/or decomtaminated (if possible) to meet the appropriate clean close standard.

(2) Swipe results converted by dividing the mass of the constituent by the mass of a 10 cm (length) x 10 cm (width) x 0.3175 cm (thick) section of roof.

Given the following: Swipe area = 10 cm x 10 cm; roof thickness = 0.3175 cm; density steel = 7.85 g/cc.

Steel (volume) = 10 cm x 10 cm x 0.3175 cm = 31.75 cc.

Steel (mass) = 31.75 cc x 7.85 gram/cc = 249.24 g = 0.24924 kg.

Constituent (mass) = 0.00036 mg.

Concentration = 0.00036 mg/0.24924 kg = 0.0014 mg/kg

Sample #CSU-233N-F-1 (north cell, floor sample location #1)

Sample Matrix - Soil, Concrete

Radioactivity Summary	Analyte	Sample Media			Release Level (RL)	Units	Comments
		concrete	soil 0'	soil 2'	concrete/soil		
	Gross alpha	1.3	1.4	2.5	<15	pCi/g	
	Gross beta	1.3	1.1	5.2	<25	pCi/g	
	Tritium	4	3.4	3.2	–		

Volatile Organic Compounds Summary	Analyte	Sample Media			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Acetone	80	<20	<20	(1)	(1)	ug/kg	
	Ethylbenzene	43	<5	<5	(1)	(1)	ug/kg	
	Oil and Grease	Not analyzed	11.7	37.1	(1)	(1)	mg/kg	
	Toluene	68	6.3	10	(1)	(1)	ug/kg	
	Xylene	370	<10	<10	(1)	(1)	ug/kg	

Metals Summary	Analyte	Sample Media (2)			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Antimony	3.5	<1.3	1.7	–	1.12	mg/kg	LOS>Clean up level, 0' sample. (3)
	Barium	1770	60.7	138	428	308.00	mg/kg	(3)
	Cobalt	5.6	33.6	13.1	12.5	14.60	mg/kg	
	Selenium	19.3	2.7	5	–	0.40	mg/kg	
	Zinc	218	31.4	46	153	75.30	mg/kg	(3)
	Thallium	<2.1	<2.1	<2.1	–	0.5	mg/kg	LOS>Soil clean up level.

Asbestos, pH Summary	Analyte	Sample Media			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Asbestos	Not analyzed	<1	<1	(1)	(1)	Percent	Soil samples analyzed for the following minerals: actinolite/tremolite, amosite, anthophyllite, chrysotile, and crocidolite.
	pH	Not analyzed	9.9	8	(1)	(1)	Units	

(1) All residue resulting from hazardous waste operations in the facility will be evaluated to determine if decontamination and/or removal is necessary to meet the appropriate clean close standard.

(2) Results in bold indicate a constituent concentration or LOS value greater than the clean up or release level.

(3) High concrete metal concentrations may be due to paint/epoxy contamination.

Sample #CSU-233N-F-2 (north cell, floor sample location #2)

Sample Matrix - Soil, Concrete

Radioactivity Summary	Analyte	Sample Media			Release Level (RL)	Units	Comments
		concrete	soil 0'	soil 2'	concrete/soil		
	Gross alpha	1.4	0.71	1.9	<15	pCi/g	
	Gross beta	1.6	0.65	2.8	<25	pCi/g	
	Tritium	3.8	3.2	3.4	–		

Volatie Organic Compounds Summary	Analyte	Sample Media			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Acetone	66	<20	<20	(1)	(1)	ug/kg	
	Ethylbenzene	23	<5	<5	(1)	(1)	ug/kg	
	Heptachlor	2.3	<2	<2	(1)	(1)	ug/kg	
	Oil and Grease	Not analyzed	59.1	21.3	(1)	(1)	mg/kg	
	Toluene	110	11	<5	(1)	(1)	ug/kg	
	Trichlorofluoro-methane	<5	<5	8.5	(1)	(1)	ug/kg	
	Xylene	205	<5	<10	(1)	(1)	ug/kg	

Metals Summary	Analyte	Sample Media (2)			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Antimony	3.1	<1.3	<1.3	–	1.12	mg/kg	LOS soil>Clean up level.
	Barium	1320	83.4	148	428.00	308.00	mg/kg	(3)
	Cobalt	7.8	28.5	11.3	12.50	14.60	mg/kg	
	Lead	203	0.87	1.1	31.60	43.70	mg/kg	(3)
	Selenium	17.4	5.4	6.2	–	0.40	mg/kg	
	Silver	0.15	0.15	51	1.3	2.5	mg/kg	
	Zinc	184	32.7	44.4	153.00	75.00	mg/kg	(3)

Asbestos, pH Summary	Analyte	Sample Media			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Asbestos	Not analyzed	<1	<1	(1)	(1)	Percent	Soil samples analyzed for the following minerals: actinolite/tremolite, amosite, anthophyllite, chrysotile, and crocidolite.
	pH	Not analyzed	10.3	8.3	(1)	(1)	Units	

(1) All residue resulting from hazardous waste operations in the facility will be evaluated to determine if decontamination and/or removal is necessary to meet the appropriate clean close standard.

(2) Results in bold indicate a constituent concentration or LOS value greater than the clean up or release level.

(3) High concrete metal concentrations may be due to paint/epoxy contamination.

Sample #CSU-233N-F-3 (north cell, floor sample location #3)

Sample Matrix - Soil, Concrete

Radioactivity Summary	Analyte	Sample Media			Release Level (RL)	Units	Comments
		concrete	soil 0'	soil 2'	concrete/soil		
	Gross alpha	1.5	0.85	1	<15	pCi/g	
	Gross beta	1.7	0.75	1.6	<25	pCi/g	
	Tritium	4	3.4	3.2	–		

Volatile Organic Compounds Summary	Analyte	Sample Media			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Acetone	70	<20	<20	(1)	(1)	ug/kg	
	Di-n-butylphthalate	610	<330	<330	(1)	(1)	ug/kg	
	Ethylbenzene	370	<5	<5	(1)	(1)	ug/kg	
	Heptachlor	2.4	<2	<2	(1)	(1)	ug/kg	
	Oil and Grease	<10	<10	23.4	(1)	(1)	mg/kg	
	Toluene	160	18	44	(1)	(1)	ug/kg	
	Xylene	2600	<10	<10	(1)	(1)	ug/kg	

Metals Summary	Analyte	Sample Media (2)			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Antimony	3.5	1.7 (2)	<1.3	–	1.12	mg/kg	LOS soil 2'>Clean up level.
	Thallium	<2.1	<2.1	2.8	–	0.50	mg/kg	LOS soil 0'>Clean up level.
	Barium	3710	86.4	127	428.00	308.00	mg/kg	(3)
	Zinc	1040	38.7	38.3	153.00	75.30	mg/kg	(3)
	Cobalt	13.3	38.1	20.4	12.50	14.60	mg/kg	
	Selenium	17.5	5.3	5.4	–	0.40	mg/kg	
	Strontium	185	19.7	24.8	169	(1)	mg/kg	(3)
	Silver	<0.15	2.9	1.6	1.3	2.5	mg/kg	

Asbestos, pH Summary	Analyte	Sample Media			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Asbestos	Not analyzed	<1	<1	(1)	(1)	Percent	Soil samples analyzed for the following minerals: actinolite/tremolite, amosite, anthophyllite, chrysotile, and crocidolite.
	pH	Not analyzed	10	8.5	(1)	(1)	Units	

(1) All residue resulting from hazardous waste operations in the facility will be evaluated to determine if decontamination and/or removal is necessary to meet the appropriate clean close standard.

(2) Results in bold indicate a constituent concentration or LOS value greater than the clean up or release level.

(3) High concrete metal concentrations may be due to paint/epoxy contamination.

Sample #CSU-233N-W-1 (north cell, wall sample location #1)

Sample Matrix - Cinder block

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Cinder block			
	Gross alpha	1.8	<15	pCi/g	
	Gross beta	2.1	<25	pCi/g	
	Tritium	4.2	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	2-Hexanone	25	(1)	ug/kg	
	4-Methyl-2-pentanone	140	(1)	ug/kg	
	Acetone	220	(1)	ug/kg	
	BHC, beta isomer	2.6	(1)	ug/kg	
	BHC, delta isomer	2.7	(1)	ug/kg	
	cis-Chlordane	7.8	(1)	ug/kg	
	Heptachlor	8.7	(1)	ug/kg	
	Methyl ethyl ketone	43	(1)	ug/kg	
	p,p-DDE	4.8	(1)	ug/kg	
	p,p-DDT	6	(1)	ug/kg	
	trans-Chlordane	6.2	(1)	ug/kg	
	Toluene	48	(1)	ug/kg	
	Xylene	8.9	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	Antimony	24.4	(1)	mg/kg	
	Barium	4400	(1)	mg/kg	(2)
	Cadmium	0.96	(1)	mg/kg	
	Chromium	63.7	(1)	mg/kg	
	Cobalt	3.5	(1)	mg/kg	
	Copper	14.5	(1)	mg/kg	
	Lead	4010	(1)	mg/kg	(2)
	Manganese	213	(1)	mg/kg	
	Mercury	1.7	(1)	mg/kg	
	Molybdenum	4.4	(1)	mg/kg	
	Nickel	10.8	(1)	mg/kg	
	Potassium	612	(1)	mg/kg	
	Selenium	15.1	(1)	mg/kg	
	Strontium	204	(1)	mg/kg	
	Vanadium	9.7	(1)	mg/kg	
	Zinc	3570	(1)	mg/kg	(2)

All metals over the detection limit reported.

(1) All residue resulting from hazardous waste operations in the facility will be evaluated to determine if decontamination and/or removal is necessary to meet the appropriate clean close standard.

(2) High metal concentrations may be due to paint/epoxy contamination.

Sample #CSU-233N-W-2 (north cell, wall sample location #2)

Sample Matrix - Cinder block wall

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Cinder block			
	Gross alpha	1.5	<15	pCi/g	
	Gross beta	1.7	<25	pCi/g	
	Tritium	4	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	2-Hexanone	30	(1)	ug/kg	
	4-Methyl-2-pentanone	400	(1)	ug/kg	
	Acetone	150	(1)	ug/kg	
	BHC, beta isomer	2.8	(1)	ug/kg	
	cis-Chlordane	4	(1)	ug/kg	
	Endrin	1.3	(1)	ug/kg	
	Heptachlor	2.9	(1)	ug/kg	
	Heptachlor epoxide	2.6	(1)	ug/kg	
	Methyl ethyl ketone	36	(1)	ug/kg	
	p,p-DDT	6.5	(1)	ug/kg	
	Toluene	75	(1)	ug/kg	
	trans-Chlordane	3.3	(1)	ug/kg	
	Xylene	52	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	Antimony	15.5	(1)	mg/kg	
	Arsenic	1.5	(1)	mg/kg	
	Barium	3250	(1)	mg/kg	(2)
	Cadmium	0.33	(1)	mg/kg	
	Chromium	29.9	(1)	mg/kg	
	Cobalt	4.7	(1)	mg/kg	
	Copper	13.1	(1)	mg/kg	
	Lead	2010	(1)	mg/kg	(2)
	Manganese	195	(1)	mg/kg	
	Mercury	3	(1)	mg/kg	
	Molybdenum	1.2	(1)	mg/kg	
	Nickel	9.4	(1)	mg/kg	
	Potassium	807	(1)	mg/kg	
	Selenium	12.3	(1)	mg/kg	
	Strontium	144	(1)	mg/kg	
	Vanadium	9.8	(1)	mg/kg	
	Zinc	778	(1)	mg/kg	(2)

All metals over the detection limit reported.

(1) All residue resulting from hazardous waste operations in the facility will be evaluated to determine if decontamination and/or removal is necessary to meet the appropriate clean close standard.

(2) High metal concentrations may be due to paint/epoxy contamination.

Sample #CSU-233N-W-3 (north cell, wall sample location #3)

Sample Matrix - Cinder block

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Cinder block			
	Gross alpha	1.7	<15	pCi/g	
	Gross beta	2.1	<25	pCi/g	
	Tritium	4.1	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	4-Methyl-2-pentanone	45	(1)	ug/kg	
	BHC, beta isomer	2.2	(1)	ug/kg	
	Heptachlor	2.2	(1)	ug/kg	
	Toluene	48	(1)	ug/kg	
	Xylene	7.9	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	Antimony	9.1	(1)	mg/kg	
	Arsenic	2	(1)	mg/kg	
	Barium	2820	(1)	mg/kg	(2)
	Cadmium	0.15	(1)	mg/kg	
	Chromium	31.3	(1)	mg/kg	
	Cobalt	4.3	(1)	mg/kg	
	Copper	17.8	(1)	mg/kg	
	Lead	2230	(1)	mg/kg	(2)
	Manganese	253	(1)	mg/kg	
	Mercury	21.7	(1)	mg/kg	
	Molybdenum	1.3	(1)	mg/kg	
	Nickel	9.9	(1)	mg/kg	
	Potassium	916	(1)	mg/kg	
	Strontium	142	(1)	mg/kg	
	Vanadium	12.8	(1)	mg/kg	
	Zinc	658	(1)	mg/kg	(2)

All metals over the detection limit reported.

(1) All residue resulting from hazardous waste operations in the facility will be evaluated to determine if decontamination and/or removal is necessary to meet the appropriate clean close standard.
(2) High metal concentrations may be due to paint/epoxy contamination.

Sample #CSU-233N-WF-1 (north cell, wood fence sample location #1)

Sample Matrix - Wood

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Wood			
	Gross alpha	0.9	<15	pCi/g	
	Gross beta	2.1	<25	pCi/g	
	Tritium	14	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Bis(2-ethylhexyl)phthalate	9100	(1)	ug/kg	
	Dimethylphthalate	370	(1)	ug/kg	
	Heptachlor	2.8	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Barium	13.8	(1)	mg/kg	
	Chromium	1.1	(1)	mg/kg	
	Cobalt	7.7	(1)	mg/kg	
	Copper	1.9	(1)	mg/kg	
	Lead	49.5	(1)	mg/kg	
	Manganese	57.4	(1)	mg/kg	
	Mercury	0.1	(1)	mg/kg	
	Nickel	0.63	(1)	mg/kg	
	Potassium	70.4	(1)	mg/kg	
	Selenium	0.84	(1)	mg/kg	
	Strontium	4.6	(1)	mg/kg	
	Zinc	109	(1)	mg/kg	

All metals over the detection limit reported.

Asbestos Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Asbestos	<1	(1)	Percent	Wood samples analyzed for the following minerals: actinolite/tremolite, amosite, anthophyllite, chrysotile, and crocidolite.

(1) See Attachment 10.

Sample #CSU-233N-WF-2 (north cell, wood fence sample location #2)

Sample Matrix - Wood

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Wood			
	Gross alpha	0.79	<15	pCi/g	
	Gross beta	2	<25	pCi/g	
	Tritium	13	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Dimethylphthalate	580	(1)	ug/kg	
	Bis(2-ethylhexyl)phthalate	1900	(1)	ug/kg	
	Toluene	1400	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Barium	30.5	(1)	mg/kg	
	Cadmium	0.054	(1)	mg/kg	
	Chromium	0.98	(1)	mg/kg	
	Cobalt	6.1	(1)	mg/kg	
	Copper	1.8	(1)	mg/kg	
	Lead	23.7	(1)	mg/kg	
	Manganese	43.3	(1)	mg/kg	
	Mercury	0.046	(1)	mg/kg	
	Molybdenum	0.18	(1)	mg/kg	
	Nickel	0.85	(1)	mg/kg	
	Potassium	127	(1)	mg/kg	
	Selenium	0.82	(1)	mg/kg	
	Strontium	4.8	(1)	mg/kg	
	Zinc	621	(1)	mg/kg	

All metals over the detection limit reported.

Asbestos Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Asbestos	<1	(1)	Percent	Wood samples analyzed for the following minerals: actinolite/tremolite, amosite, anthophyllite, chrysotile, and crocidolite.

(1) See Attachment 10.

Sample #CSU-233N-WF-3 (north cell, wood fence sample location #3)

Sample Matrix - Wood

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Wood			
	Gross alpha	1.1	<15	pCi/g	
	Gross beta	2.5	<25	pCi/g	
	Tritium	15	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Bis(2-ethylhexyl)phthalate	2100	(1)	ug/kg	
	Dimethylphthalate	450	(1)	ug/kg	
	Endosulfan sulfate	5.4	(1)	ug/kg	
	Heptachlor	2.7	(1)	ug/kg	
	Toluene	1200	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Antimony	1.5	(1)	mg/kg	
	Barium	27.4	(1)	mg/kg	
	Cadmium	0.048	(1)	mg/kg	
	Chromium	0.9	(1)	mg/kg	
	Cobalt	5.8	(1)	mg/kg	
	Copper	1.7	(1)	mg/kg	
	Lead	37	(1)	mg/kg	
	Manganese	44.6	(1)	mg/kg	
	Mercury	0.079	(1)	mg/kg	
	Molybdenum	0.25	(1)	mg/kg	
	Nickel	0.81	(1)	mg/kg	
	Potassium	136	(1)	mg/kg	
	Strontium	9.8	(1)	mg/kg	
	Vanadium	0.38	(1)	mg/kg	
	Zinc	574	(1)	mg/kg	

All metals over the detection limit reported.

Asbestos Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Asbestos	<1	(1)	Percent	Wood samples analyzed for the following minerals: actinolite/tremolite, amosite, anthophyllite, chrysotile, and crocidolite.

(1) See Attachment 10.

Sample #CSU-233S-C-1 (south cell, ceiling swipe location #1)

Sample Type - Swipe

Radioactivity Summary	Analyte	Sample Type	LOS	Units	Comments
		Swipe			
	Gross alpha	2.8	2.8	dpm	
	Gross beta	3.5	3.5	dpm	
	Tritium	22	22.0	dpm	

Volatile Organic Compounds Summary	Analyte	Sample Type	Clean Up Level	Concentration	Comments
		Swipe		(ng/kg)	
		(ng/swipe)			
	BHC, alpha isomer	5.1	(1)	20.4622	(2)

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Type	Clean Up Level	Concentration	Comments
		Swipe		(mg/kg)	
		(mg/swipe)			
	Barium	0.00036	(1)	0.0014	(2)
	Cadmium	0.00012	(1)	0.0005	(2)
	Chromium	0.00055	(1)	0.0022	(2)
	Potassium	0.01900	(1)	0.0762	(2)
	Silver	0.00032	(1)	0.0013	(2)
	Strontium	0.00057	(1)	0.0023	(2)
	Vanadium	0.00130	(1)	0.0052	(2)
	Zinc	0.01100	(1)	0.0441	(2)

All metals over the detection limit reported.

(1) All residue resulting from the handling of hazardous waste in the facility will be removed and/or decomtaminated (if possible) to meet the appropriate clean close standard.

(2) Swipe results converted by dividing the mass of the constituent by the mass of a 10 cm (length) x 10 cm (width) x 0.3175 cm (thick) section of roof.
Given the following: Swipe area = 10 cm x 10 cm; roof thickness = 0.3175 cm; density steel = 7.85 g/cc.
Steel (volume) = 10 cm x 10 cm x 0.3175 cm = 31.75 cc.
Steel (mass) = 31.75 cc x 7.85 gram/cc = 249.24 g = 0.24924 kg.
Constituent (mass) = 0.00036 mg.
Concentration = 0.00036 mg/0.24924 kg = 0.0014 mg/kg

Sample #CSU-233S-F-1 (south cell, floor sample location #1)

Sample Matrix - Soil, Concrete

Radioactivity Summary	Analyte	Sample Media			Release Level (RL)	Units	Comments
		concrete	soil 0'	soil 2'	concrete/soil		
	Gross alpha	1.7	2.8	2.1	<15	pCi/g	
	Gross beta	2	2.9	3.1	<25	pCi/g	
	Tritium	3.7	3.3	3.3	–		

Volatile Organic Compounds Summary	Analyte	Sample Media			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	4-Methyl-2-pentanone	33	ND	ND	(1)	(1)	ug/kg	
	Acetone	39	ND	ND	(1)	(1)	ug/kg	
	Di-n-butylphthalate	2100	ND	ND	(1)	(1)	ug/kg	
	Ethylbenzene	15	ND	ND	(1)	(1)	ug/kg	
	Oil and Grease	Not analyzed	18.6	ND	(1)	(1)	mg/kg	
	Toulene	63	15	10	(1)	(1)	ug/kg	
	Xylene	166	ND	ND	(1)	(1)	ug/kg	

Metals Summary	Analyte	Sample Media (2)			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Manganese	142	376	395	567	(1)	mg/kg	
	Potassium	472	1890	1950	2160	(1)	mg/kg	
	Selenium	14	4.2	7	–	0.40	mg/kg	
	Strontium	76.2	27.8	38.2	169	(1)	mg/kg	

Asbestos, pH Summary	Analyte	Sample Media			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Asbestos	Not analyzed	<1	<1	(1)	(1)	Percent	Soil samples analyzed for the following minerals: actinolite/tremolite, amosite, anthophyllite, chrysotile, and crocidolite.
	pH	Not analyzed	7.3	7.5	(1)	(1)	Units	

(1) All residue resulting from the handling of hazardous waste in the facility will be removed and/or decomtaminated (if possible) to meet the appropriate clean close standard.

(2) Results in bold indicate a constituent concentration or LOS value greater than the clean up or release level.

Sample #CSU-233S-F-2 (south cell, floor sample location #2)

Sample Matrix - Soil, Concrete

Radioactivity Summary	Analyte	Sample Media			Release Level (RL)	Units	Comments
		concrete	soil 0'	soil 2'	concrete/soil		
	Gross alpha	2.1	1.3	2.4	<15	pCi/g	
	Gross beta	2.3	1.3	2.3	<25	pCi/g	
	Tritium	4.1	3.3	3.2	–		

Volatile Organic Compounds Summary	Analyte	Sample Media			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	4-Methyl-2-pentanone	27	ND	ND	(1)	(1)	ug/kg	
	cis-Chlordane	ND	2.2	ND	(1)	(1)	ug/kg	
	Di-n-butylphthalate	2200	ND	ND	(1)	(1)	ug/kg	
	Ethylbenzene	58	ND	ND	(1)	(1)	ug/kg	
	Oil and Grease	Not analyzed	92.1	10.3	(1)	(1)	mg/kg	
	Xylene	440	ND	ND	(1)	(1)	ug/kg	
	Toluene	72	7.2	ND	(1)	(1)	ug/kg	

Metals Summary	Analyte	Sample Media (2)			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Antimony	1.3	1.5	1.8	–	1.12	mg/kg	
	Manganese	232	386	399	567	(1)	mg/kg	
	Potassium	690	1300	2030	2160	(1)	mg/kg	
	Selenium	17.7	5.3	6.5	–	0.40	mg/kg	
	Strontium	97.6	27.2	39	169	(1)	mg/kg	

Asbestos, pH Summary	Analyte	Sample Media			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Asbestos	Not analyzed	<1	<1	(1)	(1)	Percent	Soil samples analyzed for the following minerals: actinolite/tremolite, amosite, anthophyllite, chrysotile, and crocidolite.
	pH	Not analyzed	9.1	7.4	(1)	(1)	Units	

(1) All residue resulting from the handling of hazardous waste in the facility will be removed and/or decomtaminated (if possible) to meet the appropriate clean close standard.

(2) Results in bold indicate a constituent concentration or LOS value greater than the clean up or release level.

Sample #CSU-233S-F-3 (south cell, floor sample location #3)

Sample Matrix - Soil, Concrete

Radioactivity Summary	Analyte	Sample Media			Release Level (RL)	Units	Comments
		concrete	soil 0'	soil 2'	concrete/soil		
	Gross alpha	1.6	1.3	1.8	<15	pCi/g	
	Gross beta	1.7	1.6	2	<25	pCi/g	
	Tritium	4	3.3	3.4	–		

Volatile Organic Compounds Summary	Analyte	Sample Media			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Acetone	42	ND	ND	(1)	(1)	ug/kg	
	Di-n-butylphthalate	1900	ND	ND	(1)	(1)	ug/kg	
	Ethylbenzene	350	ND	ND	(1)	(1)	ug/kg	
	Heptachlor	2.5	ND	ND	(1)	(1)	ug/kg	
	Xylene	2490	ND	ND	(1)	(1)	ug/kg	
	Toluene	100	5.9	ND	(1)	(1)	ug/kg	
	Oil and Grease	ND	78.3	ND	(1)	(1)	mg/kg	

Metals Summary	Analyte	Sample Media (2)			Clean Up Level		Units	Comments
		concrete	soil 0'	soil 2'	concrete	soil		
	Antimony	2.5	1.4	ND	–	1.12	mg/kg	
	Barium	518	114	ND	428	308.00	mg/kg	(3)
	Manganese	282	412	ND	567	(1)	mg/kg	
	Mercury	0.023	0.21	ND	0.30	0.14	mg/kg	
	Potassium	789	1820	ND	2160	(1)	mg/kg	
	Selenium	17.8	5.2	ND	–	0.40	mg/kg	
	Strontium	119	34.2	ND	169	(1)	mg/kg	

(1) All residue resulting from the handling of hazardous waste in the facility will be removed and/or decomtaminated (if possible) to meet the appropriate clean close standard.

(2) Results in bold indicate a constituent concentration or LOS value greater than the clean up or release level.

(3) High concrete metal concentrations may be due to paint/epoxy contamination.

Sample #CSU-233S-W-1 (south cell, wall sample location #1)

Sample Matrix - Cinder block

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Cinder block			
	Gross alpha	1.7	<15	pCi/g	
	Gross beta	2.8	<25	pCi/g	
	Tritium	4.1	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	4-Methyl-2-pentanone	100	(1)	ug/kg	
	BHC, alpha isomer	2.8	(1)	ug/kg	
	BHC, beta isomer	16	(1)	ug/kg	
	cis-Chlordane	20	(1)	ug/kg	
	Dieldrin	41	(1)	ug/kg	
	Endosulfan II	7.3	(1)	ug/kg	
	Endrin	6.7	(1)	ug/kg	
	Ethylbenzene	5.4	(1)	ug/kg	
	Heptachlor	3.9	(1)	ug/kg	
	Heptachlor epoxide	2.4	(1)	ug/kg	
	p,p-DDD	6.4	(1)	ug/kg	
	p,p-DDE	15	(1)	ug/kg	
	p,p-DDT	20	(1)	ug/kg	
	Toluene	8	(1)	ug/kg	
	trans-Chlordane	4.2	(1)	ug/kg	
	Xylene	51	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	Antimony	33.6	(1)	mg/kg	
	Arsenic	ND	(1)	mg/kg	
	Barium	3680	(1)	mg/kg	(2)
	Beryllium	ND	(1)	mg/kg	
	Cadmium	1.6	(1)	mg/kg	
	Chromium	109	(1)	mg/kg	
	Cobalt	31.1	(1)	mg/kg	
	Copper	10.7	(1)	mg/kg	
	Lead	5510	(1)	mg/kg	(2)
	Manganese	226	(1)	mg/kg	
	Mercury	3.8	(1)	mg/kg	
	Molybdenum	5.8	(1)	mg/kg	
	Nickel	28.3	(1)	mg/kg	
	Potassium	632	(1)	mg/kg	
	Selenium	13.3	(1)	mg/kg	
	Strontium	193	(1)	mg/kg	
	Vanadium	18.1	(1)	mg/kg	
	Zinc	4660	(1)	mg/kg	(2)

All metals over the detection limit reported.

(1) All residue resulting from hazardous waste operations in the facility will be evaluated to determine if decontamination and/or removal is necessary to meet the appropriate clean close standard.

(2) High metal concentrations may be due to paint/epoxy contamination.

Sample #CSU-233S-W-2 (south cell, wall sample location #2)

Sample Matrix - Cinder block

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Cinder block			
	Gross alpha	1.3	<15	pCi/g	
	Gross beta	1.4	<25	pCi/g	
	Tritium	4.1	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	2-Hexanone	24	(1)	ug/kg	
	4-Methyl-2-pentanone	52	(1)	ug/kg	
	Acetone	160	(1)	ug/kg	
	BHC, beta isomer	2.5	(1)	ug/kg	
	BHC, delta isomer	2.2	(1)	ug/kg	
	cis-Chlordane	4	(1)	ug/kg	
	Endrin	1.2	(1)	ug/kg	
	Heptachlor	6.2	(1)	ug/kg	
	Heptachlor epoxide	3.2	(1)	ug/kg	
	Methy ethyl ketone	36	(1)	ug/kg	
	p,p-DDT	5.2	(1)	ug/kg	
	Toluene	50	(1)	ug/kg	
	trans-Chlordane	5.5	(1)	ug/kg	
	Xylene	7.7	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	Antimony	28.6	(1)	mg/kg	
	Barium	3300	(1)	mg/kg	(2)
	Cadmium	2.4	(1)	mg/kg	
	Chromium	83.3	(1)	mg/kg	
	Cobalt	4.3	(1)	mg/kg	
	Copper	12.1	(1)	mg/kg	
	Lead	4680	(1)	mg/kg	(2)
	Manganese	205	(1)	mg/kg	
	Mercury	4.8	(1)	mg/kg	
	Molybdenum	5.6	(1)	mg/kg	
	Nickel	13.9	(1)	mg/kg	
	Potassium	755	(1)	mg/kg	
	Selenium	14.6	(1)	mg/kg	
	Strontium	209	(1)	mg/kg	
	Vanadium	8	(1)	mg/kg	
	Zinc	4680	(1)	mg/kg	(2)

All metals over the detection limit reported.

(1) All residue resulting from hazardous waste operations in the facility will be evaluated to determine if decontamination and/or removal is necessary to meet the appropriate clean close standard.

(2) High metal concentrations may be due to paint/epoxy contamination.

Sample #CSU-233S-W-3 (south cell, wall sample location #3)

Sample Matrix - Cinder block

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Cinder block			
	Gross alpha	1.5	<15	pCi/g	
	Gross beta	3.9	<25	pCi/g	
	Tritium	4.1	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	2-Hexanone	38	(1)	ug/kg	
	4-Methyl-2-pentanone	62	(1)	ug/kg	
	Acetone	220	(1)	ug/kg	
	cis-Chlordane	3	(1)	ug/kg	
	Endrin	0.71	(1)	ug/kg	
	Heptachlor	2.2	(1)	ug/kg	
	Methyl ethyl ketone	56	(1)	ug/kg	
	Toluene	59	(1)	ug/kg	
	trans-Chlordane	2.1	(1)	ug/kg	
	Xylene	43	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Cinder block			
	Antimony	42.4	(1)	mg/kg	
	Barium	5180	(1)	mg/kg	(2)
	Cadmium	1.3	(1)	mg/kg	
	Chromium	87.2	(1)	mg/kg	
	Cobalt	4.1	(1)	mg/kg	
	Copper	10.9	(1)	mg/kg	
	Lead	6800	(1)	mg/kg	(2)
	Manganese	204	(1)	mg/kg	
	Mercury	2.3	(1)	mg/kg	
	Molybdenum	4.8	(1)	mg/kg	
	Nickel	11.8	(1)	mg/kg	
	Potassium	699	(1)	mg/kg	
	Selenium	12.1	(1)	mg/kg	
	Strontium	188	(1)	mg/kg	
	Vanadium	7.2	(1)	mg/kg	
	Zinc	3760	(1)	mg/kg	(2)

All metals over the detection limit reported.

(1) All residue resulting from hazardous waste operations in the facility will be evaluated to determine if decontamination and/or removal is necessary to meet the appropriate clean close standard.
(2) High metal concentrations may be due to paint/epoxy contamination.

Sample #CSU-233S-WF-1 (south cell, wood fence sample location #1)

Sample Matrix - Wood

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Wood			
	Gross alpha	1	<15	pCi/g	
	Gross beta	1.8	<25	pCi/g	
	Tritium	17	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Heptachlor	2.5	(1)	ug/kg	
	Toluene	1300	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Barium	51.5	(1)	mg/kg	
	Cadmium	0.08	(1)	mg/kg	
	Chromium	1.5	(1)	mg/kg	
	Cobalt	5.7	(1)	mg/kg	
	Copper	3.2	(1)	mg/kg	
	Lead	77	(1)	mg/kg	
	Manganese	63.5	(1)	mg/kg	
	Mercury	0.25	(1)	mg/kg	
	Molybdenum	0.32	(1)	mg/kg	
	Nickel	1.1	(1)	mg/kg	
	Potassium	101	(1)	mg/kg	
	Selenium	0.94	(1)	mg/kg	
	Strontium	10	(1)	mg/kg	
	Zinc	699	(1)	mg/kg	

All metals over the detection limit reported.

Asbestos Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Asbestos	<1	(1)	Percent	Wood samples analyzed for the following minerals: actinolite/tremolite, amosite, anthophyllite, chrysotile, and crocidolite.

(1) See Attachment 10.

Sample #CSU-233S-WF-2 (south cell, wood fence sample location #2)

Sample Matrix - Wood

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Wood			
	Gross alpha	1.2	<15	pCi/g	
	Gross beta	3.2	<25	pCi/g	
	Tritium	17	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Bis(2-ethylhexyl)phthalate	2400	(1)	ug/kg	
	Butylbenzylphthalate	600	(1)	ug/kg	
	Heptachlor epoxide	2.3	(1)	ug/kg	
	o-Cresol	1100	(1)	ug/kg	
	Toluene	1300	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Barium	38.4	(1)	mg/kg	
	Cadmium	0.1	(1)	mg/kg	
	Chromium	1.1	(1)	mg/kg	
	Cobalt	7.9	(1)	mg/kg	
	Copper	2.6	(1)	mg/kg	
	Lead	29.2	(1)	mg/kg	
	Manganese	58.7	(1)	mg/kg	
	Mercury	0.042	(1)	mg/kg	
	Molybdenum	0.78	(1)	mg/kg	
	Nickel	0.98	(1)	mg/kg	
	Potassium	189	(1)	mg/kg	
	Strontium	6.4	(1)	mg/kg	
	Vanadium	0.26	(1)	mg/kg	
	Zinc	1030	(1)	mg/kg	

All metals over the detection limit reported.

Asbestos Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Asbestos	<1	(1)	Percent	Wood samples analyzed for the following minerals: actinolite/tremolite, amosite, anthophyllite, chrysotile, and crocidolite.

(1) See Attachment 10.

Sample #CSU-233S-WF-3 (south cell, wood fence sample location #3)

Sample Matrix - Wood

Radioactivity Summary	Analyte	Sample Media	Release Level (RL)	Units	Comments
		Wood			
	Gross alpha	1.3	<15	pCi/g	
	Gross beta	3	<25	pCi/g	
	Tritium	15	–		

Volatile Organic Compounds Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Bis(2-ethylhexyl)phthalate	480	(1)	ug/kg	
	Heptachlor	2.2	(1)	ug/kg	

All VOCs over the detection limit reported.

Metals Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Barium	30.3	(1)	mg/kg	
	Cadmium	0.057	(1)	mg/kg	
	Chromium	1.1	(1)	mg/kg	
	Cobalt	5.9	(1)	mg/kg	
	Copper	1.9	(1)	mg/kg	
	Lead	20.6	(1)	mg/kg	
	Manganese	51.3	(1)	mg/kg	
	Mercury	0.046	(1)	mg/kg	
	Nickel	0.85	(1)	mg/kg	
	Potassium	156	(1)	mg/kg	
	Selenium	1.7	(1)	mg/kg	
	Strontium	5	(1)	mg/kg	
	Zinc	404	(1)	mg/kg	

All metals over the detection limit reported.

Asbestos Summary	Analyte	Sample Media	Clean Up Level	Units	Comments
		Wood			
	Asbestos	<1	(1)	Percent	Wood samples analyzed for the following minerals: actinolite/tremolite, amosite, anthophyllite, chrysotile, and crocidolite.

(1) See Attachment 10.

Work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.

PHASE I WORK PLAN FOR THE BUILDING 233
CONTAINER STORAGE UNIT

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PHASE I WORK PLAN FOR THE BUILDING 233 CONTAINER STORAGE UNIT

1.0 INTRODUCTION

The Building 233 Container Storage Unit (B233 CSU) Work Plan has been developed by Lawrence Livermore National Laboratory (LLNL) to satisfy the terms and conditions expressed by the California Environmental Protection Agency, Department of Toxic Substance Control (DTSC) during the DTSC's August 6, 2003, tour of the B233 CSU and subsequent meetings. In addition to capturing the details of the meetings, this document incorporates revised information originally appearing in LLNL's initial submittal of the B233 CSU Closure Plan to the DTSC. The steps outlined in this Plan will ensure that hazardous, mixed, or radioactive wastes, potentially generated during site-characterization activities, will not be released to the environment or present a harmful condition to human health. Appendix A contains the Health and Safety Plan for the B233 closure activities. Waste generated during site-characterization activities will be collected, sampled, and disposed of in accordance with applicable regulations.

2.0 OBJECTIVES

The primary purpose of the B233 CSU Phase I Work Plan is to describe activities that will be associated with characterizing and decontaminating the storage unit for subsequent closure. Site characterization is a precursor to final closure and is comprised of several supportive operations, i.e., field sampling, area and equipment decontamination, waste packaging, and offsite transportation. Determining the need for further remedial action (Phase II work activities) will be contingent upon the analytical results yielded from Phase I. These analytical results will be submitted to the DTSC for evaluation with respect to California Environmental Quality Act (CEQA) project documentation.

3.0 AREA BACKGROUND

3.1 Geographical Profile/ Land Use

LLNL is a multidisciplinary research and development facility that generates hazardous, radioactive, and mixed waste. It is located about 40 miles east of San Francisco, California, in the Livermore Valley. Its Main Site occupies an area of approximately 821 acres in eastern Alameda County, adjacent to the City of Livermore. LLNL is owned by the U.S. Department of Energy (DOE) and operated jointly by DOE and the University of California. The U.S. Environmental Protection Agency (EPA) identification number for LLNL is CA 2890012584. The B233 CSU is located in the southwest quadrant of the Main Site. Appendix B contains photographs of the B233 CSU, and Appendix C contains a LLNL site map.

Prior to 1942, this 1-square-mile area was used for grain production and cattle grazing. Between 1942 to 1952, the U.S. Department of the Navy, then owners of the property, used the land for a Naval Air Station, an ancillary gunnery range, flight training, and aircraft assembly and repair operations. In 1952, the site was established as the Livermore Branch of the University of California Radiation Laboratory and subsequently named the "Lawrence Livermore National Laboratory." Currently, LLNL conducts research in nuclear weapons (e.g., non-proliferation initiatives and stockpile stewardship), magnetic fusion energy, laser fusion, isotope separation, biomedicine, environmental sciences, and applied energy technology.

3.2 Typical Climate and Weather Patterns

Mild, rainy winters and warm, dry summers characterize the climate of the Livermore Valley. The mean annual temperature for the Main Site in 2001 was 14.7°C (58.5°F). Temperatures range from –5°C (23°F) during some predawn winter mornings to 40°C (104°F) during some summer afternoons. The wind blows from the northeast primarily during the winter storm season. Most precipitation occurs between October and April, with very little rainfall during the warmer months. Annual wind data for the Livermore site are given in the Figure WP-1. These data show that roughly 50 percent of the wind comes from the southwest and westerly directions. This prevailing pattern occurs primarily during the summer. During the winter, the wind often blows from the northeast. Based on a ten-year record, the highest and lowest annual rainfalls were 541 and 211 mm (21.3 and 8.3 in.), and the average annual rainfall was 360 mm (14.2 in.). In 2001, the Main Site received 339 mm (13.4 in.) of rain.

Based on recent and historical weather data, closure operations should not be affected by weather conditions. However, any activity (e.g., drilling with a drill rig or sampling on the roof) that could be dangerous to the worker or compromise the integrity of the sample due to rainfall, wind, or temperature extremes would be postponed until conditions moderate.

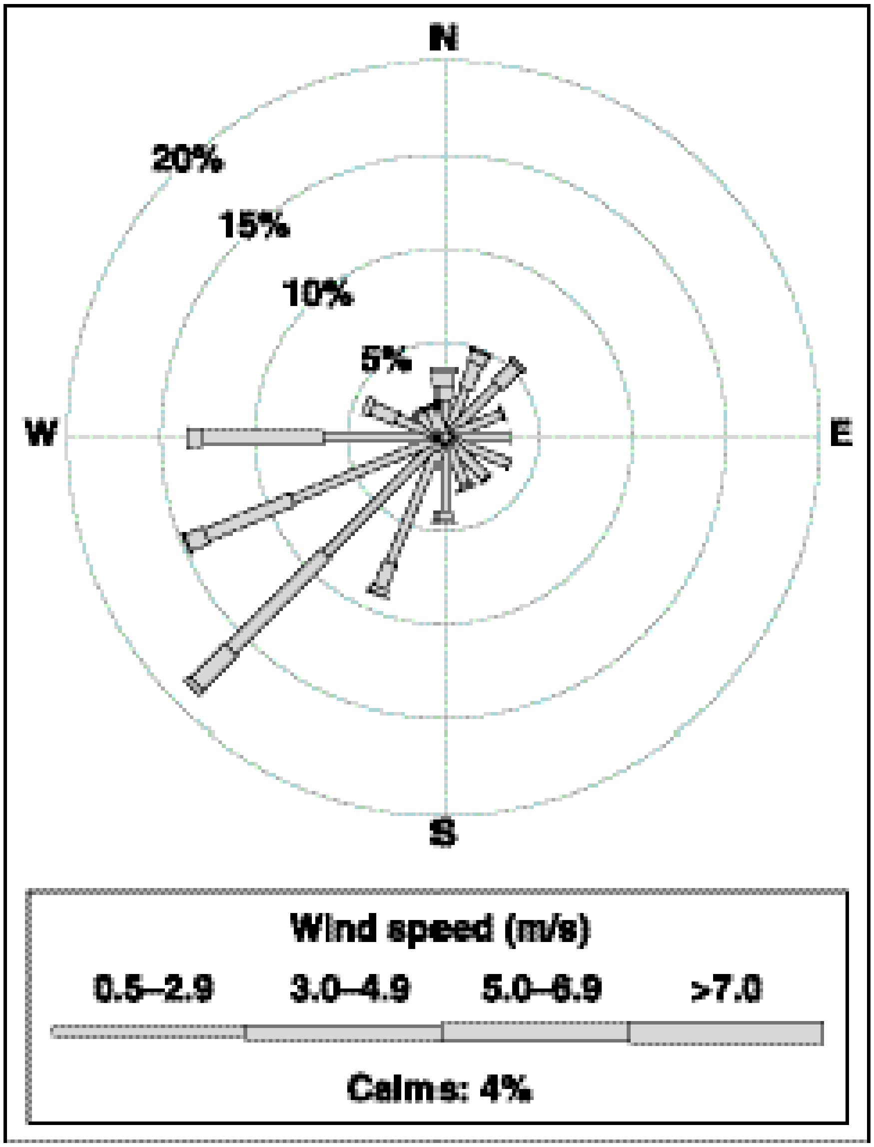

Figure WP-1. Wind rose showing the frequency of occurrence for wind speed and direction at LLNL during 2001

3.3 Potential Contaminants

The contaminants that could potentially be present in the B233 CSU structural media, concrete foundation, and soil subsurface are summarized in the following hazardous constituents list. These potential contaminants are an aggregate representation of the chemicals that, over the course of the B233 CSU history, were either used or stored in the unit. Additionally, the list includes the range of waste types that could be accepted into the storage unit as stipulated in the Part A permit application (LLNL, 1998).

3.3.1 Hazardous Constituents

An evaluation of areas and equipment was performed, and a list of constituents of concern was developed. These are materials that may have been present during the operation of the B233 CSU. The list is as follows:

acetic acid
acetone
arsenic
asbestos
barium
benzene
cadmium
carbon tetrachloride
chloromethane
cyanide
dichlorophenoxyacetic acid
endrin
ethylene dichloride
heptachlor
hexavalent chromium
hydrochloric acid
lead
methyl ethyl ketone
methylene chloride
nitric acid
polychlorinated biphenyls (PCBs)
pentachlorophenol
phosphoric acid
potassium hydroxide
selenium
silver
sodium hydroxide
sulfuric acid
tetrachloroethylene
toluene
trichloroethane
trichloroethylene
trichlorofluoromethane
trichloromethane
xylene

3.4 Historical Releases from the B233 Container Storage Unit

A review of historical incident reports for the B233 CSU has shown no documented releases. Due to this fact, the primary hazards posed to workers implementing this plan will be industrial in nature. The project-specific safety hazards and associated controls are detailed in Appendix A, "Health and Safety Plan" (HASP) of the Work Plan.

4.0 PROPOSED SEQUENCE OF EVENTS

4.1 Buried Utilities Survey and Sensitive Ecological Systems Assessment

LLNL will begin site characterization proceedings by conducting two area assessments: a buried-utilities survey and a sensitive-ecological systems assessment. Prerequisite to conducting concrete penetration or soil excavation activities, the project manager must obtain a permit from the LLNL Plant Engineering Department. Plant Engineering is responsible for ensuring that areas designated for penetration or excavation are clear of buried utilities, e.g., electrical conduits, gas, water, and air lines. Additionally, the permit acquisition process requires that a LLNL wildlife biologist and a LLNL archaeologist conduct a review to assess the proposed activity's potential impact to sensitive ecological systems and cultural resources. Adjustments will be made, as needed, to pre-selected (site-characterization) sample locations based on the respective outcomes of each review. The proposed Phase I schedule is shown in Appendix D.

4.2 Pressure Washing

The B233 CSU will be pressure-washed (with hot water) in accordance with the specifications detailed in Section III.2 of the B233 CSU Closure Plan. Rinsate generated from this process will be collected and analyzed pursuant to Subsection 5.1 of this Work Plan. The wastewater produced during this cleaning step will be disposed of in compliance with applicable federal, state and local regulations.

4.3 Swipe Samples

Swipe samples will be obtained from the B233 CSU as detailed in Section 5.0 of this Work Plan. The areas from which swipe samples are taken will be indelibly marked in a manner that does not introduce regulated chemical constituents to the area.

4.4 Wooden Slat Extractions

Portions of the wooden slat fencing will be removed from three randomly selected locations in each storage cell. The sample quantities shall be sufficient to perform the suite of analysis designated for solid samples (see Table WP-4).

4.5 Chip Samples

Three chip samples will be taken from the cement-block walls located in each cell (six samples total). The samples shall be extracted at heights (along the west walls) ranging from 1 to 3 feet. The depth of the chip samples shall be superficial so that the structural integrity of the unit is not compromised. The sample quantities shall be sufficient to perform the suite of analysis designated for solid samples (Table WP-4).

4.6 Core Samples

Drilling will be performed in the same locations from which (floor) bulk samples are obtained; these areas will bear indelible markings as indicated in Subsection 4.3 of this Work Plan (further illustrated in Figure WP-2). The initial samples of concrete and soil will be extracted by employing manual coring techniques. Two sequential soil extractions, revealing constituent levels at or below “clean-close” limits (Section 6.0), will preclude the need for further drilling and soil sampling. Additional drilling will be performed, if needed, to a maximum depth of 20 feet using powered drilling equipment.

The results obtained from the analysis of the B233 CSU samples will be used to determine the need for additional remedial action (i.e., obtaining samples at depths in excess of 20 feet and soil excavation work). If clean-closure standards are not achieved, then the feasibility of post-closure and the associated defining parameters, applicable to B233 CSU, will be evaluated.

5.0 PHASE I SAMPLING AND ANALYSIS PLAN FOR THE B233 CONTAINER STORAGE UNIT STRUCTURE, SECONDARY CONTAINMENT, AND SOIL

The Phase I sampling strategy proposed for the B233 CSU site characterization activities is based on the premise that the unit is free of anthropogenic contamination. strategy was developed in concert with DTSC during the agency’s August 6, 2003, visit to LLNL; a subsequent meeting at the DTSC Cal Center Office on March 19, 2004; and follow-up teleconference/electronic mail communications. Both parties agreed that full radiological and hazardous characterization of the unit would be achieved by obtaining chip, core and swipe (authoritative) samples, and wooden-slat (random) extractions. The analytical results that are produced from the implementation of these methods are typically sufficient to prove or discredit assumptions made regarding area cleanliness. The sufficiency of the number of initial samples (a minimum of 26 [Table WP-1]) will be determined through the application of statistical, algorithmic approaches. Calculations will be run, using the equation illustrated below, subsequent to the completion of the first suite of analysis. Additional samples will be taken, as needed, to achieve accurate characterization of the unit.

[EPA, 1986, SW-846 Table 9-1, Equation 8]

$$n = \frac{t^2.20s^2,}{\Delta^2}$$

with

Δ	=	the Regulatory Threshold (RT) minus the sample mean ($\bar{x}$)
t	=	the tabulated value for evaluating solid wastes, corresponding to the number of preliminary samples extracted minus one ("Degrees of Freedom" [n-1]).
$0.20s^2$	=	standard deviation (of the sample results) raised to the second power.

The 26 samples are divided into five groups:

- Ceiling swipes
- Chips (from the cinder block wall)
- Core (from the concrete floor)
- Core (from soil beneath the concrete foundation)
- Wooden slat removal.

The sample results obtained from each group will be evaluated independently; thus the SW-846 equation will be employed (at least) five times. The sample locations that are associated with the first four categories were selected authoritatively. The unit's size, limited use, and history warranted the truncated approach to selecting locations for the preliminary sample sets.

The type, number and location are provided in the table below:

Table WP-1. B233 CSU Sampling Strategy

Sample Type	Sample Location	Sample Quantity	Sample Depth/Area
Swipe	Ceiling	1 per cell	See Figure WP-3
Chip	Cinder block walls	3 per cell	Surface chips (see Figure WP-3)
Core	Floor (concrete)[a]	3 per cell	Total floor depth
Core	Floor (soil)[a]	6 per cell	0, 2, 5, 10, 15 and 20 ft[b]
Wooden Slat Removal	Randomly selected	3 per cell	Not applicable

a Factors that could change the designated sample locations are twofold: the accessibility of the locations by portable drilling equipment; and results of the Plant Engineering buried-utilities survey.

b If the analytical results of two sequential depth locations show no constituent levels at or below "clean-close" limits, further drilling will not be required. Samples will be obtained at the surface (0 ft) and at a depth of 2 ft for Phase I work.

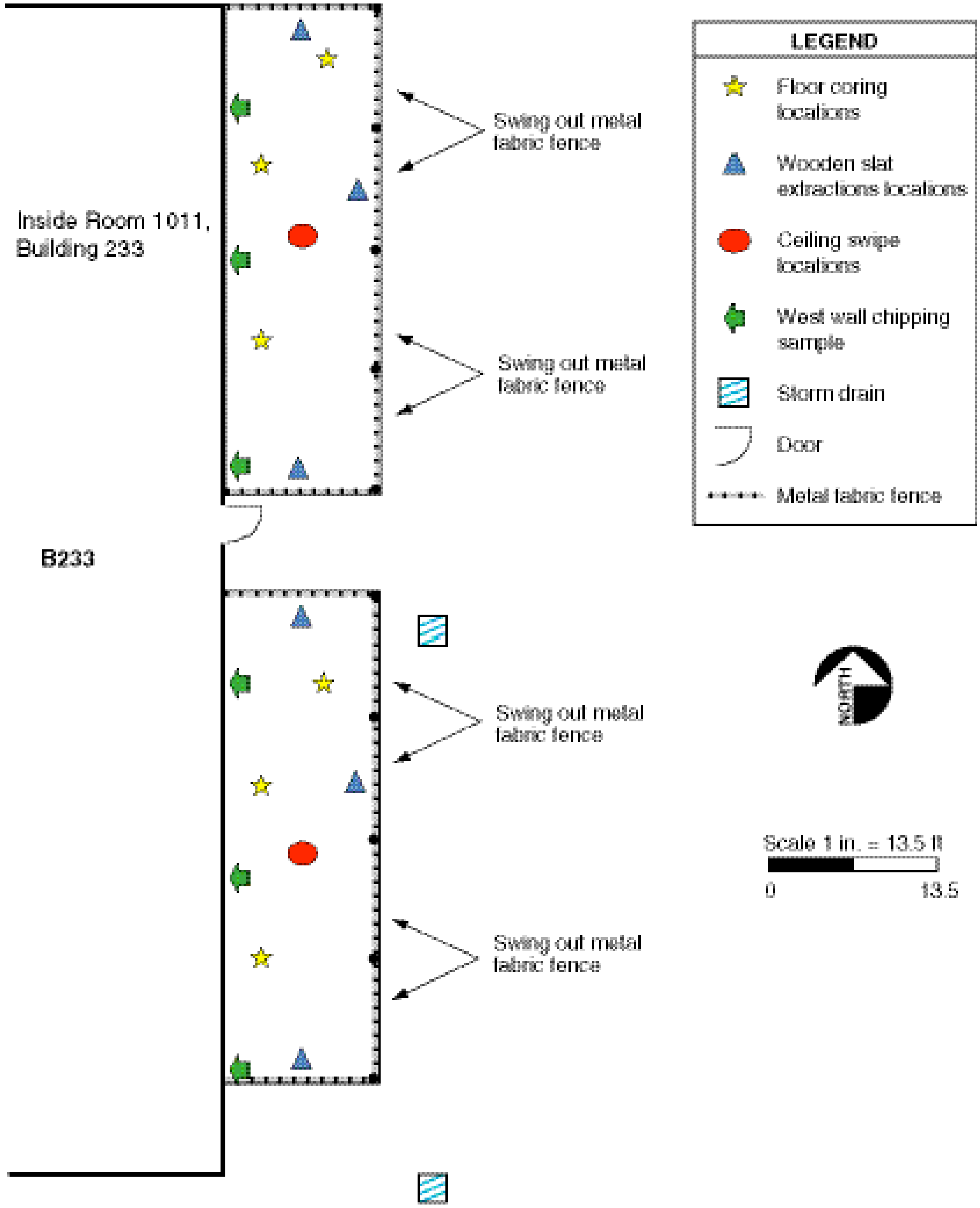

Figure WP-2. Proposed Sample Locations in B233 CSU

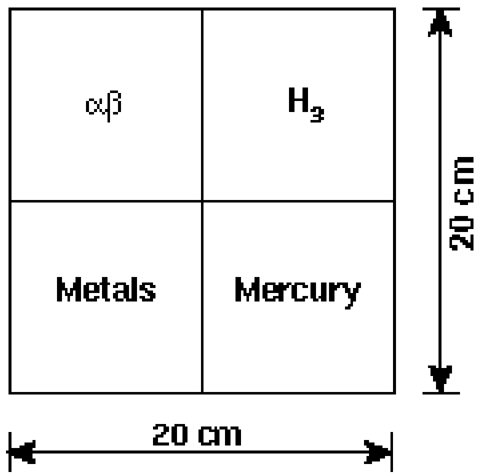

Figure WP-3. Sampling Quadrate

5.1 Sampling Methodologies

Swipe samples will be analyzed for radiological and hazardous contaminants. The methods used to extract swipes are described below and in Table WP-2:

Swiping for radiological analytes:

- Apply the appropriate swipe solution to a swipe tab (gross alpha/beta – dry tab, tritium—distilled water).
- Using moderate pressure, swipe a 100 square-centimeter area in the pre-determined spot.
- Place swipe tab in appropriately labeled container (gross alpha/beta—glassine bag, tritium—10-milliliter glass liquid scintillation vial).
- Appropriately dispose of personal protective equipment (PPE).
- Fill out paperwork and take samples to the laboratory.

Swiping for hazardous constituents:

- Apply the appropriate swipe solution to a swipe tab (See Table WP-2 below). If 10 milliliters of solution is needed, use pre-measured scintillation vials, moistening tab with appropriate solvent prior to swiping area.
- Using moderate pressure, swipe a 100-square-centimeter area in the pre-determined spot.

- ♦ Place swipe tab in appropriately labeled 10-milliliter liquid scintillation vial.
- ♦ Appropriately dispose of PPE.
- ♦ Fill out paperwork and take samples to the laboratory.

Table WP-2. Analytical Methods and Preservative Types for Swipes (obtained for hazardous constituent analysis)

Analysis Type	Preservative	Preservative Amount (mL)
8260	Methanol	10
8270	Methylene Chloride	10
Polychlorinated biphenyls (PCBs)	Hexane	10
TTLC metals	5% Nitric Acid	Sufficient to moisten swipe tab
TTLC Mercury	5% Nitric Acid	Sufficient to moisten swipe tab

TTLC = total threshold limit concentration

Chip and core samples will be obtained in accordance with the sections below.

5.1.1 Drilling Procedure

The drilling process should minimally alter the medium that is being investigated. It is essential that the drilling process not introduce hazardous or foreign substances into the borehole or create conduits that facilitate the spread of existing contaminants. Various methods are used for drilling including hollow-stem augers, mud rotary, air or air-mist rotary. The method used to obtain soil samples at depths specified in the closure plan will be evaluated on a case-by-case basis.

Drilling Preparation

The following steps outline drilling preparation:

a. Review existing geologic and hydrogeologic information to determine drilling locations and estimate key parameters (e.g., sample target zones, depth and thickness, types and concentrations of contaminants, etc.).

b. Verify that underground utilities have been surveyed and that drilling activities will not interfere.

c. Ensure the working areas are cleared of all brush and minor obstructions.

d. Decontaminate all downhole drilling and sampling equipment, including the back of the drilling rig.

e. Ensure that no solvents, light hydrocarbon-based lubricants, or paints are present or applied to downhole drilling tools or samplers.

f. Ensure that the back of the drilling rig is free of any mud, leaking hydraulic lines, and excess grease that could be dislodged during drilling. If air-rotary drilling is to be used, ensure that air systems include an in-line filter to remove all oil from the compressed air.

Drilling Operation

The following steps outline drilling operations:

a. Use the Borehole/Well Construction Log to document field information and comments.

b. Screen samples of the drilling mud using the photo ionization detector (PID) or flame ionization detector (FID) prior to entering lower hydrogeologic units to prevent possible cross-contamination between shallow and deeper zones. Prevent possible cross-contamination between shallow and deeper permeable water bearing zones by having the driller change out the drilling mud before drilling through any aquitard.

   Note: Water should not be encountered at B233.

c. Collect all soil samples as specified below.

   Note: If the borehole is left unattended at any time, the borehole shall be covered and protected.

5.1.2 Soil Sampling Procedure

Wash the soil sampling bit with detergent and analyte-free water (source should be analyzed to determine analyte-free status), and rinse, or steam clean. Collect a rinsate/equipment blank, from the interior of the sampler and submit for analysis when deemed necessary by the sampling plan. After the bore has been drilled to specified depths, the soil-sampling device such as a split-barrel sampler will be used to obtain soil samples as follows:

Volatile and semi-volatile organic compound analysis:

a. Load pre-cleaned (steam cleaned, de-ionized rinse) brass or stainless steel tubes into the soil-sampling device such as a split-barrel sampler. After the driller is certain all slough is removed from the auger and borehole, drive the sampler to desired depth in borehole.

b. To maximize sample integrity, collect the sample from the deepest tube, provided quality is good (i.e., no headspace).

c. Quickly observe lithology, and place an approximately 5-gram sample in a pre-weighed vial with a septum pursuant to EPA Method 5035 (EPA, 1986).

d. Use an indelible marker to label the sample with identification (borehole/well number followed by top of sample depth), sampling date, sample time, analysis type(s), and sample collector's initials.

e. Immediately place the sample tube in a plastic bag and seal by tying a knot in the opening. To keep samples dry, double bag. When cross-contamination is not of concern, double-bag samples in sets.

f. To facilitate rapid cooling, all samples should be placed in an insulated cooler containing bagged ice. Ice melt water is to be drained from the cooler throughout the day, and all loose ice is also double bagged at the end of the day for courier delivery to the analytical laboratory

g. Document sample identification, time and date of sample, location, turnaround time, and analysis type(s) on the Borehole/Well Construction Log.

Sample collection for metals and radiological analysis:

a. Load tubes into the soil-sampling device such as a split-barrel sampler and drive sampler to desired depth in borehole. Stainless steel sample tubes should be used during metals sampling to prevent metal cross contamination.

b. Record lithology, seal the tube ends with Teflon tape, and secure with duct tape. Alternatively, sample can be transferred to a wide-mouth glass jar and sealed with duct tape.

c. Use an indelible marker to label the sample tube or jar with the identification (borehole/well number followed by top of sample depth), sampling date/time, sample analysis type(s), and sample collector's initials. Both end caps and the duct tape should be labeled.

d. Place the sample tube or glass jar in a plastic bag and refrigerate.

e. If tritium analysis is to be performed, immediately refrigerate the sample tube or jar in plastic bags in an insulated cooler. If a jar is used, ensure that the jar is packed tightly to reduce air space, and that the lid is closed tightly and taped to help seal. If the samples are not immediately shipped to the analytical laboratory, they should be stored in a refrigerator. Samples held overnight will be transferred to a freezer.

f. Document sample identification, time and date of sample, location, turnaround time and analysis type(s) on the Borehole/Well Construction Log.

In addition to swipe, chip and core samples, rinsate generated from cleaning activities, (e.g., pressure washing, equipment decontamination) will be collected pursuant to the guidelines specified below: