U.S. Department of Energy

Oakland Operations Office, Oakland, California

ADDENDUM NO. 2 TO THE FINAL VISUAL INSPECTION AND SAMPLING PLAN FOR THE UNDERGROUND RADIUM AND STRONTIUM TREATMENT TANKS

for the:

DOE AREAS AT THE LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH UNIVERSITY OF CALIFORNIA, DAVIS

Prepared for:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 94612-5208

Prepared by:

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5801 Christie Ave., Suite 600
Emeryville, California 94608-1827

July 25, 2000
Rev. 0

DOE Oakland Operations Contract DE-AC03-96SF20686

Weiss Associates
Environmental and Geologic Services

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ABBREVIATIONS AND ACRONYMS

AH-1	Animal Hospital Number 1
ALARA	As-Low-As-Reasonably-Achievable
Am-241	americum-241
CA	Contamination Area
CCR	California Code of Regulations
cm^2	squared centimeters
COC	chain-of-custody
DOE	Department of Energy (United States)
dpm	disintegrations per minute
EPA	Environmental Protection Agency (United States)
FADL	Field Activity Daily Log
g	gram
GEL	General Engineering Laboratories, Incorporated
H-3	tritium
HWP	Hazardous Work Permit
ID	identification
IT Corp.	IT Corporation
kg	kilogram
L	liter
LEHR	Laboratory for Energy-Related Health Research

MDA	minimum detectable activity
mg	milligrams
ml	milliliters
NIOSH	National Institute for Occupational Safety and Health
pCi	picoCuries
PHSP	Project Health and Safety Plan
PPE	personal protective equipment
PTL	Project Task Leader
QAPP	quality assurance project plan
QA/QC	Quality Assurance/Quality Control
Ra-226	radium-226
RCT	radiological control technician
RSO	Radiation Safety Officer
SC	Site Coordinator
SHSO	Site Health and Safety Officer
SOP	standard operating procedure
Sr-90	strontium-90
STLC	Soluble Threshold Limit Concentration
SVOC	semi-volatile organic compounds
TCLP	Toxicity Characteristic Leaching Procedure
Th-228	thorium-228
Th-232	thorium-232
UC Davis	University of California, Davis
VOC	volatile organic compounds

WA	Weiss Associates
WET	Waste Extraction Test
WTS	Waste-Tracking Sheet

1. INTRODUCTION

This plan is an addendum to the Final Visual Inspection and Sampling Plan for the Underground Radium and Strontium Treatment System Tanks (IT Corp., 1997) and presents the approach and procedures for collecting additional sludge and wood samples from Tank A of the Strontium Treatment System associated with the former Imhoff Building at the Laboratory for Energy-Related Health Research (LEHR) at the University of California, Davis (UC Davis). This work plan includes descriptions and rationale for the planned activities, detailed procedures for all fieldwork, quality assurance/quality control (QA/QC), health and safety and waste management.

Thorough descriptions of the underground Strontium Treatment System tanks are provided in the *Final Report for the Liquid and Sludge Removal Project* (Chemical Waste, 1992), *Phase II Site Characterization Report* (Dames and Moore, 1993), *Final Draft - Remedial Investigation/Feasibility Study Work Plan* (Dames and Moore, 1994), and *Draft Final Site Characterization Summary Report* (WA, 1997a). A brief description of these tanks is provided below. The locations of the tanks are shown in Figure 1.

1.1 Work Plan Organization

Section 2 presents the procedures for sampling and packaging activities. Sections 3, 4 and 5 describe the quality assurance, data management and waste management, respectively. Section 6 summarizes health and safety requirements. Cited references are listed in Section 7. The Activity Hazard Analysis and As-Low-As-Reasonably-Achievable (ALARA) guidelines are included as Attachments 1 and 2, respectively.

1.2 Objectives

The objective of collecting additional sludge and wood samples from Tank A is to assess whether semi-volatile organic compounds (SVOCs) and metals exceed state and federal hazardous waste thresholds (i.e., the Toxicity Characteristic Leaching Procedure (TCLP) and Soluble Threshold Limit Concentration (STLC). Additionally, specific waste disposal samples are required to meet the waste acceptance criteria of Envirocare of Utah (Envirocare). Samples will be collected from only Tank A because the contents of the other treatment tanks were previously removed and disposed (Chemical Waste, 1992). Results from this activity will be used to guide the Radium/Strontium Treatment Systems Area II Removal Action.

Following completion of this task and subsequent data validation and waste designation, waste profiles will be completed. Based on preliminary results, the remaining waste will be profiled against the waste acceptance criteria of Envirocare.

1.3 Strontium Treatment Tanks

The nine underground Strontium Treatment System tanks (Tanks A through I) are part of a system once used for holding and processing biological laboratory wastes resulting from experimentation with strontium-90 (Sr-90) in Animal Hospital Number 1 (AH-1) (Chemical Waste, 1992). These tanks were located beneath the former Imhoff Building. Biological wastes from AH-1 initially drained into the sump tank. Wastes were pumped from the sump tank into a series of three settling and digestion tanks (i.e., Tanks A, B, and C) separated by weirs. The resultant supernatant from these three tanks would be pumped into the first three of six in-series tanks for chemical treatment (i.e., Tanks D, E, and F) when the settling and digestion tanks were predominantly full. The supernatant from the chemical treatment tanks would be pumped through a series of resin columns and placed in the final three storage tanks (Tanks G, H, and I). Following residence in the storage tanks, supernatant was discharged through a leach field into the subsurface. Each underground tank has two or more hatchways that are readily accessible as a result of the Imhoff Building Decontamination and Decommissioning (IT Corp., 1994) (Figures 1, 2, and 3).

1.4 Historical Background

Activities to remove wastes from the underground strontium treatment tanks were performed in 1992 (Chemical Waste, 1992). Wastes from the eight of the nine strontium tanks (Tanks B through I) were removed from the tanks, treated, packaged and shipped to the United States Department of Energy (DOE) Hanford disposal facility in Richland, Washington. Waste removal activities involved in this project did not include removal of waste from Tank A. In addition to the removal of the wastes from the tanks, inside tank wall surfaces were surveyed for radiation/contamination; samples of the tank walls and soil beneath the tanks were collected for laboratory analysis; and, in the case of the strontium treatment tanks, some of the mastic coating was removed from some of the inner tank walls.

Wastes were reported to consist of sludge and free liquid (Chemical Waste, 1992) and were radioactive. Sludge consistency ranged from very hard and compact to a thick liquid containing large particles of sludge. Two liners and 784 drums and of solidified waste associated with the Strontium Treatment System were transported to the DOE Hanford disposal facility in 14 shipments (Chemical Waste, 1992). Free liquid ranged from yellow to clear. High free liquid levels within the radium tanks was attributed to infiltrating precipitation.

Because a creosote odor was reported in Strontium Treatment System Tank A, wastes were not removed from or agitated within this tank (Chemical Waste, 1992). The presence of creosote, creosote-constituent chemicals, or other organic compounds may indicate that some of the wastes in

Tank A are mixed. However, the presence of creosote in preserved wood is not considered hazardous waste under RCRA. Photographs of Tank A contents are presented in Attachment 3. Currently, wood, debris and sludge are co-mingled in Tank A only. Some additional work may be required to move this debris in order to access the underlying sludge.

Radiation/contamination surveys performed on the inside tank walls following waste removal give an indication of radiological conditions to be expected during this phase of tank inspections and are summarized below.

- Average loose alpha contamination: 0.5 to 37 disintegrations per minute per 100 square centimeters (dpm/100 cm^2).
- Average loose beta/gamma contamination: 52 to 6,617 dpm/100 cm^2.
- Direct alpha frisk (fixed contamination): no detectable activity above background to 204 dpm/probe.
- Direct beta/gamma frisk (fixed contamination): 9,238 to 2,3337 dpm/probe.

These contamination values are greater than the allowable levels for uncontrolled areas, therefore, the tank inspection areas will be treated as contamination areas (CAs) (WA, 1997b).

Radionuclide analysis of the core samples collected from the tank walls ranged from less than 0.1 to 3.34 picoCuries per gram (pCi/g) for radium-226 (Ra-226), Sr-90, thorium-228 (Th-228), thorium-232 (Th-232), and tritium (H-3). Radionuclide analysis of soil samples collected from beneath the tanks ranged from less than 0.2 to 2.11 pCi/g for Ra-226, Sr-90, Th-228, Th-232, and H-3. Free liquid analysis are summarized below (Chemical Waste, 1992 reference).

- Gamma spec: not detected.
- Gross alpha: less than 2 to 14 picoCuries/liter (pCi/L).
- Gross beta: 29 to 193 pCi/L.
- Sr-90: 10.8 to 17.6 pCi/L.
- H-3: less than 500 to 921 pCi/L.

Volatile and semi-volatile organic compounds reported in detectable concentrations in a sludge sample collected from Tank A included various napthalenes, anthracenes, and pyrenes; xylenes; fluorene; and chrysene. The concentrations of these compounds were reported to range from slightly greater than 9 to 2,100 milligrams per kilogram (mg/kg).

In September 1997, Tank A was inspected and sampled in accordance with the *Final Visual Inspection and Sampling Plan for the Underground Radium and Strontium Treatment Tanks* (IT Corp., 1997). The tanks were inspected visually, the tank hatch area was radiologically surveyed, and water level measurements were taken inside the tanks. Photographs (Attachment 3) and a video survey were taken of the interior of the tanks. After the inspection was completed, two pressure transducers were placed in the tanks to monitor water levels. At the time of this sampling event, the sludge was not viscous; rather, it was hard with some black liquid.

Three tank sludge samples (LEHR-SL-001, -002, -003) were collected from Tank A on September 24 and 25, 1997. Two wood samples were collected from the tank on September 25, 1997. One wood sample (LEHR-W-001) was collected from below the sludge, and a second wood sample (LEHR-W-002) was collected from above the sludge.

Compounds detected in the sludge samples are summarized below:

- Gross beta and Sr-89/90 were detected in all sludge samples at maximum concentrations of 13,040 pCi/g and 18,600 pCi/g respectively. Ra-226 (3.88 pCi/g), H-3 (3.8 pCi/g), bismuth-214 (1.11 pCi/g), cesium-137 (0.71 pCi/g), and americium-241 (Am-241) (0.037 pCi/g) were also detected. No other radionuclides were detected at activity levels above the minimum detectable activity (MDA).
- SVOCs were detected at up to 5.1 mg/kg (napthalene).
- Volatile organic compounds (VOCs) were detected in all three samples at up to 22 µg/kg (2-butanone).
- Antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc were detected in all three samples.
- The only pesticide detected was 4,4-DDE, which was detected at up to 21 µg/kg. PCB-1260 was detected at up to 1,100 µg/kg.

Compounds detected in the wood samples are summarized below.

- Gross beta and Sr-89/90 were detected in both wood samples at maximum concentrations of 3,650 pCi/g and 998 pCi/g, respectively. H-3 (1.85 pCi/g), lead-214 (0.72 pCi/g), and Am-241 (0.018 pCi/g) were also detected. No other radionuclides were detected at activity levels above the MDA.
- SVOCs were detected at up to 2,200 mg/kg (fluoranthene).
- VOCs were detected in both samples at up to 33 µg/kg (styrene).
- Antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc were detected in both samples.
- No pesticides or PCBs were detected.

2. SAMPLING AND ANALYSIS

This section describes the primary activities associated with sample collection for the strontium treatment tanks.

2.1 Sample Collection

Sample matrices, unique sample identification numbers and specific analytical requirements are described in Table 1. Samples will be collected in accordance with the following standard operating procedures (SOPs):

- SOP 3.1, Surface and Shallow Subsurface Soil Sampling;
- SOP 1.1, Chain-of-Custody; and,
- SOP 2.1, Sample Handling, Packaging and Shipping.

2.2 Sample Documentation

The usability of the data obtained during this sampling event will depend on its quality. A number of factors relate to data quality. Sample collection methods are as important as the methods used for sample analysis to ensure data quality. Following proper sample collection and analysis procedures reduces sampling and analytical error. To ensure sample integrity, samples will be handled using complete chain-of-custody (COC) documentation and preserved using proper sample preservation techniques, holding times, and shipment methods. Obtaining valid and comparable data also requires adequate quality assurance/quality control QA/QC procedures and documentation.

The components of the sample documentation and custody system will include the following:

- COC Form;
- Field Logbook/Field Activity Daily Log (FADL);
- Sample Numbers;
- Sample Labels; and,
- Custody Seals.

2.2.1 Chain-of-Custody Forms

COC forms will be completed by the sample team to track sample custody as well as specify the requested analyses. COC forms will be completed in accordance with the requirements of SOP 1.1, Chain-of-Custody. An example COC is provided in Attachment 4.

2.2.2 Field Logbook/Field Activity Daily Log

Descriptions and observations made during field and sampling activities will be documented in the Field Logbook/FADL. The following information will be recorded in the Field Logbook/FADL:

- Project name and number;
- Location of site;
- Purpose of sampling;
- Description of field activities;
- Names of sampling personnel;
- Date and time of entries;
- Sample description, using the Unified Soil Classification System for soil/sediment;
- Waste description (color, consistency, matrix, etc.);
- Date and time of sample collection;
- Sample locations, identification number and sampling methodology;
- Field observations;
- Results of field measurements; and,
- Results of field calibrations for instruments used.

This information will be provided to the Project Task Leader (PTL) for distribution to the LEHR Waste Management Team and to the LEHR library for incorporation into the project files.

2.2.3 Sample Numbers

A unique alphanumeric ID number will be assigned to each sample collected, using the following format:

aabbbccc

Where,

aa = Type of sample and matrix

SS - soil sample

WS - water sample

CW - composite waste

bbb = Three-letter acronym designating the sample area at the site, e.g.:

RSC - Radium/Strontium Systems confirmation/characterization

ccc = Sequential sample number (e.g., 001, 002, 003)

Unique sample ID numbers are provided for each sample and/or sample group in Table 1.

2.2.4 Sample Labels

Sample labels will be attached to individual sample containers and will contain the following information:

- Project number;
- Sample ID number;
- Date and time collected;
- Initials of sampler; and,
- Requested analyses.

2.2.5 Custody Seals

Custody seals will be used to detect tampering and will be placed over the lid of the shipping container and annotated with the following information:

- Date and time; and,
- Initials of sampler.

2.3 Pre-Phase Inspection

A pre-phase inspection will be performed prior to the commencement of the sampling activities to assure that project and task goals are achieved. The review will verify that the procedures and guidelines specified in Section 3 "Quality Assurance" and Section 6 "Health and Safety" of this plan are satisfied. In addition, the inspection will verify that the equipment and supplies listed below are accounted for prior to the commencement of work.

2.3.1 Tools, Material and Equipment

Materials, equipment, and tools required to complete the sampling may include, but are not limited to, the following:

- Waste packages (bags, drums, etc.);
- Hand tools;
- Clear, plastic bags (various sizes for packaging);
- Absorbent material (Chemsorb, Vermiculite, etc.);
- Labeling supplies;
- Packaging supplies (e.g., duct tape, bubble-wrap, coolers, etc.);
- Herculite or polyethylene sheeting;
- Health physics supplies;
- Radiological instrumentation;
- Industrial hygiene monitoring equipment;
- Photography equipment and supplies;
- Personal protective equipment (PPE);
- Photoionization detector;
- Hand auger/slide hammer;
- Industrial hygiene monitoring equipment;
- Miscellaneous hand tools;
- Radiation control supplies; and,
- Polyethylene sheeting.

2.3.2 Work Zones

The Site Supervisor/Field Coordinator is responsible for ensuring that site access is controlled and work zone boundaries are defined and enforced. For the tasks described in this work plan, the existing fence and buildings will serve as boundaries/barriers. All gates and doorways that allow access to the Imhoff tank area will be posted and have boundary markings.

2.4 Strontium Treatment System Tank A Sampling

This section describes the activities that will be performed in order to collect samples of the materials inside Strontium Treatment System Tank A. Tank A is approximately 24-foot long, 6-foot wide and 6-foot deep. Tank A hatches are 31 inches long by 31 inches wide. The sludge in Tank A is located at approximately 4-foot depth. The wood material used to assist in sludge digestion are no longer in its operable locations and are scattered at various depths in Tank A (see Attachment 3). Samples of sludge and wood will be collected from Strontium Treatment System Tank A. Additional samples will be collected if other matrices/materials are present in the tank. Analyses will be performed on a three-week rush turnaround time. The free liquid in the tank will not be sampled at this time. Wood and debris may have to be moved using hand implements from the tank surface to access sludge at the tank bottom. Entry into the tank is not part of this work plan.

2.4.1 Sludge Sampling

One composite and one field duplicate sample of sludge will be collected for analysis (Table 1). Five sub-samples of sludge will be collected to make the composite sample (Table 1). Sub-samples will be collected from varying depths to ensure that samples are representative. Sub-sample compositing will be performed by the contract laboratory conducting the analyses.

Sludge samples will be collected through the tank hatchways using a manual corer sampling device. Viscous/flowing sludge will be collected using a wide mouth plastic scoop attached to a metal extension rod. If sludge proves too hard to sample with the manual corer, the sludge will be broken inside the tank using the extension rod and collected with the plastic scoop. Retrieved samples and sampling devices will be placed on Herculite® sheeting or equivalent that surrounds the tank hatch cover. Herculite® sheeting or equivalent will be staged such that after each sample collection, a layer of plastic sheeting will be removed and bagged for disposal. If sludge is dry and flaky, the sampling method will include wetting down the sludge with a clean pump-type sprayer containing deionized water to mitigate any airborne hazard. If airborne hazards persist above contaminant action levels, personnel will upgrade PPE as described in Section 6.4. Five eight-ounce glass containers of sludge will be collected for each sample.

Table 2 summarizes the chemical analyses that will be performed on the samples of sludge collected from Strontium Treatment System Tank A. The required sample containers and quantities for the indicated test parameters are presented in Table 1.

A description of the sludge in the tank will be recorded in the FADL, and will include references to color, consistency, odor, quantity and thickness.

2.4.2 Wood Sampling

Two discrete samples of wood from within Strontium Treatment System Tank A will be collected for analysis (Table 1). One wood sample will be collected from a point above the sludge in the tank and the other will be collected from a point below (submerged and/or in contact with) the surface of the sludge. The sample from above the sludge will be collected first.

Wood samples will be collected through the tank hatchways using a threaded skewer. The skewer will be inserted into the desired piece of wood to facilitate sawing and retrieval. Wood samples will be provided to the laboratory as chips made with a wood chisel or equivalent. Chiseling will be performed within a double bag or be wetted in order to control potential airborne contaminants. For the wood sample collected below the sludge surface, sludge will be removed from the wood prior to chiseling. One two-liter plastic container of wood will be collected for each sample.

Table 2 summarizes the chemical analyses that will be performed on the samples of wood collected from Strontium Treatment System Tank A. The required sample containers and quantities for the indicated test parameters are presented in Table 1.

A description of the wood in the tank will be recorded in the FADL, and will include references to color, condition, odor, and quantity.

3. QUALITY ASSURANCE

This section presents the QA/QC issues related to the scope of work described in this document. The objective of this section is to provide a framework to ensure that quality is integrated within every aspect of the project work.

Personnel involved in conducting or supervising the work described in this work plan are responsible for certifying that they have been instructed in all applicable sections of the work plan and project procedures which may affect their work. This certification will be obtained, documented and filed for each affected worker by the PTL, or designee, in accordance with the requirement outlined in the *Quality Assurance Project Plan* (QAPP) (WA, 2000).

Other quality assurance requirements applicable to this work plan are detailed in the QAPP for the environmental restoration activities at the LEHR Site (WA, 2000). This plan is based upon the requirements of United States Department of Energy Order 414.1A, *Quality Assurance,* and United States Environmental Protection Agency QAMS-005/8, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans,* as they are applicable to the scope of work.

The samples collected will be analyzed by General Engineering Laboratories, Incorporated (GEL) in Charleston, South Carolina. Laboratory reports (hard copies and electronic files) will be forwarded from the laboratories to the Weiss Associates Data Validation Chemist. These results will be validated and transferred to the project database by the Weiss Associates Database Manager in accordance with procedures described in the QAPP.

4. DATA MANAGEMENT

Samples collected for chemical analyses will be analyzed by a United States Environmental Protection Agency (EPA), California and Utah-certified laboratory. Laboratory report hard copies and electronic files will be forwarded from GEL to Weiss Associates (WA). Results will be validated and transferred to the project database by WA in accordance with procedures described in the QAPP (WA, 2000).

Data receipt, sample tracking, data entry, data storage and data reporting will be managed by WA according to the procedures defined for these activities in the QAPP (WA, 2000).

4.1 Data Quality Objectives

Data quality objective necessary for this plan are based on EPA-5440-R-93-071, Data Quality Objectives Process for Superfund, Interim Final Guidance, where applicable.

The Strontium Treatment System Tank A has been targeted for sampling to supplement existing information. Previous data collection activities were completed in 1997 to address the characterization of waste in Strontium Treatment System Tank A. The data resultant from the completion of this plan will be used to complete the characterization of waste in Strontium Treatment System Tank A for determination of waste classification.

The rationale for the collection of waste samples from Strontium Treatment System Tank A is to provide the minimum data necessary to complete the following activities.

- Characterize the waste; and,
- Identify the types and condition of the waste present in the tank.

Samples collected from Strontium Treatment System Tank A will be sludge and wood. Section 2.4 and Tables 1 and 2 in this plan provide detailed information regarding sample types that are required.

Measurement parameters that will be recorded, if possible, in the completion of the proposed activities in this plan include waste material descriptions and collection locations recorded by depth and relative positioning.

5. WASTE MANAGEMENT

The *LEHR Waste Management Plan* (WA, 1997c) outlines the appropriate process or expected lifecycle for all types of potential waste streams anticipated to be managed on site. Upon the completion of the tasks outlined in this work plan, the project team will be able to manage the subject wastes in the most safe, efficient, cost-effective and compliant manner possible. In addition, analytical data will be generated that will facilitate waste designation and waste profiling for eventual waste disposal. All activities will be conducted in accordance with the following SOPs:

- SOP 34.1, Waste Processing and Packaging;
- SOP 34.2, Low-Level Radioactive Waste Storage;
- SOP 34.4, Clean Waste Handling; and,
- SOP 34.5, Waste Tracking System.

5.1 Waste Minimization

The LEHR Waste Management Program is committed to minimizing waste volumes at the LEHR Site by giving preference to source reduction, material substitution, decontamination, and recycling. Whenever possible, materials will be radiologically surveyed and released for disposal at a permitted disposal facility as non-radioactive waste. Work schedules and project planning will be designed and maintained to minimize the unnecessary donning and doffing of PPE to minimize secondary wastes.

5.2 Task-Specific Guidance

Decontamination solutions will consist of water and detergent used to clean the probes and sample collection tools and personnel wash water. When possible, preliminary decontamination will be conducted so that the material from probing and sampling will be discharged into each subject tank. Excess sample material will be released into the tank it was originally collected from. Excess decontamination solutions will be collected and returned to the tank. No waste is expected to be generated with the exception of PPE and poly-sheeting which will be packaged, assigned a LEHR waste tracking number and managed as low-level radioactive waste pending analysis.

5.3 Waste-Tracking System

A Waste-Tracking Sheet (WTS) will be completed for the packaged PPE and poly-sheeting waste packages as described in SOP 34.5, Waste-Tracking System.

The WTS will be submitted to the Field Waste Coordinator for review and following review and approval, the WTSs will be submitted to the LEHR Waste-Tracking System Coordinator for incorporation into the LEHR Waste-Tracking System database.

6. HEALTH AND SAFETY

Health and safety procedures applicable to performing the visual tank inspection and sampling are described in this section.

6.1 General Procedures

Health and safety procedures that will be followed during the completion of this plan are provided in the Project Health and Safety Plan (PHSP) (WA, 1997e). In addition to the general requirements outlined in the PHSP, the following specific elements of the PHSP will be followed:

Section 2.3: ALARA Principles

Section 3.4: Safety Meetings

Section 4.41: Waste Characterization

Section 5.4.1: Chemical Hazard Management Program

Section 5.4.2: Physical Hazards Management Program

Section 5.4.3: Environmental Hazards Management Program

Section 5.4.4: Radiological Hazards Management Program

Section 5.4.6: Project Hazards

Section 6.1: Chemical Action Levels

Section 6.2: Radiological Action Levels

Section 7.1: Work Zones

Section 9: Personal Protective Equipment

Section 11: Air Monitoring

Section 12: Site Emergency Response Plan/Contingency Plan

Section 13: Spill and Discharge Control Plan

Section 14: Personnel Training Requirements

Section 15: Hazard Communications

Section 18: Worker Medical Surveillance

SOP 24.1: Radiological Areas and Postings

SOP 25.1: Radiological Surveys and Instrumentation

SOP 32.1: Contamination Control

In addition, applicable hazard analysis and controls are discussed in Sections 8.1 through 8.2 of the *Final Visual Inspection and Sampling Plan* (IT Corp., 1997). A task-specific Activity Hazard Analysis is presented in Attachment 1.

6.2 Chemical Exposure

Volatile and semi-volatile organic compounds reported in detectable concentrations in a sludge sample collected from Strontium Treatment System Tank A are discussed in Section 1.4. The atmospheric monitoring and action levels are detailed in Section 6.4.2.

Ingestion of chemicals will be minimized by use of proper PPE and personal hygiene. Administrative and engineering controls will be used to reduce potential exposure to chemicals. Should airborne concentrations exceed action levels stated in Section 6.4.2 of this work plan, additional engineering controls will be implemented if feasible before considering the use of additional PPE.

6.3 Radiological Exposure

The following summary (Table 3) is included as part of this task-specific work plan in accordance with the Project Health and Safety Plan (WA, 1997e). Based upon review of the above text, the following radiological risks and controls must be considered for the tasks described in this document.

Table 3. Isotopes and Potential Hazards

Radioactive Isotopes Present	Radiation Emitted	Potential Hazards
Sr-90	Beta	Internal exposure, lenses of eyes, skin
Ra-226	Alpha, Beta, Gamma	Whole body exposure, internal exposure, lens of the eyes, and skin
H-3	Beta	Internal exposure, lenses of eyes, skin
Th-228	Alpha, Beta, Gamma	Whole body exposure, internal exposure, lens of the eyes, and skin
Th-232	Alpha, Beta, Gamma	Whole body exposure, internal exposure, lens of the eyes, and skin

Table 4 provides a summary of possible exposure pathways associated with radiological work and their corresponding methods of control.

Table 4. Exposure Pathways and Risk Reduction

Potential Pathway	Methods to Minimize Exposure
Inhalation	Engineering Controls (all dry media will be wetted prior to handling), proper PPE, administrative controls, trained workers, follow posted and verbal instructions, appropriate health physics coverage etc. Baseline air monitoring will be performed in advance to evaluate the need for respiratory protection. No eating, drinking or smoking in the CA.
Ingestion	Proper donning and doffing of PPE, administrative controls, trained workers, follow posted and verbal instructions, appropriate health physics coverage etc. No eating, drinking or smoking in the CA.
Absorption	Proper donning and doffing of PPE, administrative controls, trained workers, follow posted and verbal instructions, appropriate health physics coverage etc. No eating, drinking or smoking in the CA.
Injection	Safe work practices, housekeeping, proper PPE, trained workers, etc. No eating, drinking or smoking in the CA.
Whole body exposure to ionizing radiation	Time, distance, and shielding as appropriate, following standard ALARA concepts, trained workers, adequate health physics coverage. No eating, drinking or smoking in the CA.

Abbreviations:

ALARA As-Low-As-Reasonably-Achievable
CA Contamination Area
PPE personal protective equipment

Waste sample handling and packaging may present exposure to radioactive materials through the potential pathways listed above. Exposure rates and contamination levels will be monitored and controlled by the radiological control technician (RCT) in accordance with the *Radiological Protection Plan* (RPP) (WA, 1999) and the following procedures:

- SOP 24.1, Radiological Areas and Postings;
- SOP 25.1, Radiological Surveys and Instrumentation;
- SOP 32.1, Contamination Control;
- SOP 37.1, Tennelec Series 5 Low Background Counting System;
- SOP 37.2, Liquid Scintillation Counter;
- HSP 14.1, Airborne Radioactivity Monitoring;
- HSP 15.1, External Radiation Control; and,
- HSP 17.1, Hazardous Work Permits.

Personnel radiological exposure will be maintained ALARA by employing all appropriate engineering and administrative controls. Administrative controls consist of the HWP, personnel training and adherence to all site procedures and postings.

Personnel will wear Modified Level D PPE as defined in the PHSP and as specified on the HWP. The level of PPE will be modified and the HWP will be revised if radiological or chemical conditions exceed anticipated action levels stated in Section 6.4.2 of this work plan.

ALARA guidelines for this activity are the same as the *ALARA Guidelines for Removal Actions at the Ra/Sr Treatment System Area I,* which is included as Attachment 2 of this document.

6.4 Hazard Controls

The following control measures will be implemented during the execution of this work plan, and will supplement the PHSP.

6.4.1 Hazardous Work Permit

HWPs will be used to control work in the CA. The HWP will be issued in accordance with the procedures specified in the PHSP. All work is to be performed in accordance with this approved HWP which will at minimum describe or reference the following:

- Scope of work to be performed;
- Anticipated radiological, safety, and industrial hygiene conditions;
- PPE and respiratory protection requirements;
- Radiological and industrial hygiene monitoring requirements;
- Dosimetry requirements;
- Work plan and/or AHA;
- Period for which the HWP is valid; and,
- Additional requirements for entry.

6.4.2 Atmospheric Monitoring and Action Levels

Table 5 is a summary of possible contaminants, monitoring instrumentation, and action levels to be used during this task.

Table 5. Atmospheric Monitoring Guidelines

Instrument	Contaminant	Frequency/ Location	Action Level	Action
Photoionization Detector	Volatile organic vapors	Baseline, worker breathing zone when any tank access is opened	5 ppm	Upgrade to Level C with full-face respirators with organic vapor cartridges or stop work and allow area to ventilate Notify SHSO of concentrations
LEL/O_2	Explosive atmosphere (Methane)	Inside tank, prior to activity that could cause a spark	10 % LEL	Stop activities and allow area to ventilate
High-volume air pump with appropriate filter head	Radioactive airborne particulate	Baseline, Worker breathing zone when any tank access is opened	3E-11 µCi/ml	Institute engineering controls and consider using respiratory protection.

Abbreviations

LEL/O_2 Lower Explosive Limit/Oxygen
LEL Lower Explosive Limit
µCi/ml microCuries per milliliter
SHSO Site Health and Safety Officer
PPM parts per million

6.4.3 Boundaries

The work area will be enclosed by boundary ropes or tape supported with stanchions. The placement of the stanchions and boundaries will be planned by the Site Supervisor/Field Coordinator to facilitate access to the work area for equipment. The boundaries will be set up and signs will be posted in accordance with the PHSP and the RPP.

6.4.4 Personal Protective Equipment

Employees will wear modified Level D PPE in accordance with the PPE selection matrix in Section 9 of the PHSP. RCTs and the Site Health and Safety Officer (SHSO) will collect air-

monitoring data during conduct of the activity. The task-specific level of protection will be upgraded or downgraded based on the measurements of direct reading instruments compared to action levels in Section 7.2.10 of this plan, a change in site conditions or other findings. Changes in the level of protection require approval by the PHSM, or designee.

Modified Level D PPE will consist of the following when specified in the HWP:

- Steel-toed shoes;
- Chemical resistant outer and inner boot covers;
- Tyvek coveralls;
- Safety glasses with side shields;
- Chemical resistant inner and outer gloves; and
- Full tape of wrists, ankles and zipper.

6.4.5 Heat Stress

This activity is scheduled for the dry season and ambient temperature may become elevated. The Health and Safety Coordinator will monitor ambient temperatures and conduct heat stress monitoring as described in HSP 3.1, Working in Hot Environments.

6.4.6 Decontamination Procedures

Decontamination procedures will be conducted in accordance with Section 10 of the PHSP for personnel decontamination, equipment decontamination and PPE decontamination, and with HSP 18.1, Personal Contamination (Rev. 0, Update 1). When performing radiological work, workers will perform personal monitoring with the guidance of a RCT. All equipment/materials will be monitored and handled/packaged in accordance with the RPP and SOP 32.1, Contamination Control.

6.4.7 Training

Personnel performing activities associated with this activity will receive training covering this plan and with HSP 20.1, Worker Safety and Radiation Protection Training (Rev. 1). Minimum training requirements will be specified on the HWP. The SHSO and Radiological Safety Officer will ensure that all personnel are trained in accordance with the PHSP and RPP as appropriate. Only qualified personnel as determined by the PM and PHSM will be allowed to carry out tasks described herein. As specified in the PHSP, daily tailgate safety meetings will be conducted to supplement the LEHR training program.

6.4.8 Buddy System

The buddy system will be utilized to protect personnel in the work area. At least two people will be required to be in the work area when posted as a CA.

The buddy system is a method of organizing employees into work groups and is designed to provide those employees with assistance when needed. Each employee in a work group is designated to be observed by at least one other person. Assignment of designated partners should take place during the daily tailgate safety meeting.

The responsibility of the buddy is to:

- Provide assistance, if needed;
- Maintain line-of-sight contact or verbal contact with other workers in the CA;
- Observe for signs of chemical or physical trauma or heat stress such as:
  - Changes in complexion and skin discoloration;
  - Changes in coordination or demeanor;
  - Excessive saliva and pupillary response; or,
  - Changes in speech pattern;
- Periodically verify the integrity of all protective clothing; and,
- Notify the SHSO and Site Supervisor/Field Coordinator if emergency help is needed.

6.4.9 Safety Equipment

In addition to other equipment specified in this work plan, the following safety equipment will be staged at the boundary of the CA:

- First aid kit;
- Portable eyewash station and hand shower;
- Air horn;
- Portable radio for emergency communications;
- Fire extinguisher; and,
- Guardrail around hatch opening to prevent falls into tank.

6.4.10 Site Emergencies and Evacuation

All site workers shall be trained on the procedures outlined in the *Contingency Plan and General Emergency Response Procedures* (CPGERP) (WA, 1998) for responding to potential incidents. The SHSO will ensure that all appropriate emergency equipment is available and review evacuation procedures with workers. It is unlikely that a work incident would require evacuation of

the LEHR Site. The emergency discoverer will have sole responsibility for determining whether all or part of the facility needs to be evacuated. If evacuation is necessary, the following procedures will be followed:

- The emergency evacuation signal will be sounded. The signal is one long blast with a compressed air horn;
- All personnel will move to the gathering point at the northwest corner of the LEHR Site. If that location is unsuitable, the gathering point will be the Northeast corner gate between the Toxic Pollutant Health Research Laboratory and the Small Animal Housing Building;
- The Incident Commander will check the area to ensure that all personnel have left. Only authorized maintenance and public safety personnel will be allowed in the area;
- A head count will be taken at the gathering point. Each contractor/ subcontractor will be responsible for taking a head count of their personnel. The name(s), description(s) and last reported location of any missing personnel must then be given to the Incident Commander; and,
- No one may re-enter the evacuated area until authorized by the Incident Commander.

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TABLES

Table 1. Strontium Treatment System Tank A Sample Collection Matrix.

Sample ID	Matrix	Sample Type	Required Containers and Volumes	Sample Description
CWRSC084	Sludge	Composite	5 x 8-oz. glass jar	Five-point subsample composite, collected from varying depths
CWRSC085	Sludge	Composite	5 x 8-oz. glass jar	Field duplicate of CWRSC084
CWRSC086	Wood	Discrete	1 x 2-L poly-container	Collected from above the sludge
CWRSC087	Wood	Discrete	1 x 2-L poly-container	Collected from below (submerged and/or in contact with) the sludge

Abbreviations:
L liter
oz. ounce

Note:
Additional samples will be collected if other matrices/materials are present in the tank.

Table 2. Analytical Methods for Sludge and Wood Samples, LEHR Site, UC Davis, California

Parameter	Analytical Method	Detection Limits
SVOCs	EPA SW-846 Method 8270	2,600 µg/kg
STLC SVOCs	CCR Title 22 WET and SW-846 Method 8270	130 µg/L
TCLP SVOCs	EPA 1311 and SW-846 Method 8270	130 µg/L
Metals	EPA SW-846 Method 6010 and 7471	2.0 mg/kg
STLC Metals	CCR Title 22 WET and SW-846 Method 6010 and 7471	0.2 mg/L
TCLP Metals	EPA 1311 and SW-846 Method 6010 and 7471	0.2 mg/L
Pesticides/PCBs	EPA SW-846 Method 8081	200 µg/kg
Herbicides	EPA 8151	1.0 mg/kg
Reactive Cyanide	EPA 7.3.3.2	1 mg/kg
Reactive Sulfide	EPA 7.3.4.2	1 mg/kg
Paint Filter Test	EPA 9095	N/A
pH	EPA 9045	N/A
Formaldehyde	Modified NIOSH 3500/AOAC 20.062	0.5 mg/kg
Ignitability	EPA 1020A or 1010	N/A
Total Plate Count	S.M. 17th Ed. 9215	N/A

Abbreviations and Acronyms:

CCR Title 22 WET	California Code of Regulations Title 22 Waste Extraction Test
EPA	United States Environmental Protection Agency
NIOSH	National Institute of Occupational Safety and Health
S.M.	Standard Method
STLC	Soluble Threshold Limit Concentration
SVOCs	Semi-Volatile Organic Compounds
TCLP	Toxicity Characteristics Leaching Procedure
WET	Waste Extraction Test
µg/kg	micrograms per kilogram
µg/L	micrograms per Liter
mg/L	milligrams per Liter
mg/kg	milligrams per kilogram

FIGURES

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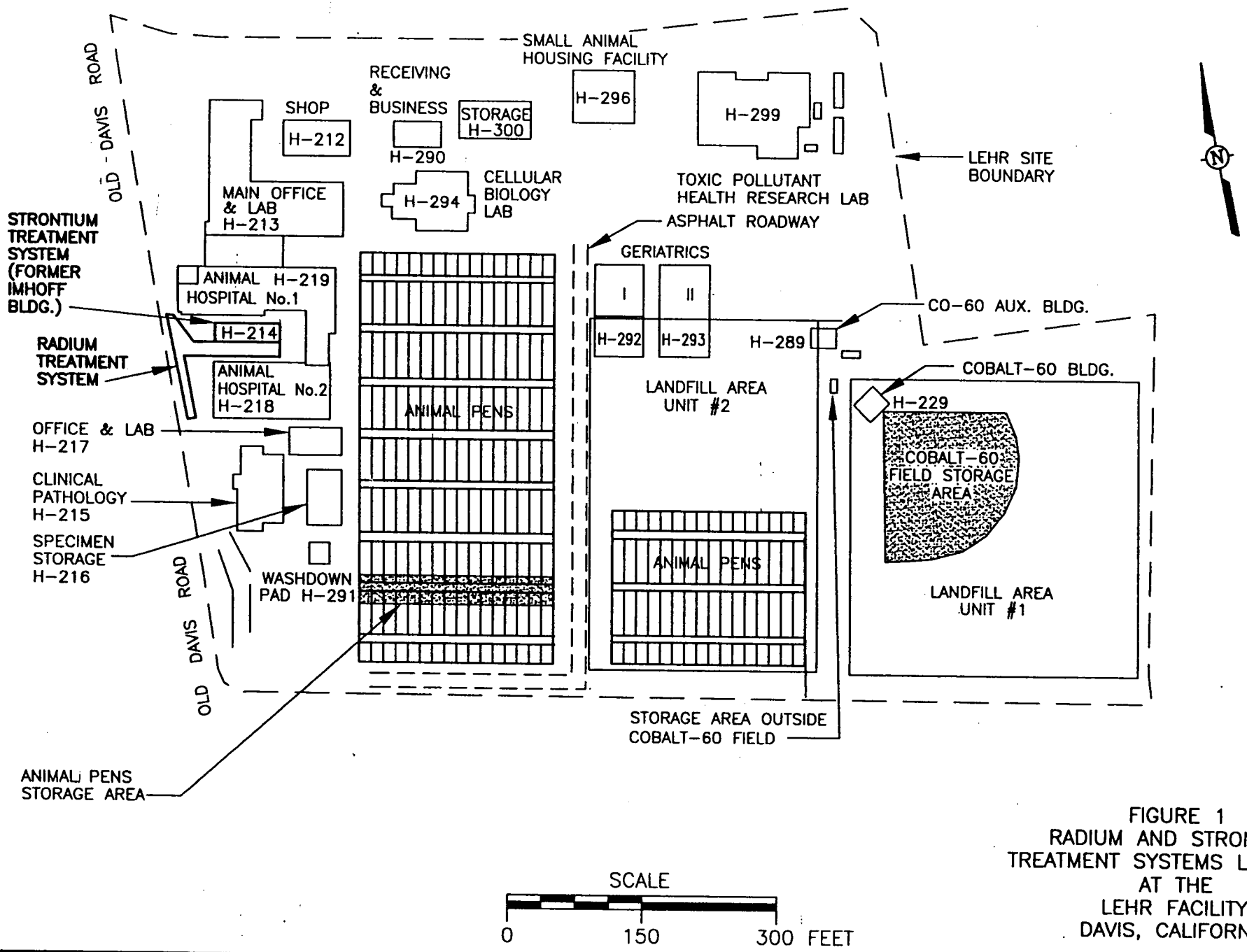
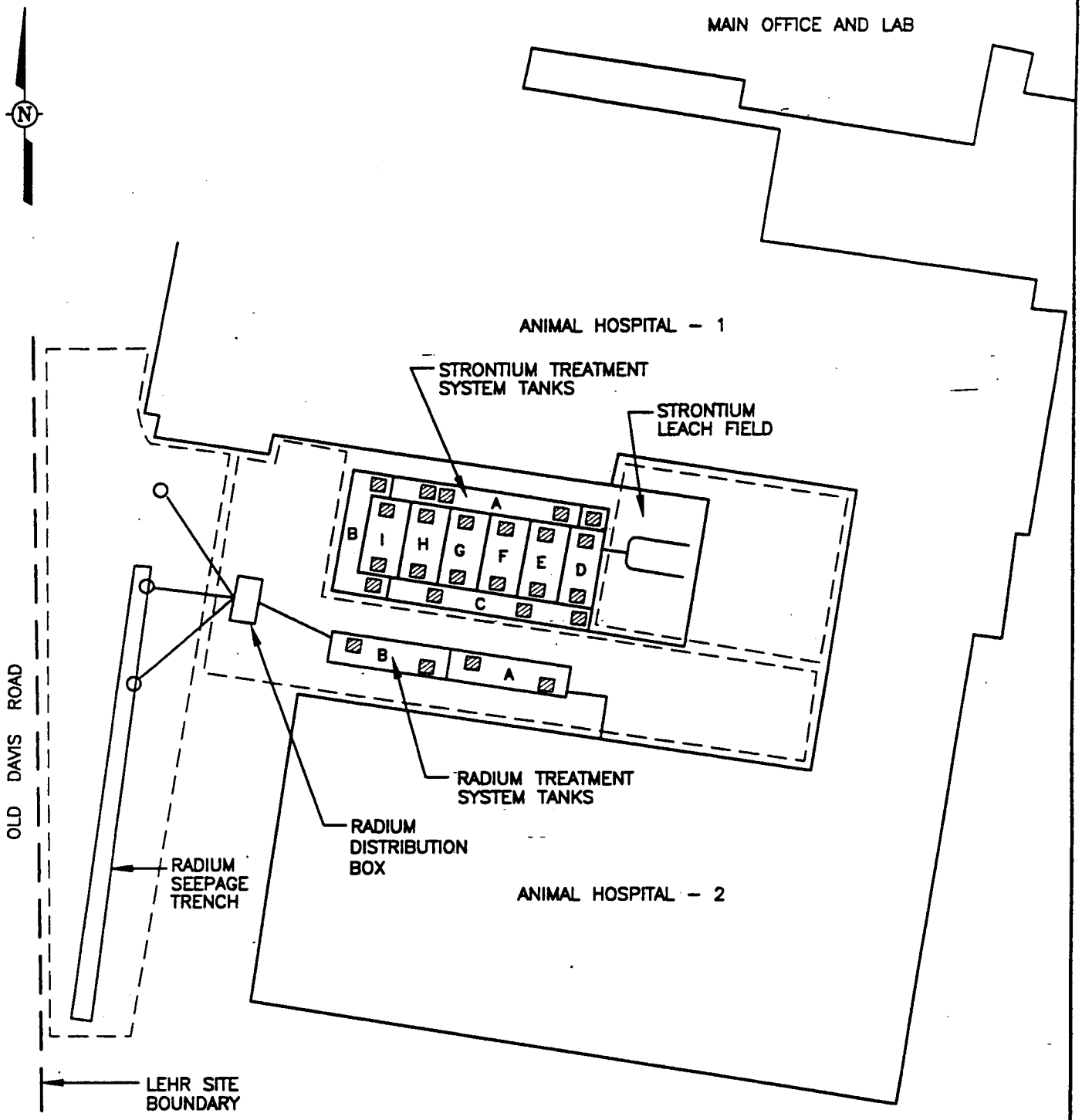


FIGURE 1
RADIUM AND STRONTIUM TREATMENT SYSTEMS LOCATIONS AT THE LEHR FACILITY DAVIS, CALIFORNIA

LE-RSTSL(LE4)



LEGEND

- HATCHWAY
- EXSITING RADIUM TREATMENT SYSTEM DRY WELL
- DISTRIBUTION LINE

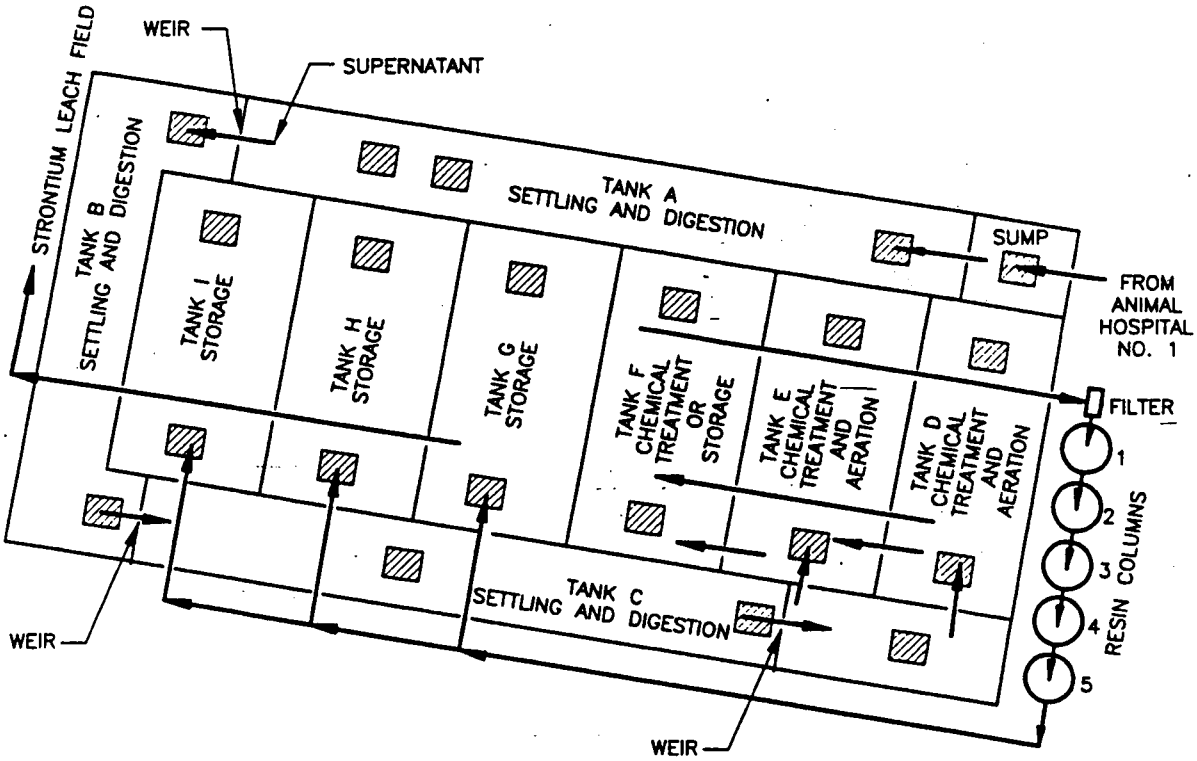
SCALE

0 30 FEET

FIGURE 2

RADIUM AND STRONTIUM TREATMENT SYSTEMS AT THE LEHR FACILITY DAVIS, CALIFORNIA

LE–RADST(LE4)



LEGEND

HATCHWAY

SUPERNATANT FLOW

SCALE

0 10 FEET

FIGURE 3

STRONTIUM TREATMENT SYSTEM AT THE LEHR FACILITY DAVIS, CALIFORNIA

LE-STTS(LE4)

ATTACHMENT 1

ACTIVITY HAZARD ANALYSIS

Work Activity	Procedure Steps	Associated Hazard	Hazard Control Method
Initial/baseline surveys	1. Perform surveys in Imhoff tank area using radiological monitoring instrumentation.	1. Radiological exposure and contamination concerns. 2. Heat stress hazard from working outdoors in PPE. 3. Slips, trips, and falls.	1. Wear PPE in accordance with the HWP. Adhere to ALARA principles. 2. Follow standard heat stress monitoring protocol and appropriate work/rest cycles. 3. Maintain employee awareness and good housekeeping.
Setup of work area/ equipment and materials.	1. Stage of equipment and supplies.	1. Heat stress 2. Slips, trips, and falls. 3. Material handling.	1. Follow standard heat stress monitoring protocol and appropriate work/rest cycles. 2. Maintain employee awareness and good housekeeping practices. 3. Use only qualified operators and use proper equipment.

Work Activity	Procedure Steps	Associated Hazard	Hazard Control Method
Visual inspection of tank interiors	1. Open tank hatches, perform visual inspection, and conduct physical probing.	1. Exposure to chemical hazards. 2. Spread of radiological contamination. 3. Radiation exposure. 4. Tank openings 5. Heat stress 6. Slips, trips, and falls.	1. Perform appropriate IH monitoring and use PPE as prescribed in HWP. 2,3. a. Provide continuous job coverage by a qualified RCT. b. Apply standard ALARA and Health physics practices. c. Ensure workers are RW II certified. 4. Equip openings with a standard railing and use of the RCT as a "spotter". 5. Use standard heat stress monitoring practices and appropriate work/ rest cycles. 6. Maintain employee awareness and good housekeeping practices. Use the technician as a "spotter".
Sampling activities	1. Open tank hatches, perform visual inspection and collect samples. 2. Remove contaminated sludge/wood/liquid from Tank A. 3. Size wood for samples. 4. Containerize samples.	1. Exposure to chemical hazards. 2. Spread of radioactive contamination. 3. Airborne radioactivity. 4. Heat Stress. 5. Tank openings. 6. Slips, trips, falls.	1. Perform appropriate IH monitoring and use of PPE as prescribed in HWP. 2,3. a. Provide continuous job coverage by a qualified RCT. b. Apply standard ALARA and Health physics practices. c. Ensure workers are RW II certified. d. If needed, use appropriate dust controls to limit airborne dust hazards. 4. Conduct standard heat stress

Work Activity	Procedure Steps	Associated Hazard	Hazard Control Method
			monitoring and enforce work/rest cycles. 5. Equip openings to be equipped with a standard railing. Use the technician as a "spotter". 6. Maintain employee awareness and good housekeeping practices.
Manual decontamination of tools, sample containers, etc.	1. Use of dry decontamination techniques, (damp towels, etc.)	1. Over exertion of extremities. 2. Heat stress. 3. Airborne radioactivity. 4. Spread of radioactive contamination	1. Use work gloves and take breaks when needed in order to avoid fatigue. 2. Conduct standard heat stress monitoring and ensure appropriate work/rest cycles are adhered to. 3,4. a. Provide continuous job coverage by a qualified RCT, b. Apply standard ALARA and Health physics practices, c. Ensure workers are RW II qualified. d. If needed, use appropriate dust controls to limit airborne dust hazards.

Work Activity	Procedure Steps	Associated Hazard	Hazard Control Method
Packaging of waste	1. Segregate clean materials from contaminated items. 2. Place wastes into appropriate packages according to radiological/ hazardous status. 3. Mark/label waste packages. 4. Place waste packages into appropriate storage areas.	1. Exposure to chemical hazards. 2. Spread of radiological contamination. 3. Radiation exposure. 4. Material handling 5. Heat stress 6. Slips, trips, and falls.	1. Perform appropriate IH monitoring and use of PPE as prescribed in HWP. 2,3. a. Provide continuous job coverage by a qualified RCT, b. Apply standard ALARA and health physics practices, c. Ensure workers are RW II qualified. 4. Use proper lifting techniques, proper equipment for each task, and qualified equipment operators. 5. Use standard heat stress monitoring practices and appropriate work/ rest cycles. 6. Maintain employee awareness and good housekeeping practices.

Abbreviations:

ALARA As-Low-As-Reasonably-Achievable
HWP Hazardous Work Permit
IH
PPE personal protective equipment
RCT radiological control Technician
RW II

ATTACHMENT 2

AS-LOW-AS-REASONABLY-ACHIEVABLE GUIDELINES

U.S. Department of Energy

Oakland Operations Office, Oakland, California

ALARA GUIDELINES FOR REMOVAL ACTIONS AT THE RA/SR TREATMENT SYSTEM AREA I

For the:

LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH (LEHR)
UNIVERSITY OF CALIFORNIA AT DAVIS, CALIFORNIA

Prepared for:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 95612-5208

Prepared by:

Weiss Associates
5500 Shellmound Street
Emeryville, CA 94608-2411

May 6, 1999

Rev. 0

DOE Oakland Operations Contract DE-AC03-96SF20686

Weiss Associates
Environmental Science, Engineering and Management

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Approvals Page

ALARA GUIDELINES FOR REMOVAL ACTIONS AT THE RA/SR TREATMENT SYSTEM AREA I

For the:

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May 6, 1999

Rev. 0

Approved by: Mary Stallard Date: 5/6/99
Mary Stallard, C.E.G.
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Approved by: JMcHugh Date: 5/6/99
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1. INTRODUCTION

As-Low-As-Reasonably-Achievable (ALARA) consideration is required for work involving removal actions at the Laboratory for Energy-Related Health Research (LEHR) in accordance with 10CFR835 and the LEHR ALARA Program. Specifically, these ALARA procedures pertain to removal actions scoped as: Soil/Concrete Removal; Soil/Concrete Segregation; Piping Removal and Segregation, Waste Characterization; Soil Loading into Boxes; Packaging; Box Storage; and, Excavation Sampling. The removal actions are detailed in the Draft Removal Action Work Plan for the Southwest Trenches, Ra/Sr Treatment Systems, and Domestic Septic System Area, Rev. E. (the Work Plan). These ALARA procedures may benefit by change (addition, deletion, or revision) as the project removal actions progress. Change should be approved by the Radiological Safety Officer (RSO) or Radiological Control Manager (RCM) and appropriately documented. These procedures may apply to other tasks upon written direction of the RSO or RCM. These ALARA procedures are not necessarily inclusive of all procedures required for either worker protection or preservation of the environment.

2. ALARA PROCEDURES

There is no anticipated significant known measurable dose (either external or internal) associated with the tasks required by this Work Plan. Therefore, a graded approach was made to evaluate and implement ALARA procedures. In accordance with the LEHR ALARA Program, every effort should be made to maintain doses to ALARA levels. Therefore, the following precautionary procedures should be implemented:

ADMINISTRATIVE CONTROLS

Training:

1. Each worker entering the exclusion zone should be instructed on these ALARA provisions (either as on the job training or at a tailgate safety meeting).

2. Reinforcement of Rad Worker II training should be periodically conducted during tailgate safety meetings and on the job instruction to demonstrate how ALARA can be achieved by use of appropriate work procedures and practices.

3. Workers should be instructed in the proper use of tools and methods that result in the generation of as little dust as possible (rather than tools that generate a lot of dust), when practical.

4. Workers should be instructed in methods of maintaining PPE intact to reduce personal contamination, including methods to reduce likelihood of cuts (creating potential for contamination) from waste (sharps) and equipment.

5. Personnel should be instructed on the proper means of egress from contaminated areas to reduce exposure and possibility of spreading contamination.

6. Workers should be advised of areas or surfaces that are known to contain appreciable levels of removable surface contamination above background.

7. New or revised ALARA procedures should be added to this list as identified throughout the task with these changes discussed during tailgate safety meetings with site workers.

All Personnel:

8. Workers should follow all applicable project procedures, practices, and work plan instructions as advised by Radiological Control Technician (RCT), Radiological Safety Officer (RSO), Site Health and Safety Officer (SHSO), and Supervisory personnel.

9. Workers should not follow procedures that are deemed as non-ALARA by RCT, RSO, SHSO, or Supervisory personnel.

10. Workers should optimize all work and operations to maintain dose at ALARA, when and where practical.

11. Workers should not bring construction materials, tools, and equipment not required for work in the CA into the CA, where practical.

12. Workers or supervisors should ensure equipment is operational and functional prior to bringing it in to dose exposures in the contamination area.

13. Workers should stand upwind of any dust generating activities, when practical.

14. Workers should maintain a distance between themselves and the work task if their duties do not require their immediate presence at the task site.

15. Workers should keep the elevation of their head above (not below) that elevation where a dust generating activity may be ongoing, when practical.

16. Workers should follow protocols for personal decontamination, personal hygiene, and work zone controls to minimize exposures.

17. All waste handling should be done in a safe, expedient and planned manner.

Supervisors/Managers:

18. Supervisory personnel should optimize all work and operations to maintain dose at ALARA, when and where practical.

19. Only workers that have a need to be within the contamination area (exclusion zone) should be permitted to enter the contamination area (exclusion zone).

20. Supervisors should attempt to eliminate any unnecessary work.

21. Supervisors should ensure use of a trained work force, sequence tasks to reduce exposure, schedule work in an efficient manner, and identify/coordinate necessary resource requirements.

22. Any construction materials, tools, or equipment required for work in the Contamination Area (CA) should be evaluated by a RCT for ease of decontamination prior to bringing this equipment into the CA.

23. Equipment should not be knowingly exposed to contamination that knowingly can not be decontaminated without major personnel exposures.

24. When practical, extension tools should be used to eliminate or minimize personnel entry into the CA.

25. Supervisors should ensure equipment is operational and functional prior to bringing it in to dose exposures in the contamination area.

26. Workers should be supervised and monitored to minimize exposure to airborne contamination.

27. Mock up should be staged for difficult or complicated work to reduce time spent exposed to known sources of ionizing radiation.

28. Work should begin with the least contaminated area and finish with the most contaminated area when practical.

ENGINEERING CONTROLS

29. Use of wet suppression as an engineering control should be used when practical unless this is counter to environmental considerations. A water source should be identified and utilized to aid in wetting the soil, when practical. Water should not be used concurrent with the application of lime based products or in indoor environments without revision of this ALARA procedures list.

30. Use of portable air conditioning units and/or fans should be considered for worker cooling where practical.

31. All work areas, including lay down and waste storage areas, should be chosen with ALARA considerations in mind.

32. Traffic patterns and pathways should be chosen to minimize the potential spread of contamination and cross contamination.

33. Precautions should be taken to prevent and to mitigate any waste spills, especially to drainage pathways, and to prevent the off site release of airborne contaminants.

34. Air intakes should be re-routed to minimize exposure to adjoining structures and personnel when practicable.

35. Direct contact with objects containing known and measurable radiological contamination should be avoided by placement of barriers, such as plastic, between the workers and these objects when practical.

36. Precautionary ALARA measures should be implemented during disconnection and subsequent handling of pipes and structures.

MONITORING

37. Every effort should be made to keep all doses ALARA and less than 100 mrem Committed Effective Dose Equivalent (CEDE).

38. Monitoring should be conducted and consideration of measured levels should be utilized in ALARA procedures review and revision.

39. RCTs should incorporate radiological hold points into monitoring and evaluation.

40. Waste containers should be swipe sampled and analyzed, when directed by the RSO, prior to CA removal or excessive handling.

41. Unknown waste materials should not initially be approached by other than an RCT.

ATTACHMENT 3

TANK A CONTENT PHOTOGRAPHS

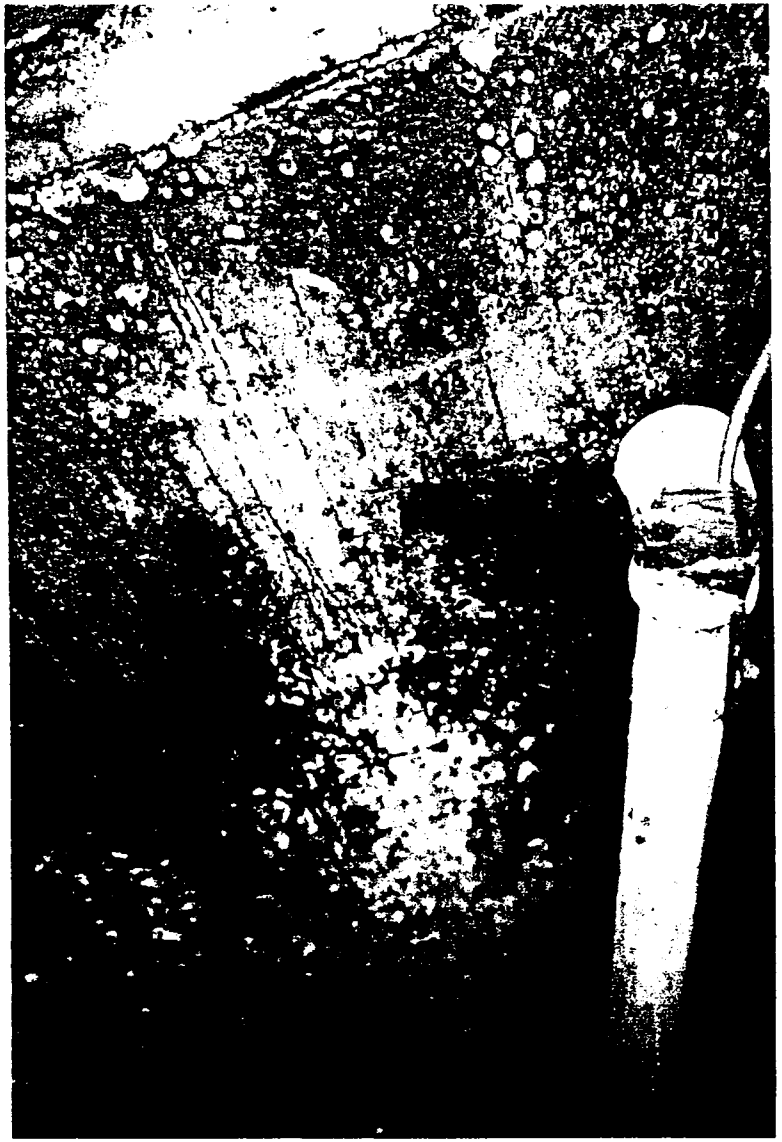
LEHR Project No. 770529
September/October 1997
Radium tank ☐ Strontium tank ☒

Tank (A) B C D E F G H I Sump
View is North South (East) West
wall ☒ floor ☒ ceiling ☒

LEHR Project No. 770529
September/October 1997
Radium tank ☐ Strontium tank ☒

Tank (A) B C D E F G H I Sump
View is North South East (West)
wall ☒ floor ☒ ceiling ☐

Notes:



LEHR Project No. 770529
September/October 1997
Radium tank ☐ Strontium tank ☒

Tank A B C D E F G H I Sump
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wall ☒ floor ☒ ceiling ☐

Notes:

LEHR Project No. 770529
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Notes:

ATTACHMENT 4

EXAMPLE CHAIN-OF-CUSTODY

Weiss Associates
Environmental Science and Engineering Services
5500 Shellmound Street, Emeryville, CA 94608
Phone: 510-450-6000 Fax: 510-547-5043

LEHR Chain-of-Custody Record

Control Number: LEHR-RS-WC-____

Project Name LEHR/RS/Waste Characterization

Project Number 128-4006-410

Sampled by _____

Send Results To: Santiago Lee

Email: data@weiss.com

Fax: (510) 547-5043

Sampler's Signature: _____

Lab Name: GEL/EPI

Lab Address: 2040 Savage Road
Charleston, SC 29407

Lab Login: _____

	Sample					Analysis Requested																				Additional Comments
						SW-846					Radionuclides									Other						
Sample ID	Date	Time	Matrix (1) / Container (2)	Number of Containers	Preservative Y/N (type)	Semivolatiles (8270)	TCLP & STLC SVOCs	Pesticides/PCBs (8080)	Metals (6010&7471)	TCLP & STLC Metals										Chromium (VI) (7196)	Nitrate (300.0)	Herbicides (8151)	Other Analyses			Turnaround Time: **2-Week Rush**
CWRSC084			Sludge / G		N	X	X	X	X	X												X	X			Composite A-E.
CWRSC085			Sludge / G		N	X	X	X	X	X												X	X			Composite A-E.
CWRSC086			Wood / P		N	X	X	X	X	X												X	X			
CWRSC087			Wood / P		N	X	X	X	X	X												X	X			
			/																							
			/																							
			/																							
			/																							
			/																							
			/																							

Signature	Company	Date	Time
Relinquished by:			
Received by:			
Relinquished by:			
Received by:			
Relinquished by:			
Received by:			

(1) Matrix: S - Soil, W - Water, O - Other (describe)

(2) Other Analyses:

1. Reactive Cyanide by 7.3.3.2
2. Reactive Sulfide by 7.3.4.2
3. Paint Filter by 9095
4. Formaldehyde by AOAC
5. pH by 9045
6. Ignitability (210°C)
7. Total Plate Count by S.M. 17th Ed. 9215