ENVIRONMENTAL MONITORING AND SURVEILLANCE PLAN
FOR THE LABORATORY FOR ENERGY-RELATED HEALTH
RESEARCH ENVIRONMENTAL RESTORATION PROJECT

September 1992

U.S. Department of Energy
San Francisco Field Office
Office of Environmental Restoration and Waste Management

Prepared by

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Control Copy # 13

APPROVAL PAGE

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10/21/92

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**ENVIRONMENTAL MONITORING PLAN
FOR THE
LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH
ENVIRONMENTAL RESTORATION PROJECT**

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ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing of Materials
DOE	U.S. Department of Energy
DOE-SF	U.S. Department of Energy, San Francisco Field Office
D&D	Decontamination and decommissioning
EH&S	Environmental Health and Safety
EML	DOE's Environmental Measurement Laboratory
EMO	Battelle's Environmental Management Operations
ER	Environmental restoration
EPA	U.S. Environmental Protection Agency
HEPA	High Efficiency Particulate Air
LEHR	Laboratory for Energy-Related Health Research
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NWS	National Weather Service
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act as amended by the Solid Waste Disposal Act
TPHRL	Toxic Pollutant Health Research Laboratory
UCD	University of California at Davis
WEQAP	Work Element Quality Assurance Plan

PREFACE

This Environmental Monitoring Plan has been developed for the U.S. Department of Energy, San Francisco Field Office for the Laboratory for Energy-Related Health Research Environmental Restoration Project. This plan is based upon many design criteria, including regulatory requirements, potential for release, exposure pathways, and U.S. Department of Energy directives. The Environmental Monitoring Plan is dynamic, thus this plan describes the Environmental Monitoring Program as it currently exists with planned modifications for fiscal year 1993.

Environmental Characterization

The multi-phased comprehensive characterization of radiological and chemical contamination at the Laboratory for Energy-Related Health Research site is currently in progress. This plan reflects the current knowledge of the contamination on the Laboratory for Energy-Related Health Research site from completed characterization activities. This plan will be revised as necessary based upon the results of characterization data.

Environmental Restoration

The methods to be used to decontaminate buildings and other structures on-site and remediate environmental contamination have not yet been fully determined. This plan reflects the current planning for the decontamination and decommissioning and environmental restoration of the Laboratory for Energy-Related Health Research site. This plan will be amended prior to commencing any new project task that could adversely effect the human environment.

EXECUTIVE SUMMARY

This Environmental Monitoring and Surveillance Plan was prepared in response to the requirements in DOE Order 5400.1, "General Environmental Protection Requirements," Chapter IV, "Environmental Monitoring Requirements." DOE Order 5400.1 requires that a plan for environmental monitoring be developed for the Laboratory for Energy-Related Health Research.

Environmental monitoring of the Laboratory for Energy-Related Health Research is performed by the University of California at Davis under contract with Environmental Management Operations. Environmental Management Operations is under contract with the U.S. Department of Energy, San Francisco Field Office to manage the environmental restoration of the facility.

This plan identifies the scope of the fiscal year 1993 environmental monitoring and surveillance program with respect to the rationale and design criteria dictated by DOE Order 5400.1. The extent and frequency of sampling, procedures for laboratory analysis, quality assurance requirements, program implementation procedures, and guidelines for the preparation and distribution of reports are outlined in this plan. The Environmental Monitoring and Surveillance Program for the Laboratory for Energy-Related Health Research site is dynamic and will change as needed to respond to modification of clean-up operations and to modifications of regulatory guidance and requirements. These changes will be reflected by amendments and updates to this plan.

Currently, there are no buildings that have effluent monitoring dictated by their current use and regulatory requirements. The current environmental surveillance program will be expanded to provide comprehensive monitoring of potential pathways of environmental exposure from residual low-level radioactive and hazardous contaminants present on the site.

Written procedures are in place for most of the environmental sampling. Laboratory analysis of samples follow the U.S. Environmental Protection Agency standard methods, when such methods are available. Reports are prepared and distributed as required by regulatory agencies.

1.0 INTRODUCTION

1.1 INTRODUCTION

The Laboratory for Energy-Related Health Research (LEHR) is a government-owned facility located on land leased from the Regents of the University of California at Davis (UCD). Battelle's Environmental Management Operations (EMO) has been contracted by the U.S. Department of Energy, San Francisco Field Office (DOE-SF) to manage the environmental restoration (ER) of the LEHR site. DOE-sponsored research at the LEHR site was concluded in 1989. Several areas of low-level radiological and chemical contamination exist on the LEHR site from previous DOE and UCD operations and the site is undergoing environmental restoration. Environment, safety, and health support at the site, including environmental monitoring and surveillance, is provided by UCD under contract with EMO.

Department of Energy Order 5400.1 (DOE 1990a) requires the development and implementation of a facility-specific environmental monitoring plan. This plan is designed to evaluate control technologies in use and to assess any impact of releases from operations. An effective environmental monitoring plan and subsequent environmental monitoring program will minimize the risk to the public and the environment by ensuring compliance with applicable federal, state, and local regulations, and by using accepted techniques and methods to assess public doses from contaminants released from DOE operations.

Environmental monitoring is composed of two principle activities: effluent monitoring and environmental surveillance. Effluent monitoring involves the collection and analyses of liquid and gaseous effluent samples in order to characterize and quantify contaminants released to the environment. Data are used to assess the exposure of and risk to the public and to demonstrate compliance with applicable regulations. Environmental surveillance involves the collection and analysis of air, waster, soil, terrestrial foodstuffs, biota, and other media from on or near DOE sites and the measurement of external radiation. Data are used to assess potential exposure to the public, evaluate impacts on the environment, and demonstrate compliance with applicable regulations.

This document, the Environmental Monitoring and Surveillance Plan, describes the Environmental Monitoring Program for the LEHR ER Project. This Plan is intended to be a dynamic document in that it will be periodically revised in response to changing activities at the LEHR site and changing regulatory requirements and standards. This Plan is required to comply with the EMO Quality Assurance (QA) Plan and the UCD LEHR ER Work Element Quality Assurance Plan (WEQAP).

Besides establishing a written plan for monitoring activities, this Plan also documents changes to the program and serves as a blueprint for subsequent improvements and changes to the program. Due to increasing regulatory emphasis on nonradioactive pollutants, more efforts are dedicated to these potential contaminants (Gray 1990). With regard to nonradiological pollutants, DOE requires its contractors to comply with U.S. Environmental Protection Agency (EPA) regulations unless specifically authorized by EPA.

Environmental monitoring for the LEHR ER Project is managed and performed by the UCD and other EMO contractors for EMO. The mission of the environmental monitoring program is to develop and operate a program for sampling and analyzing air, water, soil, flora, and fauna from the environs of the LEHR site for radioactive and nonradioactive pollutants. The UCD, Office of Environmental Health and Safety (EH&S) conducts programs for measuring and documenting environmental releases and is responsible for evaluating environmental data to find the effects of DOE operations at LEHR on the off- and on-site environment. These programs support environmental compliance requirements, including the DOE requirement to produce and publish an annual Environmental Monitoring Report.

The program described in this plan has evolved from general sampling for radiation surveillance, as historically contained in Chapter III of DOE Order 5484.1 (DOE 1990b). With the implementation of the Resource Conservation and Recovery Act of 1980 (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1985, a variety of hazardous constituents has been added to the list of analytes. More recently, the DOE Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE 1991) has influenced the structure and conduct of the LEHR ER Project environmental monitoring program.

The following sections of this document describe the Environmental Monitoring Program. Section 2 describes the facilities at LEHR and the effluent treatment systems, discharges to the environment and effluent monitoring for these facilities. It includes discussion of sampling systems, locations, frequencies and analysis. Section 3 describes environmental surveillance including the media sampled, locations and frequency of sampling, sample analysis, data reporting and analysis. Section 4 describes the meteorological data

support provided by off-site meteorological monitoring systems. Section 5 discusses quality assurance of the various aspects the environmental monitoring program including considerations in the field and in the laboratory. Section 6 discusses laboratory procedures for various kinds of analyses. Included in this section are discussions of sample holding times and sample custody control. Section 7 describes the data bases, data tracking, data validation and dose calculations. Section 8 describes the process for records maintenance and disposal and lists the reports that are required by various regulations and DOE Orders. Section 9 briefly discusses staffing level, staff training and analytical support services, monitoring equipment and facilities requirements. Section 10 discusses the coordination of monitoring and characterization activities with the UCD and State of California. Appendix A will contain interim amendments to the Environmental Monitoring Plan. These amendments are used to define additions and changes to the environmental monitoring program for LEHR ER activities that are currently not sufficiently well defined to be included in this plan.

1.2 FACILITY AND AREA DESCRIPTION

The LEHR facility is located approximately 1.5 miles south of the main UCD campus and the town of Davis on County Road 79 (Old Davis Road) in Solano County, California (See Figure 1.1) in a rural-type setting.

The site is located on approximately 15 acres which consist of several one- and two-story laboratory, office, and animal-handling facilities. Of the 15 acres, approximately 40 percent is paved with asphalt or concrete, or covered by structures. Approximately 30 percent of the site is unpaved and kept reasonably free of vegetation. The dog pen areas occupy approximately 20 percent of the LEHR facility and approximately 5 percent is heavily vegetated with large deep rooted vegetation (Dames & Moore 1992). Based on habitat present at LEHR, the site is potentially host to a variety of animals including many species of birds, mammals, several of which are burrowing species, and reptiles including snakes.

The major buildings and structures located on the LEHR site are listed in Table 1.1 and shown in Figure 1.2.

The land is owned by the Regents of the University of California and leased to DOE. All structures at LEHR are owned by DOE. Also located at the LEHR facility are two inactive landfills: the Old UCD Landfill, closed in 1966, and a campus and DOE low-level radioactive waste disposal site, closed in 1974. A third inactive landfill unit is located approximately 600 feet east of LEHR below the area currently occupied by the UCD Raptor Center.

The site is bounded to the north and east by UCD research facilities. The southern border of the LEHR facility is the northern levee of the South Fork of Putah Creek. Private land is adjacent to and surrounds UCD property on all sides. Most of the private land is used for agricultural purposes.

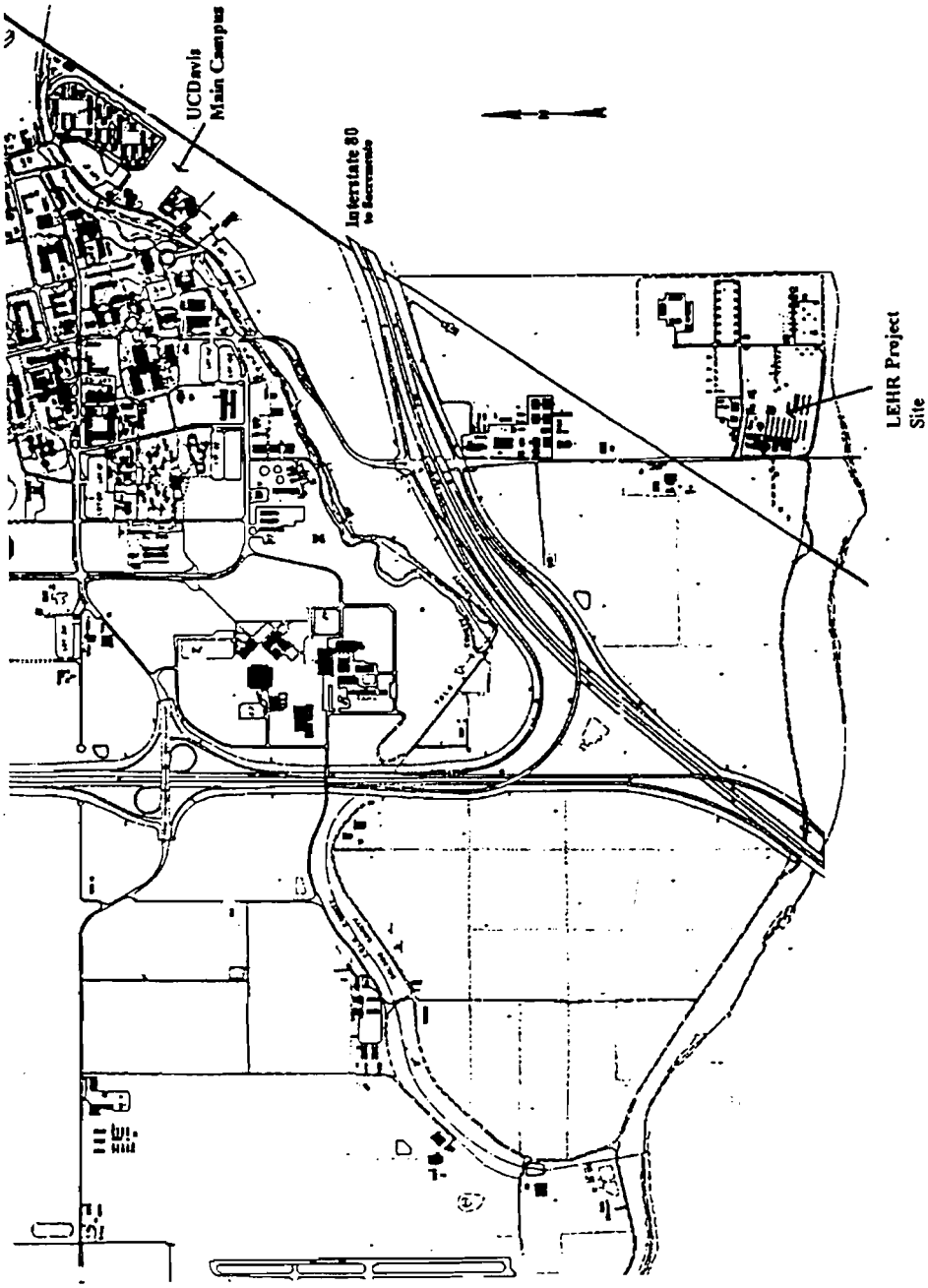

Figure
1.1
LOCATION
OF LEHR
SITE

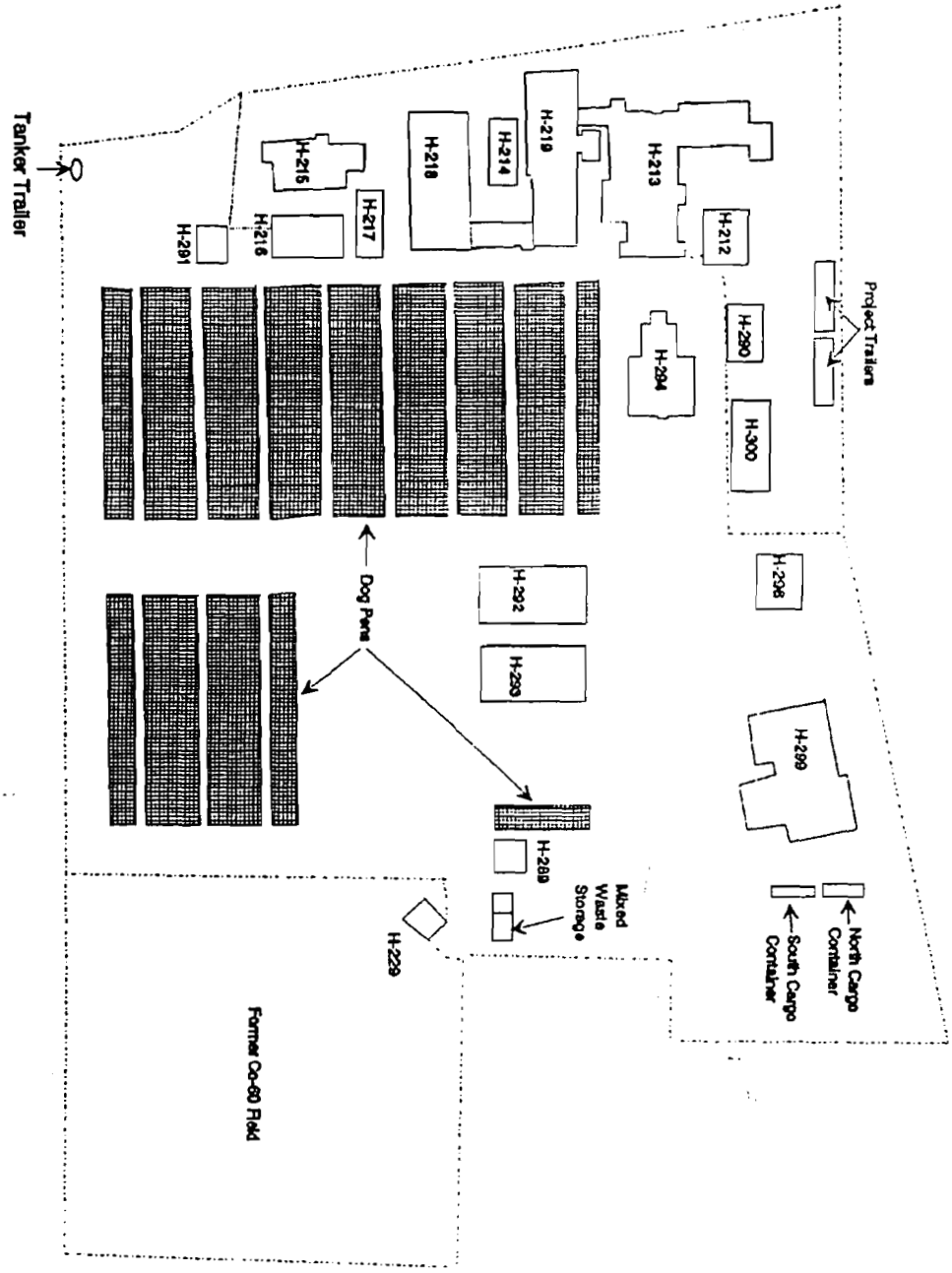

Figure 1.2
PLOT OF LEHR SITE

Table 1.1. Major Structures on the LEHR Site

Building Number	Name
H-212	Maintenance Shop
H-213	Main Office and Laboratory
H-219	Animal Hospital 1
H-218	Animal Hospital 2
H-214	Imhoff
H-217	Pathology Laboratory
H-215	Clinical Medicine
H-216	Specimen Storage and Feed Mix
H-229	Cobalt-60 Building
H-289	Cobalt-60 Auxiliary Building
H-290	Receiving and Business
H-291	Washdown Pad
H-292	Geriatrics 1 (Radioactive Waste Storage Facility)
H-293	Geriatrics 2
H-294	Cellular Biology Lab
H-296	Small Animal Quarters
H-299	Toxic Pollutant Health Research Laboratory
H-300	Storage

1.2.1 History of Operations

UCD has conducted radiological studies on laboratory animals for DOE (and its predecessors) at LEHR since the early 1960s. Full-scale experimental use of radioactive materials, including strontium-90 and radium-226, began at LEHR in 1960. Portions of the LEHR facility site had previously been used as the UCD campus landfill. The landfill consisted of two separate disposal units. Disposal in the oldest unit (Inactive Disposal Unit No. 1) began in the 1940s and ceased in the late 1950s to early 1960s. The area is now covered by the Cobalt-60 field at the LEHR facility. The next oldest disposal area (Inactive Disposal Unit No. 2) received wastes from 1956 to 1967. This disposal area is partially covered with the eastern most of two sets of dog pens used for animal research at the LEHR facility. A third landfill disposal unit located approximately 600 feet east of LEHR (Inactive Disposal Unit No. 3), was used from 1963 to 1967. The combined total acreage for the three disposal areas is estimated at approximately six acres (Dames & Moore 1992).

In the early 1970s, an outdoor Cobalt-60 Field was constructed at the LEHR facility to study the effects of low-level chronic exposure. The study was terminated in 1988; however, the radioactive source remains in place. In 1975, a program in basic aerosol science was initiated at the LEHR facility to link the evaluation of airborne materials and the laboratory study of these materials using cellular and animal models. The DOE reported that research activities in this program focused on the potential health effects of release to the atmosphere of combustion products from fossil fuel power plants with emphasis on coal flyash.

In 1983, construction of the Toxic Pollutant Health Research Laboratory (TPHRL) was completed at LEHR. This facility was designed for the study of highly toxic and carcinogenic agents including both radioactive and chemical materials. Research at the TPHRL included studies of the behavior of plutonium-241 and americium-241 in beagles and monkeys; radioactive and toxic gas-particle mechanistic aerosol studies; monodisperse aerosol inhalation deposition; intratracheal applications of carcinogen-coated particles; and an organic vapor uptake using beagles.

1.2.2 Nearby Wells and Drinking Water Sources

Many domestic and supply wells are located near the LEHR facility. Thirty-four groundwater wells are located within approximately one mile of the LEHR facility. Although the purpose of some of these wells is not documented, some are used for irrigation and some for domestic purposes (Dames & Moore 1992).

Pumping rates for groundwater wells are variable, and depends on several factors such as:

- purpose (municipal, domestic, irrigation, industrial, etc.)
- individual and local domestic needs

- industry type and size
- time of year and crop requirements
- well construction
- pump size and efficiency.

Drinking water is being provided to the LEHR site and surrounding university areas from uncontaminated sources pending the completion of environmental characterization activities.

1.2.3 Potential Environmental Impacts

During the 30-year operation of the LEHR facility, a variety of wastes were generated and disposed of on-site. These wastes included radioactive, biological, chemical, municipal, and laboratory debris. Detailed descriptions of known waste-generating and disposal processes are described in the DOE, Environmental Survey Preliminary Report, dated March 1988.

1.2.3.1 Radiological Waste Treatment Systems

Radiological wastes generated from animal experiments were treated using two primary systems. From 1960 to 1987, effluent from strontium-90 experiments was processed through an Imhoff sewage treatment system. From 1982 to 1984, a total of 39.59 mCi of plutonium-241 and 0.136 mCi of americium-241 were processed through the Imhoff system. The total throughput of strontium-90 to the Imhoff system is estimated at 943.2 mCi. After treatment through the Imhoff system, an estimated 2.55 mCi of strontium-90 and trace amounts of other radionuclides were released to the Imhoff Leach Field and subsurface soil. The Imhoff system used the principles of primary sedimentation, aeration, chemical clarification, and filtration prior to passing wastewater through a cation exchange column. Liquid level in the tanks was monitored by a float system. The tanks are below-grade and lined with concrete that is sealed with plastic sealant. The average concentration of strontium-90 reportedly released to the leach field was discharged in compliance with established standards. The system has been inactive since 1987 and the continued integrity of the Imhoff system has not been tested.

The second waste treatment system consisted of the radium-226 processing system. An estimated 3.8 mCi of radium-226 was subsequently discharged to the radium-226 processing system. This system consisted of septic tanks, seepage pits, and a leach line. The septic tanks allowed for the settling of solids, whereas fluids were fed through a distribution box to one of three vertical seepage pits. After frequent failures with the original system, a 91-foot-long, 14-foot-deep, and 3-foot-wide cobble-lined seepage pit was added in 1965. While the system has been taken out of service, no formal closure has been initiated. Radiological wastes were also buried in trenches and pits. Radium-226 waste was separated through the septic tank system, then discharged to concrete-lined dry wells and a cobble-filled seepage pit located west of the septic system.

1.2.3.2 Septic Systems

Non-radioactive liquid was disposed of at six on-site septic tanks prior to 1971, when the LEHR facility was connected to the currently active UCD Sewage Treatment Plant located at the main campus. Septic tanks were reported to have received all liquid wastes from the LEHR facility except for strontium-90 and radium-226 project wastes. However, during backup of the radium-226 system, Tank 2 was reported to have received effluent from Animal Hospital-2. One septic tank, located between Animal Hospitals 1 and 2, was reported to be in use until 1988.

1.2.3.3 Chemical Dispensing Areas

The LEHR facility used various chemicals including acetone, kerosene, toluene, xylene, benzene, formaldehyde, ethyl alcohol, formalin, diesel oil, and chlordane. The chemicals were dispensed from two areas on the LEHR site. Chemicals may have been dumped in trash pits in the old landfill or the trenches and pits where radioactive wastes were buried. Chemical wastes associated with animal experiments also may have been disposed of through the septic system leach fields and seepage pits.

1.2.3.4 Waste Burial

Low-level radioactive solid waste generated by DOE-sponsored research at the LEHR facility was disposed of in

trenches and pits located in the southern portion of the site. UCD disposed of experimental waste in 19 trenches and 49 pits located along the southern boundary and eastern portion of the LEHR facility. The wastes were reportedly disposed of following applicable regulations in place during that time. The UCD waste trenches are reported to have been approximately 2 feet wide and from 33 to 270 feet long. Disposal pits were typically 4 feet by 4 feet. Other trenches and pits were reported to be between 8 and 10 feet deep. Potentially radiological waste from other UCD activities was reportedly disposed of in the trenches and pits at the LEHR site as well.

In addition, it was reported by UCD personnel that some chemicals and laboratory wastes were disposed of in the trenches and pits. Some waste has been confirmed to be biological (animal carcasses). Waste was reportedly covered with up to four feet of material. Most burial trenches or pits could contain both chemical and radiological wastes.

1.2.3.5 Inactive Landfill Units

Prior to construction and during operation of the current LEHR facility, UCD disposed of sanitary and chemical wastes on the LEHR property in the Old UCD Landfill. The inactive landfill consists of three separate landfill units that were operated at different times. Two of the inactive landfill units are located on the LEHR site. The oldest of the three inactive disposal units (No. 1) is presently covered by the Cobalt-60 Field. Disposal reportedly began in this unit in the 1940s and ceased in the 1950s. General campus wastes and possibly chemical wastes and sewage sludge from the adjacent sewage treatment plant was reportedly disposed of in the landfill. The disposal for these wastes were acceptable at the time of disposal.

The second disposal unit (No. 2) was operated from 1956 to 1967, and consisted of twelve east-west oriented disposal pits. This unit is located in the mid-portion of the LEHR facility, and is partially covered with the easternmost of two sets of dog pens. The cells are reported to have averaged 10 feet in depth and are unlined. UCD staff report that the types of waste disposed of at this unit include household wastes, rubble, animal bedding, and general campus wastes.

UCD operated a third disposal unit (No. 3) from 1963 to 1967. This unit is located east of the LEHR facility and former UCD Sewage Treatment Plant. Wastes were placed in two large, pit-like excavations and covered with a soil cap. This disposal area is outside the LEHR facility boundaries.

1.2.3.6 Dog Pen Area

Two out-door dog pens containing approximately 350 separate pens are located at LEHR. The westernmost set of pens originally contained 304 pens. In 1975, 48 pens were removed to allow construction of the Cellular Biology Lab (Building H-294). These pens reportedly housed the dogs, which received the highest dosages of strontium-90 and radium-226. The outdoor pens were used to house the dogs after their initial treatments.

Excreta from dogs housed in outdoor pens contained low levels of radiological materials. Solids were removed from the pens daily. An estimated 2 mCi of strontium-90 and 0.5 mCi of radium-226 was potentially excreted in dog urine over the life of the project. A mixture containing 0.25% chlordane was used on dogs kept in outdoor pens from 1960 until the early 1970s to control fleas. The chlordane mixture was sprayed on dogs or dogs were dipped in chlordane mixture, or with chlordane-kerosene mixture, and returned to the dog pen areas. Annual usage of chlordane is estimated between 25 and 50 gallons (Dames & Moore 1992).

1.2.3.7 Stormwater

Stormwater runoff, observed to pond at several locations at the LEHR facility, has the potential to contact impacted soils or facilities and to subsequently impact other areas. Potential sources include the southwest disposal area, trenches and burial pits along the southern border of the site, the dog pens, and the former chemical dispensing areas. Stormwater at the LEHR facility was controlled with underground drainage systems that feed into ditches on the LEHR site. The runoff was then pumped into a ditch that feeds into the South Fork of Putah Creek.

1.2.3.8 Other Potential Sources

Other potential sources of environmental impact at the LEHR facility include, but are not limited to:

- Sewer lines and other piping that previously carried organic or radiological waste

- A reported spill of the tanker truck
- Airborne constituents, fugitive dust
- Other potential spills or unrecorded handling activities.

1.2.4 Physical Setting

The LEHR facility is located in the southern portion of the Sacramento Valley. The LEHR facility sits in a flat-lying or gently sloping area of former farmland.

The LEHR facility is located in a rural area, with approximately 75 percent of the surrounding land currently being used for agriculture. Approximately 40 percent of that land is currently irrigated. Major crops currently include fruits, nuts, and grains. Additionally, some nearby lands are currently used for cattle grazing.

1.2.4.1 Topography

The regional topography surrounding the LEHR facility is typical of the relatively flat Sacramento Valley. The Sacramento River, the primary drainage of the Sacramento Valley, is approximately 12 miles east of the site.

The site is situated on flat-lying land termed the Putah Plain. The average elevation at the site is approximately 50 feet above mean sea level. Relief across the site is approximately two feet, with the lowest portion in the area of the Cobalt-60 Field. Local drainage on LEHR is generally to the south-southwest.

1.2.4.2 Hydrology

The major groundwater sources for public and private water supplies in the Sacramento Valley are the unconsolidated deposits of Pliocene and Pleistocene age, and the older alluvium (Dames & Moore 1992). Groundwater is recharged through leakage from streams and rivers, and direct infiltration from precipitation and irrigation.

The geohydrology of the Sacramento Valley is characterized by both unconfined and confined aquifers in the near flat-lying or gently sloping sedimentary deposits in the upper 3,000 feet of section beneath the valley. No regionally identified confining units exist in the Sacramento Valley.

Groundwater is encountered beneath the site at depths ranging from approximately 45 to 70 feet below ground surface.

1.2.5 Meteorology

The climate in the region of the LEHR facility is Mediterranean, with mild winters and long summers. In winter, the average temperature is 46.9 degrees Fahrenheit (°F), and the average daily minimum temperature is 37.6 °F. The mean annual precipitation at is 17.0 inches, most of which occurs between October and April. The average daily relative humidity is about 80 percent in the winter, and 40 percent in the summer and early fall. Local humidity generally increases at night.

The sun shines approximately 95 percent of the time in summer and about 45 percent in winter. The prevailing wind direction is from the south, reflecting frequent incursion of marine air through the Carquinez Strait into the Sacramento Valley. Changes in wind direction are common, with flows from the northwest occurring diurnally. Several times a year, strong winds blow from the north, generally following the passage of Pacific storm systems. When winds are present, 40 percent of the time, speeds are less than 3.7 mph; 50 percent of the time they are less than 8.1 mph; and exceed 16.2 mph only 10 percent of the time for short periods.

1.2.6 Land Use

Land use near UCD and the LEHR facility is predominantly agricultural. Approximately 80 percent of the land in Yolo County is classified as farmland, and about 40 percent is irrigated crop land. Neighboring Solano County, where the facility is located, is also an agricultural area. About 60 percent of Solano County's total area is farmland, and 20 percent of the total land is irrigated crop land. The major crops in the area are grains, nuts, and fruit. Stock animals are also raised.

1.2.7 Population Data

UCD has a student population of approximately 21,000 and employs approximately 12,000 full-time faculty and staff. The current population of Davis is approximately 46,000 and the current total population of Yolo County is about 141,000. The LEHR facility is located in a rural area in northern Solano County just outside Davis. The immediate vicinity comprises primarily agricultural land. Solano County has a total population cf 340,092. The more densely populated and metropolitan Sacramento area is approximately 12 miles east of LEHR. The current population of Sacramento County is about 1,040,000, and approximately 370,000 people live in the City of Sacramento.

2.0 EFFLUENT MONITORING

Effluent monitoring is the monitoring or sampling of effluent streams for the presence of contaminants. Monitoring or sampling is undertaken to identify, quantitatively or qualitatively, releases from specific discharge location. Such locations may be either point sources (e.g., pipes or stacks) or diffuse sources (e.g., wind blown dusts).

This plan separates the liquid and airborne effluent monitoring activities for the LEHR ER Project. This meets the guidelines of the DOE Environmental Regulatory Guide (DOE 1991a) for radiological effluents and is extended in this plan to hazardous effluents to satisfy DOE Order 5400.1. The sections below address the monitoring of radiological and hazardous constituents that may be present in liquid and airborne effluent streams.

2.1 LIQUID EFFLUENT MONITORING

There are no liquid effluent streams presently monitored by the LEHR ER Project Environmental Monitoring and Surveillance Program. Based on the following sections, no additional liquid effluent streams will require monitoring as part of the fiscal year 1993 additions to the Environmental Monitoring and Surveillance Program.

2.1.1 Facility and Point of Discharge Descriptions

There are currently no active radiological or hazardous liquid effluent discharges from DOE-operated LEHR facilities to the environment. The two facilities at LEHR that historically released liquid effluents to the environment, the Imhoff Treatment Facility and Radium-226 Septic System, have ceased operation and are subject to decontamination and decommissioning (D&D) as part of the LEHR ER Project. Prior to D&D activities, any required changes to the effluent monitoring program will be evaluated and documented by addendum to this plan.

Liquid effluent to the sanitary and combined sewers on the LEHR site are treated by the UCD Waste Water Treatment Plant. Storm drains on the LEHR site are either directed into the UCD combined sewer and subsequently treated by the UCD Waste Water Treatment Plant or are directed into ditches that drain to the South Fork of Putah Creek.

2.1.2 Applicable Regulation and Compliance Summary

The State of California, Environmental Protection Agency has primacy for administering most elements of RCRA, the Clean Air Act, and the Clean Water Act in California. The UCD Waste Water Treatment Plant operates under National Pollution Discharge Elimination System (NPDES) Permit No. CA0077895 which contains the waste water discharge requirements for this facility. Environmental monitoring and surveillance of the UCD Waste Water Treatment Plan is the responsibility of UCD, and is contained in UCD environmental monitoring program.

2.1.3 Sampling and Laboratory Analysis

There are now no liquid effluent discharges to the environment from DOE-sponsored activities at the LEHR facility. This plan will be amended or updated to include appropriate sampling and laboratory analysis procedures should any portion of the LEHR ER project require liquid effluent monitoring.

2.1.4 Characterization of Effluent Streams

At present there are no liquid effluent discharges to the environment from DOE-sponsored activities at the LEHR facility. If any portion of the LEHR ER project generate liquid effluent streams that are discharged to the environment, then this plan will be amended or updated to characterize said liquid effluent streams.

2.2 AIRBORNE EFFLUENT MONITORING

The LEHR ER Project Environmental Monitoring and Surveillance Program presently does not monitor any airborne effluent streams. Based on the following sections, no additional airborne effluent streams will require monitoring as part of the fiscal year 1993 additions to the Environmental Monitoring and Surveillance Program.

2.2.1 Facility and Point of Discharge Descriptions

The following sections contain a brief summary of the potential point and diffuse airborne effluent sources on the LEHR site.

2.2.1.1 Building H-214

Building H-214, the Imhoff Water Treatment Facility, is serviced by chemical fume hood systems. There are an inactive underground septic system and two leach fields associated with this facility. Operations at the facility have been terminated and the building, chemical fume hoods, and septic system are not in use. There is low-level radioactive material contamination within building H-214. The ground above the septic system and leach fields is covered with an asphalt surface.

2.2.1.2 Building H-216

Building H-216, the Specimen Storage and Feed Mix Building, is serviced by a single HVAC system. The building has been declared a surplus facility and is currently awaiting D&D.

2.2.1.3 Building H-218

The portions of building H-218, Animal Hospital 2 (AH-2), that have not been released for unrestricted use receives heating and cooling from a single HVAC unit on the west end of the building. Each permanent dog cage exhausts through a manual vent and grating system in the ceiling of the cage. The exhaust from each cage is channeled into a plenum above the cage row. Each cage row exhaust plenum connects to a common header on the south wall of the building. The exhaust is drawn through the header into a HEPA filter unit located in Room 310. After being filtered, exhaust is drawn into the exhaust fan and discharged through a short roof stack (BEI 1991).

The portable dog cages in Room 209 of AH-1 are exhausted through a flexible vent pipe and hose into a plenum. The plenums are drawn into a central header that leads to a HEPA filter unit in Room 209. After being filtered, exhaust is drawn into the exhaust fan and discharged through a short roof stack.

Building H-218, a surplus facility, has low-level radioactive contamination and is waiting D&D. The HVAC systems from the contaminated portions of building H-218 are secured.

2.2.1.4 Building H-219

AH-1, building H-219, has three separate HVAC units. Each permanent dog cage exhausts through a manual vent and grating system in the ceiling of the cage. The exhaust from each cage is channeled into a plenum above the cage row. Each cage row exhaust plenum connects to a common header on the south wall of the building. The exhaust is drawn through the header into a HEPA filter unit located in Room 200B. After being filtered, exhaust is drawn into the exhaust fan and discharged through a short roof stack.

Rooms 212 and 219 of AH-1 each contain a hood that has a dedicated exhaust fan and stack on the roof of the building. The filters for each system are housed in an assembly within the respective hood structure. These hoods have been secured and are no longer operated.

Building H-219 has been declared a surplus facility. Several areas of the building have low-level radioactive material contamination and the building is currently awaiting D&D. The ventilation systems from the contaminated portions of building H-219 are secured.

2.2.1.5 Building H-229

Building H-229, the Cobalt-60 Building, is serviced by one HVAC system. Hazardous chemical or radioactive material contamination has not been detected within the structure. The building is not in use.

2.2.1.6 Building H-290

Building H-290, the Cobalt-60 Auxiliary Building, is serviced by one HVAC system. The building is currently used by UCD personnel and hazardous chemicals or radioactive material contamination has not been observed within.

2.2.1.7 Building H-292

The southern portion of building H-292, the Geriatrics-1 Building, is used for radioactive waste storage. The northern portion of the building has been returned to UCD and is used as a warehouse space. Ventilation for building H-292 is provided by natural circulation through roof vents. Only sealed, radioactive waste

containers are stored in building H-292. Prior to transport to building H-292 the externals of the waste containers are verified to have removable contamination levels less than those requiring special controls. The building is also routinely surveyed for removable radioactive material contamination. Because of the lack of contamination within building H-292, the airborne effluents from the facility should not be contaminated.

2.2.1.8 Other Sources

There are several other areas at the LEHR site that have the potential to be sources of airborne contaminants, either as point or diffuse sources.

2.2.1.8.1 Tank Trailer

The tank trailer located at the southwestern corner of the LEHR site has been previously emptied. The trailer has an unfiltered ambient vent to the atmosphere and was historically used to hold radioactive liquid waste. The liquid removed from the tank trailer in 1991 was not contaminated. Approximately 250 gallons of sludge remain in the tank trailer. The tank trailer is not known to have notable levels of hazardous or radiological contaminants remaining, e.g., radioactive material measurements made during routine surveillance have not detected contamination on the exterior of the trailer.

2.2.1.8.2 Radium-226 Septic System

The Radium-226 Septic System is an inactive radioactive liquid disposal system located west of building H-219. The system is not serviced by a ventilation system. Access to the Radium-226 Septic System Seepage Pits is through bolted maintenance holes. The ground above the Radium-226 Septic System is covered with asphalt.

2.2.1.8.3 Waste Storage

There are several structures on the LEHR site that are used to store DOE and UCD radioactive, hazardous, and mixed waste. Wastes are stored in closed container and according to applicable regulations.

2.2.1.8.4 Chemical Dispensing Areas

The former North and South Chemical Dispensing Areas are awaiting remediation as part of the LEHR ER Project. Hazardous materials have been detected at very low-levels in the soil of these areas.

2.2.1.8.5 Dog Pens

Two outdoor dog pen areas are present on the LEHR site. These pens were historically used to house the dogs used in the radionuclide ingestion experiments. The dog pen areas are potential diffuse sources of airborne effluents. The surface gravel/soil from the dog pen areas have had sporadic and very low level hazardous (chlordane) and radioactive material contamination measured. Some pens are still being used to house dogs for UCD research.

2.2.1.8.6 Radioactive Waste Disposal Trenches

The radioactive waste disposal trenches located in the southern portion of the LEHR site are a potential source of diffuse airborne effluents. These trenches were capped with soil when disposal operations were completed. Hazardous material and radioactive material contamination have not been measured in the surface soil above the trenches.

2.2.1.8.7 Inactive UCD Landfills

The old UCD landfills located in the southern portion of the LEHR site and to the east of the LEHR site are a potential source of diffuse airborne effluents. Although these landfills are UCD concerns, the DOE liability for these units has not been established. The landfills were capped with soil when dumping operations ceased and measurements of contamination in the surface soil over landfills has not detected hazardous or radioactive material contamination.

2.2.2 Applicable Regulation and Compliance Summary

Airborne emissions of radioactive and hazardous materials from DOE-controlled facilities are subject to the regulations of the EPA. The primary regulation is the "National Emission Standards for Hazardous Air

Pollutants" (40 CFR 61). The LEHR ER Project is not currently required to be permitted by the regional Air Quality Control Board.

Under normal operating (realistic exposure) conditions, the airborne effluent discharged from the point and diffuse sources at the LEHR site would not result in an effective dose equivalent of greater than 0.1 mrem to any member of the public (Chapman 1992). The EPA limit for exposure to the member of the public from air emissions of radioactive materials from DOE sites is 10 mrem per year. Therefore, according to the requirements of 10 CFR 61.92, DOE Orders 5400.1 and 5400.5 (DOE 1990c), and DOE/EH-0173T, the airborne effluents from the LEHR site do not require continuous sampling for radionuclides. Because the ventilation systems that exhaust from contaminated areas are not in operation, periodic confirmatory sampling is not required.

Under realistic conditions, the airborne effluent discharged from the point and diffuse sources at the LEHR site do not require sampling for hazardous materials because there are no appreciable quantities of uncontained hazardous materials in facilities and in the surface soils (Dames & Moore 1992, BEI 1991), i.e., there is an insufficient quantity of these materials.

2.2.3 Sampling and Laboratory Analysis

There are currently no operating effluent air samplers at the LEHR site. Prior to each ER Project activity the need for continuous or periodic radiological or hazardous material air effluent monitoring will be evaluated and documented by an addendum to this plan.

2.2.4 Characterization of Effluent Streams

Prior to each D&D or ER activity the need for radiological or hazardous material airborne effluent streams will be characterized and any sampling requirements documented by an addendum to this plan.

3.0 ENVIRONMENTAL SURVEILLANCE

Environmental surveillance involves the collection and analysis of air, surface water, groundwater, soil, vegetation, and fauna as well as measuring penetrating radiation. Each media-specific subsection below discusses the locations to be sampled, frequency of sampling, analyses to be performed, review of data, and reporting of data.

3.1 AIR SAMPLING

Currently, air monitoring is not performed as part of the LEHR ER Project Environmental Monitoring and Surveillance Program.

DOE regulations say that environmental surveillance of the air should be performed to monitor the effects, if any, of DOE activities on the on- and off-site environment. Because of the very low-levels of radioactive and hazardous material contamination in the buildings and surface soils of the site (BEI 1991, Dames & Moore 1992), environmental surveillance air sampling is not required at this time (Chapman 1992).

Calculations using the EPA-approved CAP88-PC computer code show that the maximum credible dose equivalent to a member of the public from residual contamination on the LEHR site is less than 0.001 mrem (Chapman 1992). These calculations were based upon the residual radioactive material contamination measured during site characterization activities. Environmental surveillance of the ambient air at the LEHR site would not be able to provide useful information because radioactive and hazardous material contamination is no longer being generated on-site and the low-levels of residual contamination would not be measurable with current technology even if there were active ventilation systems.

If analysis of upcoming D&D and ER activities suggest that continuous air sampling is beneficial at a future date, air sampling stations will be sited using the guidance developed by Waite (1973).

3.2 SOIL SAMPLING

Soil sampling is conducted to ascertain the deposition and/or buildup of radiological and hazardous materials in surface soils. Currently routine soil sampling is not performed as part of the LEHR ER Environmental Monitoring Program. A total of 8 surface soil sampling locations have been added as part of the fiscal year 1993 additions to the LEHR ER Project Environmental Monitoring and Surveillance Program. Routine sediment sampling has been performed as part of the ongoing LEHR ER environmental characterization activities.

3.2.1 Sampling Locations

Surface soils are sampled at 4 on-site, 2 off-site, and 1 background location and sediments are sampled at 1 on-site, 2 off-site, and 1 background location. The locations of surface soil and sediment sampling is listed in Table 3.1 and as shown in Figure 3.1.

Soil sampling locations were chosen based upon providing on- and off-site samples surrounding the LEHR site. One sediment sample is taken downstream of the LEHR site to find the effect of the site on South Fork of Putah Creek. The UCD Waste Water Treatment Plant discharge was chosen for sediment sampling to differentiate between the effects of the plant's operation and those from the LEHR site. Sampling at the outfall of the lift station is done to find the effect of discharges of stormwater collect from the LEHR site.

Table 3.1. Location of Soil and Sediment Samples

LEHR Sample Location ID	Location/Description
Soil Samples	
SS-AS-1	Northeast site boundary
SS-AS-2	Northwest site boundary
SS-BK-1	Near UCD Climatological Station (background)
SS-LF-1	Southeast site boundary
SS-LF-2	Southwest site boundary
SS-OD-1	West of LEHR site, near monitoring well UCD-17
SS-RC-1	Eastern Raptor Center, near monitoring well UCD-10
Sediment Samples	
SS-LS-1	LEHR Site Stormwater Lift Station
SS-OF-1	UCD Waste Water Treatment Facility Outfall
SS-PD-1	Putah Creek, Downstream of LEHR Site
SS-PU-1	Putah Creek, Upstream of LEHR Site (background)

3.2.2 Sampling Frequency

The collection frequency of soil samples and the types of analyses performed are summarized in Table 3.2. Surface soil and sediment samples are taken annually. An annual sampling frequency was chosen because a historical baseline is not available. As such, it is possible that the minimum DOE-required surveillance frequency of 5 years would not provide sufficient data on radioactive and hazardous materials in the environment.

3.2.3 Sample Analysis

Soil samples are analyzed for radiological and hazardous materials. The type of analysis to be performed on a sample from a specific location is detailed in Table 3.2. The types of analysis chosen are based upon those contaminants historically present on the LEHR site and those monitored for as part of ongoing LEHR ER Project environmental characterization activities. Procedures for the collection and analysis of surface soil and sediment samples are under development. These procedures will be issued prior to the initiation of soil sampling activities. Sediment sampling procedures are in place (Dames & Moore 1992).

3.2.4 Data Review and Reporting

Analytical results from laboratory analyses are reviewed for accuracy when received. The analytical results are then tabulated and reviewed for trends. Standard statistical methods are used in the determination of accuracy and trending. Should any analytical result show an abnormally high or low result or exceed an action level, an investigation will be promptly initiated to validate the result and/or learn the cause of the abnormal result.

Table 3.2. Frequency and Analyses of Soil and Sediment Samples

LEHR Sample Location ID	Frequency	Type of Analyses
All	Annual	Gross alpha Gross beta Strontium-90 Radium-226 Gamma-emitting isotopes Tritium 17 CAM metals Hexavalent chromium Nitrate (as nitrogen) Formaldehyde Organochlorine pesticides Volatile Organic Compounds

Semivolatile Organic Compounds

3.2.5 Sampling Changes and Special Projects

Baseline information for on-site soils has not been established. Analytical data from all locations will be reevaluated within the context of American Society for Testing and Materials (ASTM) recommendations (1989). Based upon comparisons from historical and control reference concentrations, some sites may be recommended for increased or reduced sampling frequency.

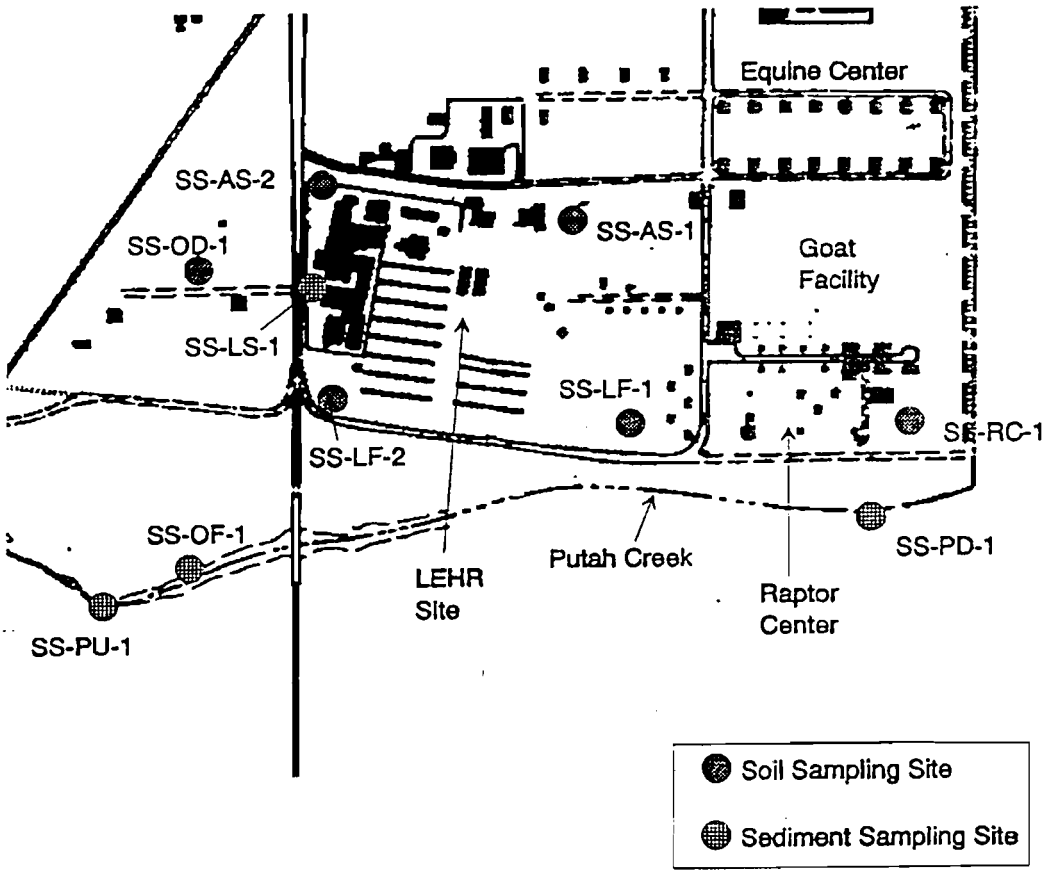

Figure 3.1 LOCATION OF SOIL AND SEDIMENT SAMPLES

3.3 TERRESTRIAL FOODSTUFFS

Terrestrial foodstuffs is a broad category that includes vegetation and fauna. Surveillance of terrestrial foodstuffs is required to quantify radioactive materials and chemicals and to demonstrate that radioactive and hazardous materials are not building up in the environment. Terrestrial foodstuff monitoring has not been performed in the past, but will be initiated as part of the Environmental Monitoring Program in fiscal year 1993.

3.3.1 Sampling Locations

Because of the very low potential for exposure to a member of the public from hazardous or radiological

materials from the LEHR site, only periodic sampling of native vegetation is performed (Chapman 1992). Other terrestrial foodstuffs such as milk, vegetables, meat, eggs, grains, fruit, and game animals are not routinely sampled as part of the LEHR ER Project Environmental Monitoring and Surveillance Program. Pathway analyses to find the risk of exposure to a member of the public are included in the annual review of this plan. Should the annual review of pathway analyses find that sampling of other terrestrial foodstuffs is required, an addendum to this plan will be issued to document the changes in sample location, type, and frequency.

Vegetation samples are to be taken at 5 on-site, 3 off-site, and 1 background location (sampling to begin in fiscal year 1993). The location of vegetation samples is described in Table 3.3 and shown on Figure 3.2. Vegetation samples are taken together with soil sampling locations to allow for the determination of how radioactive and chemical materials are taken up by native vegetation. A vegetation sample is also taken together with the sediment sample downstream of the LEHR site to ascertain radioactive and hazardous material uptake by creek side vegetation.

Table 3.3. Locations of Vegetation Sampling

LEHR Sample Location ID	Location/Description
VS-AS-1	Northeast site boundary
VS-AS-2	Northwest site boundary
VS-BK-1	Near UCD Climatological Station (background)
VS-LF-1	Southwest site boundary
VS-LF-2	East of abandoned dog pens, by monitoring well UCD-8
VS-LS-1	West boundary of site, near stormwater lift station
VS-OD-1	West of LEHR site, near monitoring well UCD-17
VS-PD-1	North bank of Putah Creek, Downstream of LEHR Site
VS-RC-1	Eastern Raptor Center, near monitoring well UCD-10

3.3.2 Sampling Frequency

The collection frequency of vegetation samples and the types of analyses performed are summarized in Table 3.4. Vegetation samples are taken annually. An annual sampling frequency was chosen because a historical baseline is not available. As such, it is possible that the minimum DOE-required surveillance frequency of 5 years would not provide sufficient data on radioactive and hazardous materials in the environment.

3.3.3 Sample Analysis

Vegetation samples are analyzed for radiological and hazardous materials. The type of analysis for each sample is given in Table 3.4. The types of analysis chosen is based upon those contaminants historically present on the LEHR site and those monitored for as part of ongoing LEHR ER Project environmental

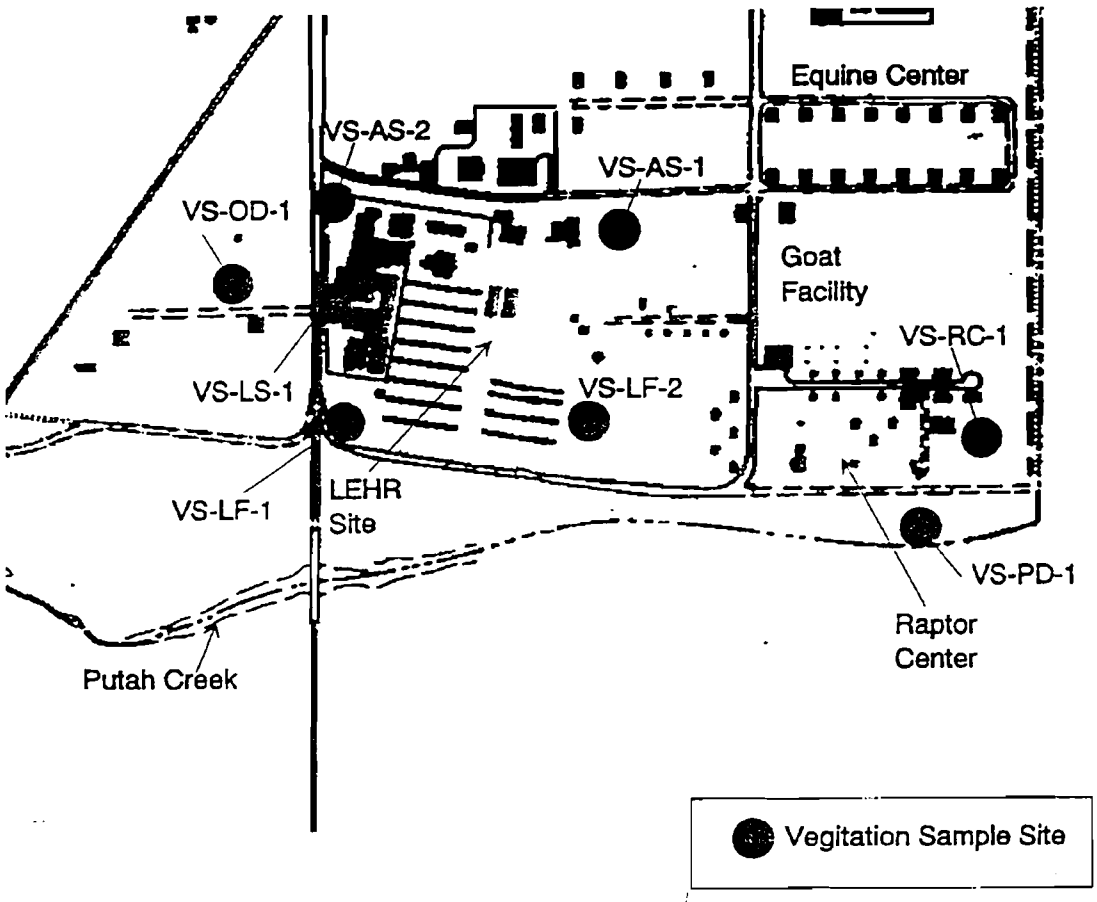

Figure 3.2 LOCATIONS OF VEGETATION SAMPLING

characterization activities. Procedures for the collection and analysis of vegetation samples are under development. These procedures will be issued prior to the initiation of vegetation sampling activities.

3.3.4 Data Review and Reporting

Analytical results from laboratory analyses are reviewed for accuracy when received. The analytical results are then tabulated and reviewed for trends. Standard statistical methods are used in the determination of accuracy and trending. Should any analytical result show an abnormally high or low result or exceed an action level, an investigation will be promptly initiated to validate the result and/or find the cause of the abnormal result.

Table 3.4. Frequency and Analyses of Vegetation Sampling

LEHR Sample Location ID	Frequency	Type of Analyses
All VS	Annual	Gross alpha Gross beta Strontium-90 Radium-226 Gamma-emitting isotopes Tritium 17 CAM Metals

3.3.5 Sampling Changes and Special Projects

Baseline information for on- and off-site vegetation has not been established. Based upon comparisons from historical and regional reference concentrations, vegetation sampling frequency may be increased or reduced to once every five years.

3.4 GROUNDWATER MONITORING

Groundwater that could be effected by DOE-sponsored activities shall be monitored to find the effects on groundwater quality and to demonstrate compliance with applicable federal, state and local regulations. A groundwater monitoring plan for the LEHR site is under development. This groundwater monitoring program will be designed and implemented according to 40 CFR Part 264, Subpart F, or 40 CFR Part 265, Subpart F. Monitoring for radionuclides shall be follow DOE orders in the 5400 series dealing with radiation protection of the public and the environment. Meanwhile, until the groundwater monitoring program is implemented, routine groundwater monitoring will continue using the available on-site wells. The geohydrology of the LEHR site has been preliminarily described in the Phase II Site Characterization Report (Dames & Moore 1992). Further investigations of the LEHR site groundwater will be completed as part of the ongoing environmental characterization activities.

3.4.1 Sampling Locations

The locations of monitoring wells are described in Table 3.5 and shown on Figure 3.3. There are 23 wells monitored as part of the routine groundwater monitoring program. The depth of the static water table varies at each monitoring location. The first water-bearing formation is between 45 feet and 80 feet beneath ground surface. The second water-bearing zone is between 80 feet and 135 feet beneath ground surface. Sampling locations coincide with the wells installed as part of the ongoing LEHR ER Project environmental characterization.

Table 3.5. Locations of Groundwater Monitoring Wells

LEHR Sample Location ID	Location	Screened Interval (feet)	HSU Monitored
UCD-1	Northwest corner of site	46.5-56.5	First
UCD-2	Abandoned		
UCD-3	Northeast corner of west dog pen area	39.0-49.0	First
UCD-4	Southwest corner of site	45 - 55	First
UCD-5	East of Main Admin. Building	38.0-48.0	First
UCD-6	Southwest corner of AH-1	40 - 50	First
UCD-7	100 feet east of SE corner of Cell Bio.	80 - 90	Second
UCD-8	West of midsection of old Co-60 field	43.5-53.5	First

UCD-9	North of Co-60 Aux. building	40.0-50.0	First
UCD-10	700 feet east of northeast corner old Co-60 field	54 - 69	First
UCD-11	Northeast corner of of old Co-60 field	50 - 65	First
UCD-12	North of Co-60 Aux. building	49.5-64.5	First
UCD-13	East of midpoint of east dog pen area	50 - 65	First
UCD-14	West of midsection of old Co-60 field	75 - 85	Second
UCD-15	100 feet east of SW corner of site	91 - 116	Second
UCD-16	50 feet north of site boundary, north of Main Admin. Bldg.	92 - 117	Second
UCD-17	700 feet west of west site boundary	88 - 113	Second
UCD-18	700 feet west of Southwest site boundary	54 - 69	First
UCD-19	50 feet north of site boundary, north of TPHRL	41.5-56.5	First

Table 3.5. continued

LEHR Sample Location ID	Location	Screened Interval	Monitors HSU
UCD-20	Northeast corner of west dog pen area	57 - 72	First
UCD-21	Southwest of Cell Biology building	57 - 72	First
UCD-22	Southwest corner of AH-1	57 - 72	First
UCD-23	Southeast of Specimen Storage Building	56.5-71.5	First
UCD-24	East boundary of west dog pen area	57 - 72	First

Table 3.6. Frequency and Analyses of Groundwater Wells

LEHR Sample Location ID	Frequency	Type of Analyses
All wells	Quarterly	Gross alpha
		Gross beta
		Strontium-90
		Radium-226
		Gamma-emitting isotopes
		Tritium
		Metals
		Hexavalent chromium
		Formaldehyde
		Nitrates as nitrogen
		Turbidity
		Organochlorine Pesticides
		Volatile Organic Compounds
		Semivolatile Organic Compounds
		Phosphate
		Chloride
		Alkalinity
		Total Dissolved Solids
		Chemical Oxygen Demand
		Calcium
		Magnesium
		Potassium
		Sulfate
		Sodium

3.4.2 Sampling Frequency

Groundwater samples are collected and analyzed quarterly. A quarterly sampling frequency was chosen to coincide with the ongoing LEHR ER Project characterization activities. The collection frequency and types of analyses are listed in Table 3.6. During the seasonally dry portions of the year, water samples may not be obtainable from certain monitoring wells in the shallow aquifer.

3.4.3 Sample Analysis

Groundwater samples are analyzed for radioactive and hazardous materials. The types of analysis chosen is based upon those contaminants historically present on the LEHR site and those monitored for as part of ongoing LEHR ER Project environmental characterization activities. In addition, water level measurements are also made. Groundwater sampling procedures have been developed (Dames & Moore 1992). These procedures comply with the requirements of EPA (1990) for chemical analyses and DOE radiological analyses.

3.4.4 Data Review and Reporting

Analytical results from laboratory analyses are reviewed for accuracy when received. The analytical results are then tabulated and reviewed for trends. Standard statistical methods are used in the determination of accuracy and trending. Should any analytical result show an abnormally high or low result or exceed an action level, an investigation will be promptly initiated to validate the result and/or find the cause of the abnormal result. Besides analytical results, water levels are also measured and charted.

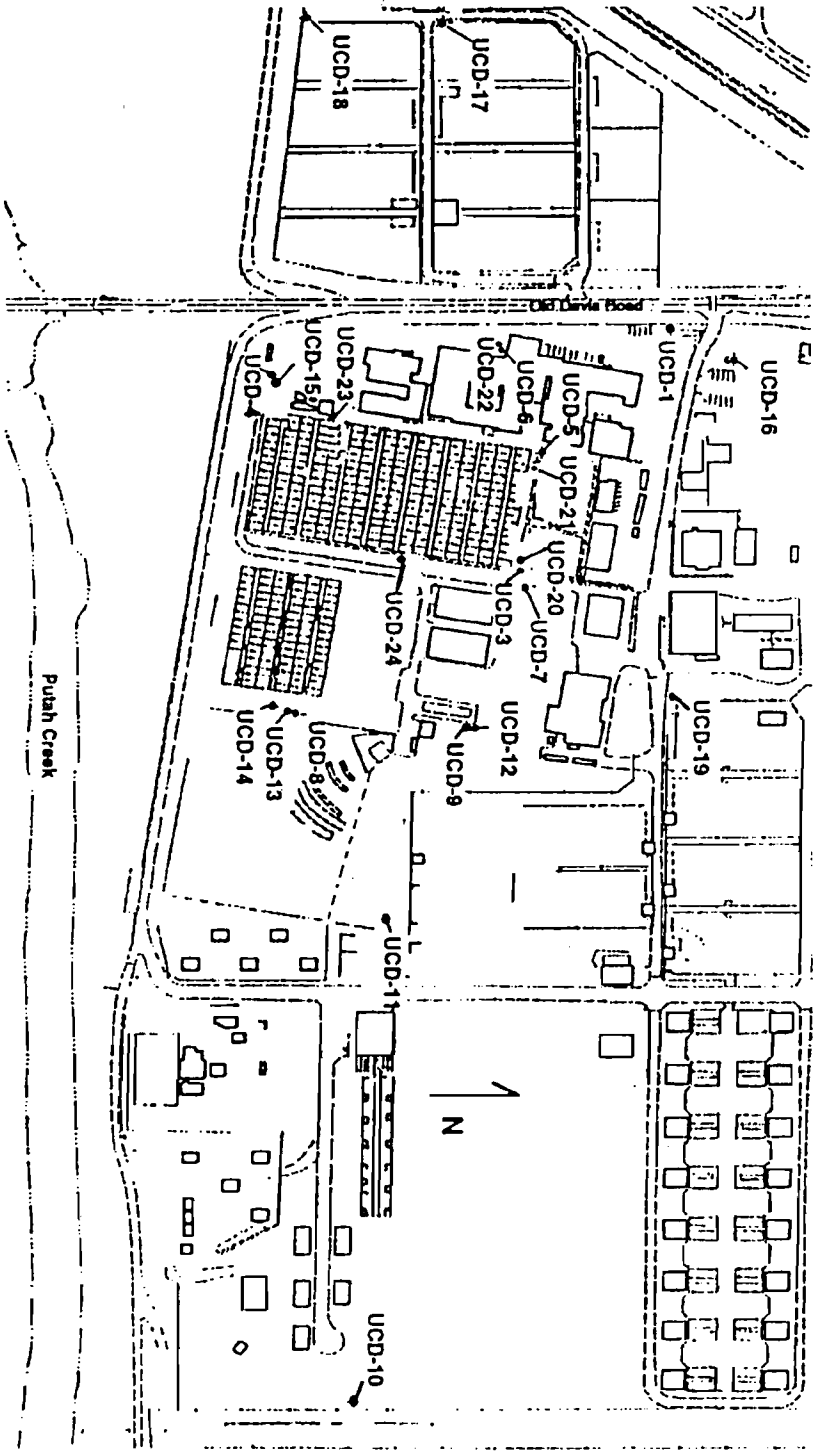

Figure 3.3
LOCATIONS OF
GROUNDWATER
MONITORING WELLS

3.4.5 Sampling Changes and Special Projects

The current groundwater monitoring scheme will be evaluated and modified as necessary to coincide with the ongoing LEHR ER Project environmental characterization and Groundwater Monitoring Program.

3.5 SURFACE WATER MONITORING

The only surface water near the LEHR site is the South Fork of Putah Creek. The South Fork of Putah Creek is a losing stream, that is, it is continually recharging the underlying aquifers (Dames & Moore 1992). Surface water monitoring has been performed in the past as part of the ongoing environmental characterization activities.

3.5.1 Sampling Locations

Surface water is sampled at 3 locations, listed in Table 3.7 and as shown in Figure 3.4. In addition, a control sample from an upstream (background) area is obtained. One surface water sample is taken downstream of the LEHR site to determine the effect of the site on South Fork of Putah Creek. The UCD Waste Water Treatment Plant discharge and entrance of the discharge to Putah Creek were chosen for sampling to differentiate between the effects of the plant's operation and those from the LEHR site.

Table 3.7. Location of Surface Water Sampling

LEHR Sample Location ID	Location
SW-01	Approx. 500 feet upstream of UCD Waste Water Treatment Plant outfall in Putah Creek (background)
SW-02	UCD Waste Water Treatment Plant outfall approx. 60 feet prior to entering Putah Creek
SW-03	Just downstream of UCD Waste Water Treatment Plant outfall in Putah Creek
SW-04	Approx. 700 feet downstream of LEHR Site in Putah Creek

3.5.2 Sampling Frequency

The collection frequency of surface water samples and the types of analyses performed are summarized in Table 3.8. Surface water samples are taken quarterly. A quarterly sampling frequency was chosen to coincide with the ongoing LEHR ER Project characterization activities.

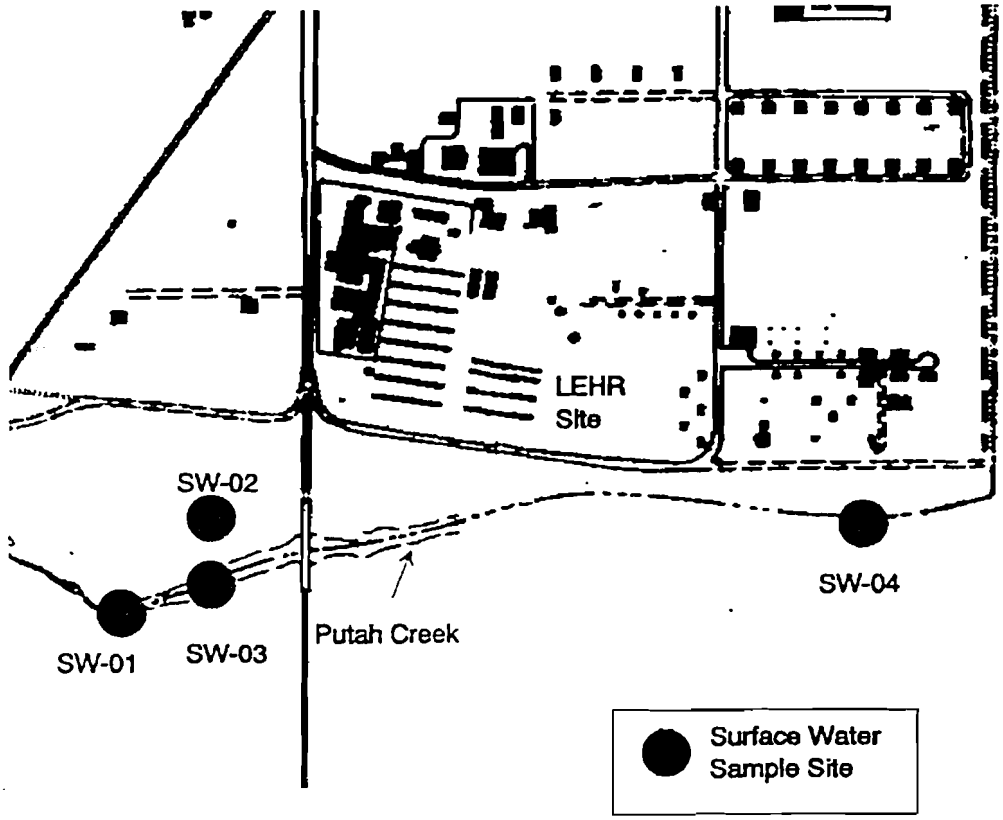

Figure 3.4 LOCATION OF SURFACE WATER SAMPLING

3.5.3 Sample Analysis

Surface water samples are analyzed for radioactive and hazardous materials. The types of analysis chosen is based upon those contaminants historically present on the LEHR site and those monitored for as part of ongoing LEHR ER Project environmental characterization activities. Surface water sampling procedures have been developed (Dames & Moore 1992). These procedures comply with the requirements of EPA (1990) for chemical analyses and DOE for radiological analyses.

Table 3.8. Frequency and Analyses of Surface Water

LEHR Sample Location ID		Frequency	Type of Analyses
All SW	Quarterly	Gross alpha	
			Gross beta
			Strontium-90
			Radium-226
			Gamma-emitting isotopes
			Tritium
			Metals
			Hexavalent chromium
			Formaldehyde
			Nitrates as nitrogen
			Turbidity
			Organochlorine Pesticides
			Volatile Organic Compounds
			Semivolatile Organic Compounds
			Phosphate
			Chloride
			Alkalinity
			Total Dissolved Solids
			Chemical Oxygen Demand
			Calcium
			Magnesium
			Potassium
			Sulfate
			Sodium

3.5.4 Data Review and Reporting

Analytical results from laboratory analyses are reviewed for accuracy when received. The analytical results are then tabulated and reviewed for trends. Standard statistical methods are used in the determination of accuracy and trending. Should any analytical result show an abnormally high or low result or exceed an action level, an investigation will be promptly initiated to validate to the result and/or find the cause of the abnormal result.

3.5.5 Sampling Changes and Special Projects

Baseline information for surface water has been established. Based upon comparisons from historical and reference concentrations, some surface water sampling locations may be recommended for increased or reduced sampling frequency.

3.6 NONROUTINE SAMPLING

Nonroutine samples are collected from soils, waters, and wastes as needed to evaluate the material tested or to decide if a spill or release has occurred. Requests are processed by the Environmental Monitoring and Surveillance Program coordinator with the concurrence of EMO Project Management. Samples are obtained using approved sampling and analysis procedures, when available, or according to appropriate EPA or industrial standards.

3.7 ENVIRONMENTAL DOSIMETRY

Environmental dosimeters, as part of the overall environmental surveillance program, are used to quantify the exposure of on- and off-site personnel to penetrating radiation. Currently, there are 20 locations monitored for penetrating radiation. An additional 14 locations will be added to the Environmental Monitoring and Surveillance Program in fiscal year 1993.

3.7.1 Locations

There are 34 locations monitored by environmental dosimeters. The location of environmental dosimeters is

described in Table 3.9 and illustrated on Figure 3.5. Environmental dosimeters are also placed to find natural background radiation and control dosimeters are used to ensure continued accuracy because of off-site processing. Dosimeters are placed at a height of 1-meter above ground level, except that the dosimeters around the former Cobalt-60 Field (TLD-7 through TLD-13) are located approximately 2-meters above the ground. While the Cobalt-60 Field was in use the heights used were found more representative of the highest radiation exposure expected to be received by personnel. Although the Cobalt-60 Field has been retired, the dosimeters are maintained at this location because the radioactive source is located on top of building H-229 and also as to preserve the value of historical data for trending purposes.

3.7.2 Frequency and Analysis

The frequency that environmental dosimeters are collected and analyzed is summarized in Table 3.10. The dosimeters located in areas where radiation doses could exceed 100 mrem per year, e.g., active radioactive material storage areas, are evaluated monthly to allow for timely determination of radiation levels. The monthly process period for pre-fiscal year 1993 dosimeters that otherwise would not meet the 100 mrem/y criterion (e.g., TLD-3, 33, and 34) will not be changed. Other dosimeters are processed quarterly.

Environmental dosimeters are analyzed by a laboratory that has been certified in environmental dosimetry processing by the National Voluntary Laboratory Accreditation Program. The current contracted laboratory is the Radiation Detection Company.

Table 3.9. Location of Environmental Dosimeters

LEHR Sample Location ID	Location/Description
TLD-1	Northeast corner of site
TLD-2	Northwest corner of site
TLD-3[a]	LEHR ER Project Trailer
TLD-4[a]	West side of North Cargo Container
TLD-5[a]	West side of South Cargo Container
TLD-6[a]	Northwest corner of mixed waste storage building
TLD-7[a]	Middle of north fence of former Co-60 Field
TLD-8[a]	North portion of east fence of former Co-60 Field
TLD-9[a]	South portion of east fence of former Co-60 Field
TLD-10[a]	East portion of south fence of former Co-60 Field
TLD-11[a]	West portion of south fence of former Co-60 Field
TLD-12	Middle of west fence of former Co-60 Field
TLD-13	Northwest corner of fence of former Co-60 Field
TLD-14[a]	South side of building H-292, radioactive waste storage
TLD-15[a]	East side of building H-292, radioactive waste storage
TLD-16[a]	North side of building H-292 radioactive waste storage partition wall
TLD-17[a]	West side of building H-292, radioactive waste storage
TLD-18	Between east and west dog pen area
TLD-19	South site boundary, south of west dog pen area
TLD-20[a]	Southwest corner of site
TLD-21	South of building H-216
TLD-22	Between building H-216 and building H-215
TLD-23	Between building H-217 and building H-218
TLD-24	Southwest of southwest corner of building H-218
TLD-25[a]	West site boundary, west of building H-214
TLD-26	West of building H-219
TLD-27[a]	Northwest corner of building H-218
TLD-28[a]	Building H-218, Room 307
TLD-29[a]	East of building H-214
TLD-30[a]	Building H-219, Room 203
TLD-31	Between building H-219 and building H-213
TLD-32[a]	Freezer of building H-219
TLD-33[a]	Building H-213, Room 159 bulletin board
TLD-34[a]	Building H-213, Room 159 desk
TLD-35[a]	Background, UCD Equine Center
TLD-36	Background, UCD EH&S Office at UCD Campus

TLD-37	Control, UCD EH&S Office at LEHR
TLD-38	Control, UCD EH&S Office at LEHR

(a) Denotes fiscal year 1992 TLD locations.

3.7.3 Data Review and Reporting

Analytical results from laboratory analyses are reviewed for accuracy when received. The analytical results are then tabulated and reviewed for trends. Standard statistical methods are used in the determination of accuracy and trending. Should any analytical result show an abnormally high or low result or exceed an action level, an investigation will be promptly initiated to validate the result and/or learn the cause of the abnormal result.

Table 3.10. Frequency of Environmental Dosimeter Evaluation

LEHR Sample Location ID	Frequency	LEHR Sample Location ID	Frequency
TLD-1	Quarterly	TLD-20	Monthly
TLD-2	Quarterly	TLD-21	Quarterly
TLD-3	Monthly	TLD-22	Quarterly
TLD-4	Quarterly	TLD-23	Quarterly
TLD-5	Quarterly	TLD-24	Quarterly
TLD-6	Quarterly	TLD-25	Monthly
TLD-7	Quarterly	TLD-26	Quarterly
TLD-8	Quarterly	TLD-27	Monthly
TLD-9	Quarterly	TLD-28	Monthly
TLD-10	Quarterly	TLD-29	Quarterly
TLD-11	Quarterly	TLD-30	Monthly
TLD-12	Quarterly	TLD-31	Quarterly
TLD-13	Quarterly	TLD-32	Monthly
TLD-14	Monthly	TLD-33	Monthly
TLD-15	Monthly	TLD-34	Monthly
TLD-16	Monthly	TLD-35	Monthly
TLD-17	Monthly	TLD-36	Quarterly
TLD-18	Quarterly	TLD-37	Monthly
TLD-19	Quarterly	TLD-38	Monthly

3.7.4 Sampling Changes

Baseline information for penetrating radiation levels has been established. Based upon comparisons from historical and reference doses, some sampling locations may be recommended for increased evaluation frequency, reduced evaluation frequency, or retirement.

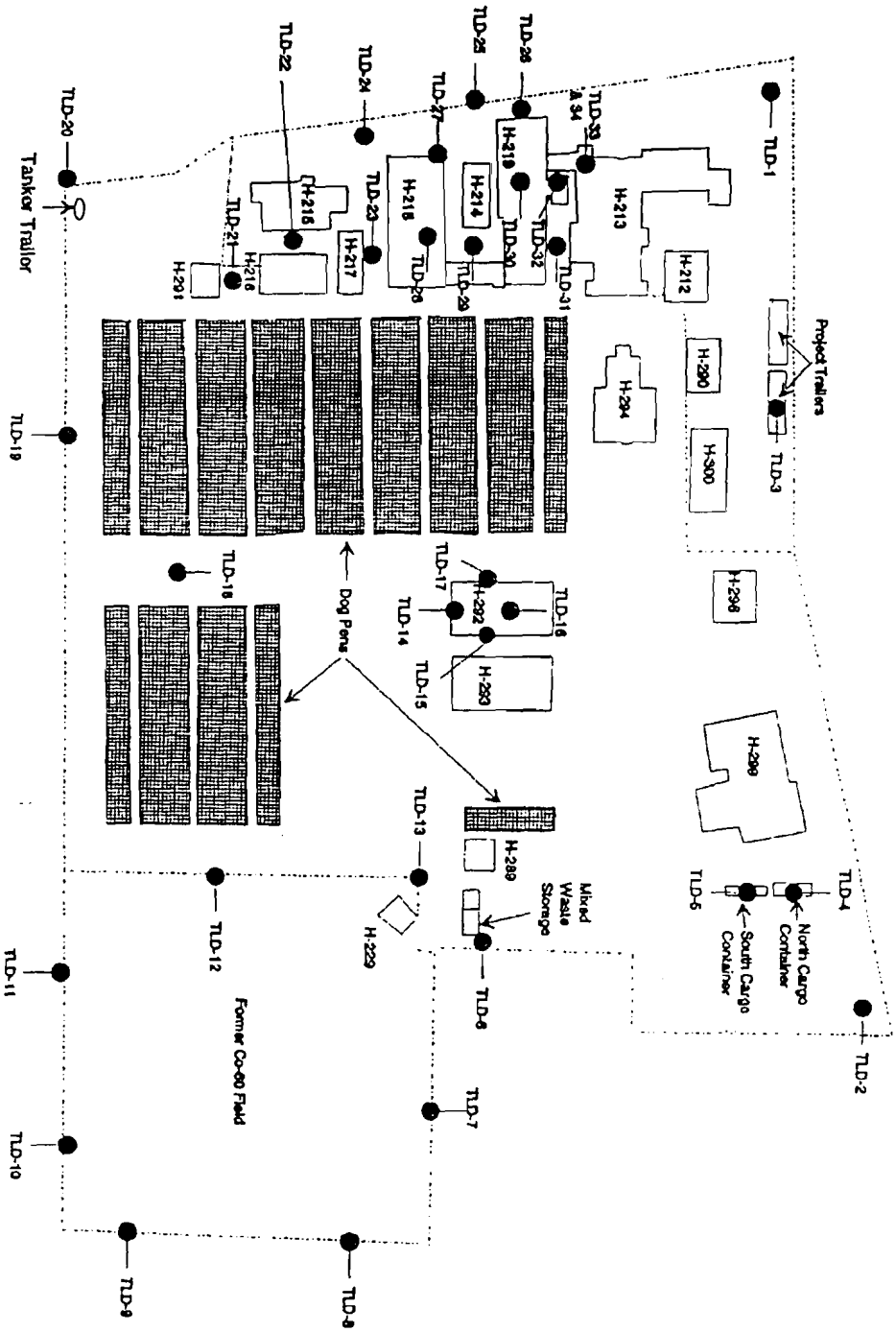

Figure 3.5 LOCATION OF ENVIRONMENTAL DOSIMETERS

4.0 METEOROLOGICAL MONITORING

DOE Order 5400.1 contains the meteorological requirements for DOE facilities. Site meteorological facilities are intended to support impact assessments, environmental surveillance activities, and emergency response and dose assessment programs. The UCD Office of Environmental Health and Safety has required summary information for most of the meteorological data needs for the LEHR site. Meteorological data are also required for the assessment of dose from potential radiological releases from the LEHR facility in compliance with EPA's NESHAP regulation. These calculations are performed using the EPA-approved CAP88-PC computer code.

The UCD Department of Land, Air, and Water Resources operates a National Oceanic and Atmospheric Administration (NOAA) reference Climatological Station for the National Weather Service (NWS) on the UCD Campus. This meteorological monitoring station is located approximately two and one-quarter miles northwest of the LEHR site (See Figure 4.1) and has been in operation since the early 1920s. The State of California Air Resources Board also uses the UCD Climatological Station for air quality measurements. Due to the low probability of airborne releases and relatively even terrain of the campus area, the use of this single, off-site monitoring station is considered adequate.

4.1 MEASUREMENTS

The UCD operates a 20-meter Climatological Station that currently collects information at the 0.5-meter, 2-meter, 10-meter, and 15-meter elevations. Wind speed is recorded at the 0.5-meter, 2-meter, and 10-meter elevations. Wind direction is measured at the 2-meter elevation and air temperature is measured at the 2-meter and 15-meter elevations. Relative humidity, precipitation, and barometric pressure are also measured. The tower system downloads the meteorological data to a computer. Averages, along with the maximum and minimum readings during the interval, are recorded for each tower measurement. Daily and monthly summaries of tower data are also generated.

4.2 DATA PROCESSING

Backup power systems have been installed to guard against tower data loss. The tower runs on AC power and does not have an uninteruptable backup. Data is recorded directly onto a strip chart recorder and/or a personal computer.

4.3 QUALITY ASSURANCE

Annual calibrations of tower measurement devices are conducted by the NWS. Routine QA checks of tower devices are run by UCD personnel. A formal log of maintenance activities is maintained.

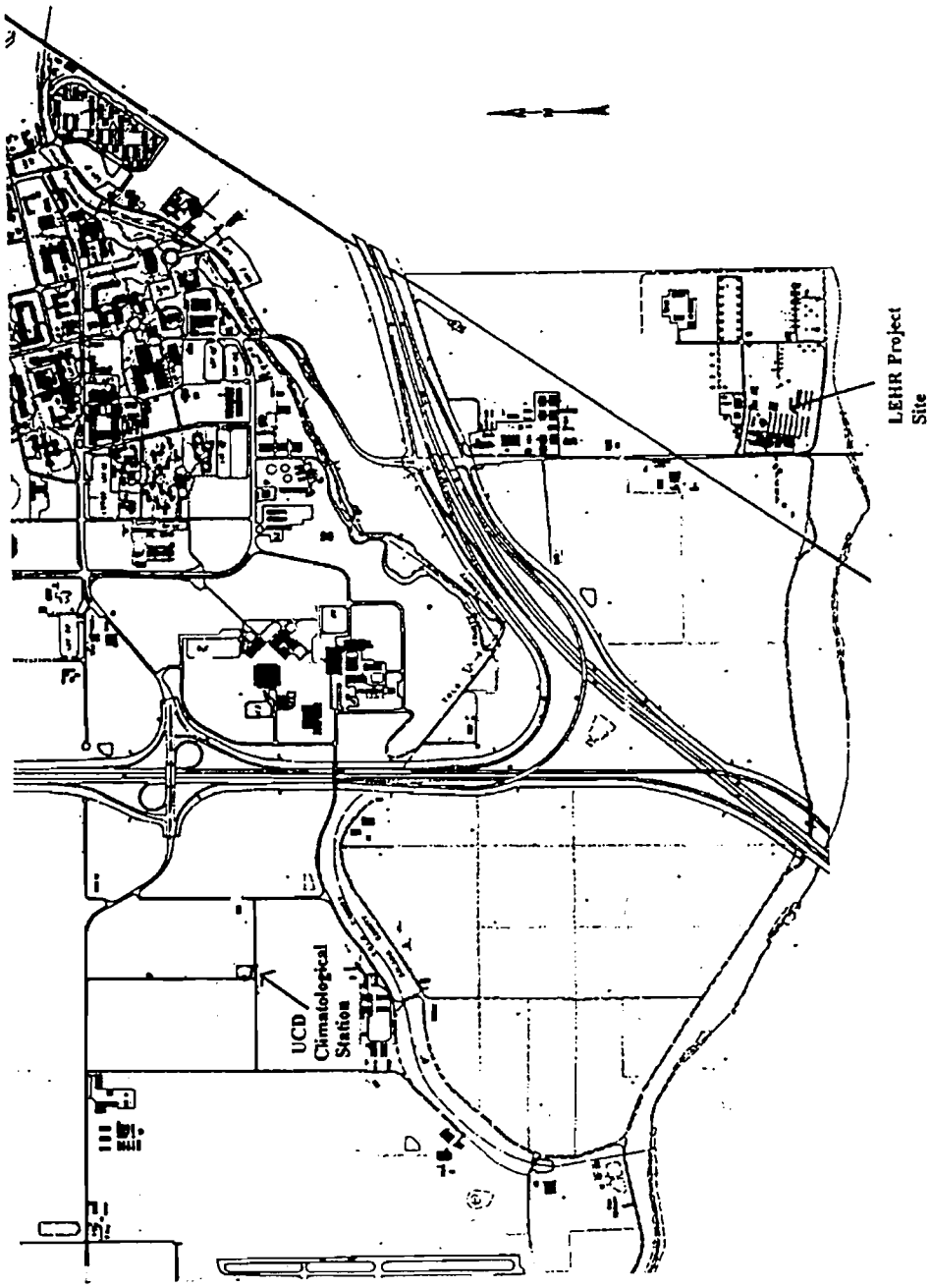

Figure
4.1
LOCATION
OF UCD
CLIMATOL
OGICAL
STATION

5.0 QUALITY ASSURANCE

Department of Energy Order 5400.1 requires that a QA program, consistent with the requirements of DOE Order 5700.6C be established for each element of the Environmental Monitoring and Surveillance Program. Requirements for quality assurance plans for the LEHR Environmental Monitoring and Surveillance Program are defined in the UCD LEHR ER WEQAP and other UCD LEHR ER Project internal operating procedures. The UCD WEQAP identifies controlling documents (DOE Orders); responsible organizations; policies, standards, and procedures that implement the requirements of the controlling documents; and applicable NQA-1 requirements with cross-referencing to DOE Orders and to the procedural requirements for the Environmental Monitoring and Surveillance Program at the LEHR Site.

Various UCD procedures for implementing the Environmental Monitoring and Surveillance Program at LEHR are in place or under development. These procedures will include all parts of the program from environmental media sampling to data reduction and dose calculations.

The UCD EH&S staff at the LEHR site has primary responsibility for implementation of the quality assurance program. This activity is supported by EMO and subcontractor organizations.

For the best QA, quality control (QC) must be present in all aspects of the sampling project. Quality control samples are run with each sample batch at the laboratory to validate the method of analysis and the proficiency of the technician. Because holding times are an important factor in the quality of the sample, these will be controlled within applicable limits. To ensure the comparability of the analytical data with previous and future data, all samples are analyzed by EPA-approved methods when available, including QA/QC procedures.

5.1 FIELD QUALITY ASSURANCE

UCD personnel routinely collect samples of various environmental media for analysis. QA of field sampling procedures is checked by using field duplicates, decontamination rinsates, trip blanks, and field blanks. Duplicates are collected to check for consistent sampling. Decontamination rinsates are analyzed to check for cross-contamination from sampling equipment. Trip blanks are sent with each shipment of volatiles to check for volatile contamination from other samples during shipment. Field blanks are collected to check for contamination during the sampling process. Blanks, rinsates, and duplicates are submitted to TMA/Eberline for QC of nonradiological analyses.

5.2 LABORATORY QUALITY ASSURANCE

Laboratories providing services to the Environmental Monitoring Program are evaluated by the UCD and EMO to assure compliance with the QA program requirements. The references to currently used laboratories does not signify that these are the only laboratories that can be used. The reference to current laboratories is to demonstrate that qualified laboratories are in use and to illustrate their QA programs. The use of a laboratory not referenced does not require a specific update to the document. Such changes are included during revisions required by other program changes or during the required 3 year update.

A limited number of environmental sample analyses are done by UCD. Most samples collected for radiological and chemical analysis are currently analyzed off-site by Controls for Environmental Pollution. The UCD EH&S Laboratory provides screening of air monitoring filters for gross alpha and gross beta counts. The TMA/Eberline laboratory is currently used for sample analysis intercomparisons.

Laboratory quality assurance is analyzed externally by the submission of split samples, spiked samples, and blanks to the laboratories performing analysis for environmental samples. Split samples will be sent for radionuclide and nonradionuclide analysis to a second laboratory regularly to cross check the precision of the laboratory. Deionized water will be sent as a blank occasionally to find background contamination from the laboratory.

Method QA is measured internally by using laboratory QC samples, including blanks, duplicates, surrogates, and standard reference materials. Quality control sample results will be included in data reports received from the laboratory.

5.2.1 University of California at Davis Laboratory

The UCD EH&S Laboratory, when used by trained UCD LEHR ER project personnel, provides screening of samples

for radioactive materials. QA is performed according to the requirements of the UCD LEHR ER WEQAP.

5.2.2 Primary Laboratory

Most radioactive and nonradioactive analyses are performed by Controls for Environmental Pollution, Inc. The EMO subcontractor that performs the groundwater and surface water monitoring use laboratories that are equivalent to the UCD-contracted laboratory. The QA program at Controls for Environmental Pollution is summarized as follows:

Analysts undergo an on-the-job training program. Training records for each technician are maintained by the laboratory. Analytical results of all QC samples are reviewed and compared by each analyst. All reagents, carrier, and radioactive QC solutions that are in regular use and critical to proper results are standardized monthly or prior to use, as appropriate.

All instruments are maintained through preventive maintenance programs. Each instrument is calibrated with traceable standard sources. If the calibration detects any anomaly from the routine performance of the instruments, no analysis is allowed to be performed by that instrument until it is functioning properly.

Quality assurance audits are periodically performed on each department to evaluate adherence to the Controls for Environmental Pollution, Inc., QA Plan. Results of these audits are provided to the area supervisors. Any observation reports or corrective action reports must be reviewed and a response made to the QC officer of Controls for Environmental Pollution, Inc.

Interlaboratory comparisons are conducted with the EPA and the U.S. Department of Energy Environmental Measurements Laboratory (EML). The Controls for Environmental Pollution, Inc. QA program is designed to comply with the requirements of the Nuclear Regulatory Commission specifications found in Regulatory Guide 4.15 (NRC 1980).

Laboratory quality control samples include blanks, duplicates, spikes, surrogates, and standard reference materials. Quality control sample results are included in all data reports received from the laboratory. A documented internal operating procedure used by the contract laboratory follows EPA standards for laboratory analyses. The following QC samples are analyzed by the contract laboratory.

Reagent Blank. The blank is an aliquot of deionized water that is treated as if it were a sample. The blank, where appropriate, should be subjected to a digestion, distillation, or any other pretreatment process required on the samples. The acceptance criteria for the blank is that it must be below the detection limit or, if the blank has a value, the only sample results that are acceptable must be 10 times the reported blank value. Any samples that are less than 10 times the value of the blank must be rerun.

Check Sample. The purpose of these samples is to verify the accuracy of the analytical technique. These check samples are obtained from the appropriate office of the EPA, from the state, or from a secondary source are prepared in the laboratory that was not used for the preparation of the calibration standards. The check sample should be subjected to any digestion, distillation, or other pretreatment process required on the samples. The acceptance criteria for these check samples is +15%. Should the results lie outside these limits, the supervisor will review further the acceptability of the data.

Relative Percentage Difference. The relative percentage difference (% RPD) is used for measurement of precision (or agreement) between two measurements (i.e., duplicates, repeats) made under identical test conditions. The calculation is as follows:

$$\% \text{ RPD} = \frac{S - D/(S + D)}{2} \times 100$$

where S is the sample measurement and D is the duplicate measurement

The acceptance criteria for such measurements are as follows:

a) If the sample values are less than five times the detection limit, the acceptable limit is ± the detection limit.

b) If the sample values are greater than five times the detection limit, the acceptable limit is ± 20% RPD.

c) If either sample value is below the detection limit, the %RPD is not calculated.

If any measurements lie outside these limits, they are determined to be "out of control" and the analysis must be rerun. One duplicate, where appropriate, should be run for every 10 samples per set submitted to the laboratory.

5.2.3 Comparison Laboratory

Independent data verification requirements for radionuclides were addressed by participation in the EML Quality Assurance Program in which samples are analyzed by Controls for Environmental Pollution, Inc., and EML.

6.0 LABORATORY PROCEDURES

Methods approved by the EPA are used by Controls for Environmental Pollution. The methods used for radioactive analytes are summarized below.

6.1 SAMPLE ANALYSIS

The EPA methods that are used for each nonradioactive analyte are listed in Table 6.1.

Table 6.1. Standard EPA Methods for Nonradiological Analysis

Analyte	EPA Method
Volatiles	8240, 8260
Semivolatiles	8270
Dioxins	8280
Pesticides, PCBs	8080
Herbicides	8150
TOC (total organic carbon)	9060, 415.1, ASTM D4129
TOX (total organic halide)	450.1
Ammonia	350.3
Nitrate	353.2
Nitrite	354.1
Cyanide	335.3
TSS (total suspended solids)	160.2
TDS (total dissolved solids)	160.1
Oil and grease	413.2
Sulfate	375.4
Chloride	325.2
Arsenic	206.2
Barium	6010, 200.7, 200.8
Cadmium	6010, 200.7, 200.8
Chromium	6010, 200.7, 200.8
Hexavalent chromium	18.5
Copper	6010, 200.7, 200.8
Lead	239.2
Mercury	245.1
Nickel	6010, 200.7, 200.8
Selenium	270.2
Silver	6010, 200.7, 200.8
Zinc	6010, 200.7, 200.8
Other Metals	6010, 200.7, 200.8
Ph	150.1
Specific Conductance	120.1
Fluoride	340.2

The standard methods used by Controls for Environmental Pollution, Inc., for radionuclide analysis are shown in Table 6.2.

Table 6.2. Methods and Instrumentation for Radionuclide Analysis

Radionuclide	Methods	Instrumentation
Carbon-14	HASL 300	LS5801 Liquid Scintillation counting system (Beckman Instrumentation)
Gamma Spectroscopy	HASL 300	Nuclear Data Genie Model ND9900 Gamma Spectrometer
Gross Alpha & Beta	HASL 300	Berthold 10 Channel Low-level Planchet Counting System
Isotopic Plutonium	HASL 300	Alpha Spectrometer, Canberra Model 7404 Quad Alpha

		Spectrometer connected to ND 9900 System
Radium-226 & -228	HASL 300	Nuclear Data Genie Model ND9900 Gamma Spectrometer
Total radium	HASL 300	Nuclear Data Genie Model ND9900 Gamma Spectrometer
Strontium-89 & -90	HASL 300	Numelec NU20 Low Background System
Isotopic Thorium	HASL 300	Alpha Spectrometer, Canberra Model 7404 Quad Alpha Spectrometer connected to ND 9900 System
Tritium (Azeotropic Distillation)	HASL 300	LS5801 Liquid Scintillation counting system (Beckman Instrumentation)

6.2 SAMPLE HOLDING TIMES

SW-846, "Test Methods for Evaluating Solid Waste Physical/Chemical Methods," Third ed., Revision 1, December 1987, was reviewed for applicable holding times. Holding times are an important part of the QA procedures. The sample holding times ensure that the analyte being analyzed is still present at the tame concentration as when the sample was taken. The sample holding times along with preservation and bottles that will be used in the monitoring program are presented in Table 6.3. Sample holding times for metals are 6 months except for mercury and hexavalent chromium. The holding time for mercury is 28 days. The holding time for hexavalent chromium is 24 hours. The holding times for ammonia, oil & grease, total organic carbon, chloride, and sulfate are all 28 days. Volatiles have a holding time of 14 days (7 days for nonpreserved samples) if there are no air bubbles in the sample; if there is an air bubble larger than a pea, the sample will not be analyzed. The holding time for semivolatiles, total dissolved, and suspended solids is 7 days.

6.3 CHAIN OF CUSTODY

All environmental monitoring samples remain under strict custody while on the LEHR site and are tracked with a chain-of-custody form any time they leave the custody of the field sampling crew. The environmental monitoring field personnel are experienced and knowledgeable in sampling. All activities are performed according to written procedures. When directed by the Environmental Monitoring and Surveillance Program lead person or an existing schedule, field personnel take a sample, number it, and attach a custody seal. The seal is placed such that the sample container cannot be opened without breaking the seal. A log book entry gives the sample number, date, time, location, analysis to be run, media, weather while sampling, and the personnel doing the sampling. The sample is placed in a cooler. The sample cooler remains with the crew or within a vehicle with the doors locked. The samples are taken to an appropriate locked storage area until they can be shipped to a laboratory.

When samples are removed from storage for shipment to a laboratory, a chain-of-custody form is completed and the custody form number is listed in the log book. The samples and the chain-of-custody forms are taken to a UCD laboratory or placed inside a custody-sealed container and delivered to UCD Central Stores Receiving Department for shipment. The UCD laboratory will check the chain-of-custody forms against samples received and check custody seals on samples. The person receiving the samples signs the chain-of-custody form, and the person releasing the samples returns a copy to the UCD EH&S personnel at LEHR for tracking purposes. UCD Central Stores Receiving keeps track of all internal move orders and the bills of lading for each shipment.

When the samples reach the contract laboratory, they are checked for custody seal, sample condition, and chain-of-custody form. A sample acknowledgment is sent from the contract laboratory to the UCD EH&S staff at LEHR, listing the samples received and the analysis requested. The sample acknowledgment is checked for completeness when received by the UCD EH&S staff at LEHR. A copy of the chain-of-custody is sent with all analysis results from the contractor or the UCD laboratory. A copy of the chain-of-custody form is on file with all data packages retained at the laboratories.

Table 6.3. Sample Preservation, Holding Times, and Bottles

Analysis	Preservation	Holding Time
Volatiles	cool to 4°C	14 days
Semivolatiles, PCBs	cool to 4°C	7 days
Herbicides, Pesticides		7 days
Metals	HNO_3	6 months
Mercury		28 days
Oil & Grease	H_2SO_4 cool to 4°C	28 days
Ammonia	H_2SO_4 cool to 4°C	28 days
Nitrate		48 hours
Total Organic Carbon	H_2SO_4 cool to 4°C	28 days
Total Organic Halogen	cool to 4°C	7 days
Total Suspended Solids	cool to 4°C	7 days
Total Dissolved Solids		7 days
Chloride		26 days
Sulfate		28 days
Hexavalent Chromium		24 hours

Table 6.3. continued

Analysis	Preservation	Holding Time
pH		14 days
Specific Conductance		28 days
Nitrite		48 hours
Radiological		6 months
Asbestos		6 months
Fluoride		28 days
Phosphate		28 days

Bottle	Label	Volume Used Per Analysis
2-40 ml. glass	organic	5 mls.
1/2 gal. glass	organic	1 L 500 mls. 35 mls.
70 ml. glass	organic	5 mls.
I L plastic	metals	50 mls. 100 mls.
I L glass	O&G	I L
1/2 L plastic	nutrient	100 mls.
70 ml. glass	nutrient	2 mls.
I L plastic	general	100 mls. 50 mls. 15 mls. 25 mls. 20 mls. 10 mls.

7.0 DATA MANAGEMENT AND ANALYSIS

7.1 TRACKING

Data tracking is maintained by UCD using a computer program based upon the database software package FoxPro™. UCD staff use personal computers to manage and track the data associated with the environmental monitoring program. Data reported for groundwater and surface water monitoring are also managed using this system.

7.2 DATA VALIDATION

Level III Data Quality Objectives are to be used for this plan, as defined in "Data Quality Objectives for Remedial Response Activities," EPA, March 1987, Appendix A. All QC results for the data (other than radioactivity data) will be checked by UCD EH&S staff to see if the results fall within specified limits. All external QC will be evaluated by UCD EH&S staff. Notations will be made, to accompany data, expressing the validity and any qualifiers of the data. The person performing the quality validation will initial and date the validation report and return the data report attached to the validation report.

7.3 DOSE CALCULATIONS

7.3.1 NESHAPS Compliance Calculations

NESHAP requires that the exposure level to off-site individuals at DOE sites be determined by using one of three EPA-approved atmospheric diffusion codes. The LEHR site currently uses the EPA approved CAP88-PC code for the calculation of the maximally exposed off-site individuals. Default meteorology data is from NOAA for the Sacramento Area.

7.3.2 Other Dose Calculations

Other dose calculations are performed according to procedures. The procedures are under development and will follow the guidance given in DOE Order 5400.5.

8.0 RECORDS AND REPORTS

8.1 RECORDS

All records required to document the environmental monitoring program are copied and maintained at the LEHR ER Project Office. Record copies are transferred to the Records Storage at the main EMO office in Richland, Washington. Records generation, handling, and storage will follow the EMO records standard procedure.

8.2 REPORTING REQUIREMENTS

There are several reports that must be produced annually in compliance with DOE orders and other applicable regulations. The most important of these reports are addressed below.

Annual Site Environmental Report - Required by DOE Order 5400.1.

The Annual Site Environmental Report characterizes the environmental status of the site for the previous calendar year, including review of the environmental monitoring programs and status of regulatory compliance. This report must be distributed by June 1 each year.

NESHAPS Report - Required by the Clean Air Act.

The EPA regulates airborne radioactive releases from the LEHR site through Subpart H of 40 CFR Part 61. An annual compliance report is due June 30 each year. This report is produced annually by the EMO and submitted through DOE/HQ to the EPA.

Preoperational Report - Required by DOE Order 5400.1.

Prior to the start-up of a new facility or process that has the potential for adverse environmental impact or that will process, release, or dispose of radioactive materials, a preoperational environmental assessment will be prepared. This report is produced as needed.

Annual Environmental Status Sheet - Required by DOE Order 5400.1.

An up-to-date summary of information regarding the environmental status of the LEHR site will be prepared and submitted to DOE/EH by April 1 each year through the AAO.

Radioactive Effluent and On-Site Discharge Data Report - Required by DOE Order 5400.1

Reports on radioactive effluents and on-site discharges will be submitted to the Waste Information Systems Branch, EG&G, Idaho, Inc., annually by April 1. A copy of the transmittal cover letter will be sent to EH-1.

Unusual Environmental Occurrence Reporting - Required by DOE Order 5400.1

If an abnormal situation is observed, a sample is obtained. The DOE requires formal reporting-of all occurrences, as described in DOE Order 5000.3A (DOE 1990d). If a employee on the LEHR site observes what can loosely be called an "abnormal situation," he or she is required to contact the UCD Emergency Response Services and the Project Manager or Project Health and Safety Officer. If a significant nonroutine release of any pollutant or hazardous substance, appropriate regulatory agencies notifications and reports will be prepared and submitted. The DOE Headquarters Emergency Operations Center will be notified followed by the required report of follow-up actions and resolution.

9.0 OPERATIONAL CONSIDERATIONS

DOE Order 5400.1 identified eleven elements necessary to assure that data of known quality is obtained. One of the eleven elements, human factors, is not addressed by the Quality Assurance Plan, as that plan is based on the eighteen elements of NQA-1 as identified by DOE Order 5700.6C. As the Environmental Monitoring Program must be dynamic to maintain consistency with the ever changing regulations and industry standards, then the staff becomes a key critical factor. This section describes the staff requirements as well as the support requirements needed to maximize the efficiency and quality performance of the staff.

9.1 STAFF

To collect and interpret annual environmental monitoring data according to DOE Order 5400.1, the following types of staff are required for the Environmental Monitoring and Surveillance Program:

Program Coordinator and alternate

Technical Specialists/Technicians
- Air
- Flora and biota
- Groundwater
- Geology/soils
- Surface water

Support Staff
- Clerical

Thus, 1 employee will coordinate the program with the assistance of other staff as required for sampling. Each staff member has additional duties in conjunction with the LEHR ER Project.

9.2 SUPPORT FUNCTION

9.2.1 Analytical Support

Current analytical support is provided by Controls for Environmental Pollution and screening by UCD laboratories.

9.2.2 Equipment Support

A variety of equipment is required to collect samples. Sample bottles are obtained from the analytical laboratory with required preservatives. A variety of sampling equipment is required to ensure proper and efficient sampling including:

- properly and safely equipped vehicles
- surface water sampling and decontamination equipment
- compressors and generators for operating portable pumps for sampling groundwater
- portable pH meters
- digging equipment for soil and sediment sampling
- clippers/shears for vegetation and crop sampling
- trailers for carrying large pieces or amounts of equipment
- analytical equipment for laboratory analysis.

The UCD EH&S staff at LEHR are responsible for controlling sample equipment and ensuring equipment is calibrated, if required, and maintained according to Environmental Monitoring and Surveillance Program procedures.

9.2.3 Facilities

Adequately sized and appropriately located and arranged office, laboratory, monitoring-trip preparation space, and supplies and equipment storage area will be provided and maintained by UCD as part of their subcontract with EMO.

10.0 COORDINATION WITH ACTIVITIES OF OTHER AGENCIES

10.1 STATE OF CALIFORNIA

The Groundwater and Surface Water Monitoring Implementation Plan will be coordinated with the regional Water Quality Control Board to avoid duplication of effort. Should air surveillance monitoring be initiated, it will be coordinated with State of California regional Air Resources Board activities.

11.0 PERIODIC REVIEW AND INTERIM UPDATES

This Plan shall be reviewed annually according to the requirements of DOE Order 5400.1. The annual review of this Plan shall be documented. Major updates to this plan will be prepared, approved, and issued when required. At a minimum this Plan will be updated every 3 years (as required by DOE Order 5400.1). Between major updates to the plan, amendments will be issued to change the environmental monitoring program as required by LEHR ER project activities.

11.1 INTERIM AMENDMENTS

Interim amendments to this Plan shall be issued to document changes in the LEHR ER Environmental Monitoring Program. Prior to the start of any project D&D or ER activity at LEHR, the need for additional or revised environmental monitoring or surveillance will be analyzed. An Interim Amendment will be issued to document this analysis. Prior to any D&D/ER activity at LEHR that requires environmental monitoring or surveillance outside the scope of this Plan and its amendments the appropriate environmental monitoring/surveillance will be started as specified in the appropriate interim amendment.

A standard outline shall be used for interim amendments to this Plan (see Table 11.1). If a specific element or section of the standard outline is not applicable, that section will be so marked in the Interim Amendment.

11.2 UPDATES

Interim amendments shall be incorporated into this Plan as part of each update. Updates to the plan shall be completed at a minimum of every 3 years.

11.3 METHOD OF REVIEW

The effluent monitoring and environmental surveillance activities included as part of the this plan will be reviewed prior to the initiation and following termination of LEHR ER Project activities that could effect the environment. Based on the applicable regulatory guidance, effluent monitoring and environmental surveillance activities may require revision.

Table 11.1. Format for Interim Amendments to the LEHR Environmental Monitoring Plan

1.0 INTRODUCTION

2.0 EFFLUENT MONITORING
- 2.1 LIQUID EFFLUENT MONITORING
- 2.2 AIRBORNE EFFLUENT MONITORING
- 2.3 SOLID WASTE EFFLUENT MONITORING

3.0 ENVIRONMENTAL SURVEILLANCE
- 3.1 AIR SAMPLING
- 3.2 SOIL SAMPLING
- 3.3 VEGETATION AND FAUNA
- 3.4 SURFACE WATER MONITORING
- 3.5 NONROUTINE SAMPLING
- 3.6 ENVIRONMENTAL DOSIMETRY

4.0 METEOROLOGICAL MONITORING

5.0 QUALITY ASSURANCE
- 5.1 FIELD QA
- 5.2 LABORATORY QA

6.0 LABORATORY PROCEDURES
- 6.1 SAMPLE ANALYSIS
- 6.2 SAMPLE HOLDING TIMES
- 6.3 CHAIN OF CUSTODY

7.0 DATA MANAGEMENT AND ANALYSIS
- 7.1 TRACKING
- 7.2 DATA VALIDATION
- 7.3 DOSE CALCULATIONS

8.0 RECORDS AND REPORTS
- 8.1 RECORDS
- 8.2 REPORTING REQUIREMENTS

9.0 OPERATIONAL CONSIDERATIONS

10.0 COORDINATION WITH ACTIVITIES OF OTHER AGENCIES
- 10.1 STATE OF CALIFORNIA
- 10.2 UNIVERSITY OF CALIFORNIA

REFERENCES

Given that historical (baseline) data is not available for many environmental media to be sampled, the fiscal year 1993 additions to the Environmental Monitoring and Surveillance Program have been designated conservatively. Once baseline information has been obtained it is expected that several environmental surveillance activities may be designated for reduced sampling frequency or terminated altogether. The evaluation for the consolidation of environmental surveillance activities will be based upon LEHR ER Project status and applicable regulations.

11.4 REVIEW AND APPROVAL PROCESS

Updates to this plan require the prior review and concurrence of DOE-SF. Interim Amendments to this plan do not require prior review and concurrence by DOE-SF. Interim amendments to this plan are provided to DOE-SF.

12.0 REFERENCES

Bechtel Environmental, Inc. (BEI). 1991. Characterization Report for Animal Hospital Buildings (AH 1 and AH 2). Prepared for Environmental Management Operations, Richland, Washington.

Chapman, T.E. 1992. Basis Information for the Environmental Monitoring and Surveillance Program for the Laboratory for Energy-Related Health Research. PNL-(DRAFT). Prepared for Environmental Management Operations by Pacific Northwest Laboratory, Richland, Washington.

Dames & Moore. 1992. Phase II Site Characterization Report, LEHR Environmental Restoration. Prepared for Environmental Management Operations, Richland, Washington.

Gray, R.H. (ed.) 1990. Environmental Monitoring, Restoration and Assessment: What Have We Learned? Proceedings of the Twenty-eighth Hanford Symposium. Pacific Northwest Laboratory, Richland, Washington.

U.S. Department of Energy (DOE). 1991a. Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance. DOE\EH-0173T. Washington, D.C.

U.S. Department of Energy (DOE). 1991b. Quality Assurance. DOE Order 5400.5. Washington, D.C.

U.S. Department of Energy (DOE). 1990a. General Environmental Monitoring Program. DOE Order 5400.1. Washington, D.C.

U.S Department of Energy (DOE). 1990b. Environmental Protection, Safety and Health Protection Information Reporting Requirements. DOE Order 5484.1, change 7. Washington, D.C.

U.S. Department of Energy (DOE). 1990c. Radiation Protection of the Public and the Environment. DOE Order 5400.5. Washington, D.C.

U.S. Department of Energy (DOE). 1990d. Occurrence Reporting and Processing of Operations Information. DOE Order 5000.3A. Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1990. Guidelines Establishing Test Procedures for the Analysis of Pollutants; Identification of Test Procedures. Protection of the Environment, 40 CFR 136.3. Office of the Federal Register, National Archives and Records Administration. Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1989. Statistical Analysis for Groundwater Monitoring Data at RCRA Facilities - Interim Final Guidance. Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1980. Quality Assurance for Radiological Monitoring Programs (Normal Operations) -- Effluent Streams and the Environment. Regulatory Guide 4.15. Washington, D.C.

Waite, D. A. 1973. An Analytical Technique for Distributing Air Sampling Locations Around Nuclear Facilities. BNWL-SA-4534. May 1973. Pacific Northwest Laboratories. Richland, Washington.

U.S. Code of Federal Regulations, Title 40, Part 61. 1992. National Emissions Standards for Hazardous Air Pollutants. U.S. Environmental Protection Agency. Washington, D.C.

ADDENDUM 1 TO
THE ENVIRONMENTAL MONITORING PLAN AT
THE LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH
UNIVERSITY OF CALIFORNIA, DAVIS

SEPTEMBER, 1992

Final

ADDENDUM 1 TO THE ENVIRONMENTAL MONITORING PLAN

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1.0 INTRODUCTION

This addendum serves as a specific plan for the environmental monitoring actions that will be performed during the decontamination and decommissioning (D&D) activities in AH-1 and AH-2 at the Laboratory for Energy-Related Health Research (LEHR).

This plan was prepared in accordance with the requirements of DOE Order 5400.1 Chapter IV. Battelle's Environmental Operations (EMO) is providing the U.S. Department of Energy (DOE) San Francisco Office (SF) with the management of an environmental restoration (ER) project at the Laboratory for Energy-Related Health Research (LEHR), University of California, Davis (UC Davis).

1.1 Description of Activities

Since 1951, DOE and its predecessor agencies funded UC Davis to investigate the biological effects of low levels of ionizing radiation. Both external (gamma and X-ray) and internal (^{90}Sr and ^{226}Ra) sources were used during these investigations. This DOE-sponsored research ended in 1988.

The LEHR facility is located approximately 1.5 miles south of the main UC Davis campus and the town of Davis on County Road 79 (Old Davis Road) in Solano County, California (See Figure 1.1) in a rural-type setting.

The site is located on approximately 15 acres and consists of 15 one-story and one two-story building which consists of laboratories, offices, and animal-handling facilities. Of the 15 acres, approximately 40 percent is paved with asphalt or concrete, or covered by structures. Approximately 30 percent of the site is unpaved and kept reasonably free of vegetation. The dog pen areas occupy approximately 20 percent of the LEHR facility and approximately 5 percent is heavily vegetated with large deep rooted vegetation (Dames & Moore 1992). Based on habitat present at LEHR, the site is potentially host to a variety of animals including many species of birds, mammals, several of which are burrowing species, and reptiles including snakes.

The major buildings and structures located on the LEHR site are shown in Figure 1.1.

The land is owned by the Regents of the University of California and leased to DOE. All structures at LEHR are owned by DOE. Also, located at the LEHR facility are two inactive landfills: the Old UC Davis Landfill, closed in 1986, and a campus and DOE low-level radioactive waste disposal site, closed in 1974. A third inactive landfill unit is located approximately 600 feet east of LEHR below the area currently occupied by the UC Davis Raptor Center.

The site is bounded to the north and east by UC Davis research facilities. The southern border of the LEHR facility is the northern levee of the South Fork of Putah Creek. Private land is adjacent to an surrounds UC Davis property on all sides. Most of the private land

is used for agricultural purposes.

The site is located on approximately 15 acres and consists of 15 one-story and one two-story building which consists of laboratories, offices, and animal-handling facilities. Of the 15 acres, approximately 40 percent is paved with asphalt or concrete, or covered by structures. Approximately 30 percent of the site is unpaved and kept reasonably free of vegetation. The dog pen areas occupy approximately 20 percent of the LEHR facility and approximately 5 percent is heavily vegetated with large deep rooted vegetation (Dames & Moore 1992). Based on habitat present at LEHR, the site is potentially host to a variety of animals including many species of birds, mammals, several of which are burrowing species, and reptiles including snakes.

The major buildings and structures located on the LEHR site are shown in Figure 1.1.

The land is owned by the Regents of the University of California and leased to DOE. All structures at LEHR are owned by DOE. Also, located at the LEHR facility are two inactive landfills: the Old UC Davis Landfill, closed in 1986, and a campus and DOE low-level radioactive waste disposal site, closed in 1974. A third inactive landfill unit is located approximately 600 feet east of LEHR below the area currently occupied by the UC Davis Raptor Center.

The site is bounded to the north and east by UC Davis research facilities. The southern border of the LEHR facility is the northern levee of the South Fork of Putah Creek. Private land is adjacent to an surrounds UC Davis property on all sides. Most of the private land is used for agricultural purposes.

The key aspects of the D&D work are summarized as follows:

- The scope of work addressed the two Animal Hospital Buildings, AH-1 and AH-2. It will involve complete decontamination of the buildings, which may include dismantlement, removal, and off-site disposal of contaminated equipment, components, and structures, decontamination of the remaining structure, and post-decontamination radiation and contamination surveys to verify compliance with DOE and State of California criteria for release to unrestricted use. Upon conclusion of these activities, EMO will arrange for confirmatory surveys.

- Renovation activities will be compete to the extent that the remaining facility structures are left in a safe condition for UC Davis reoccupation.

- All D&D activities performed by EMO contractors and subcontractors will be performed in accordance with approved written procedures, specifications, and work instructions.

- As applicable, D&D activities will be conducted in accordance with approved written procedures which will provide direction to maintain radiation exposures and

releases of radioactive materials to unrestricted locations As-Low-As-Reasonable Achievable (ALARA).

- D&D activities will be conducted in accordance with the California Division of Industrial Safety Construction Safety Orders, Title 8, Subchapter 4, of the California Code of Regulations.

- All radioactive waste generated during D&D is expected to be Category 8 waste and will be disposed of at DOE's Hanford, WA disposal site.

- Since there is no hazardous waste, as defined by the Resource Conservation and Recovery Act (RCRA) anticipated in AH-1 and AH-2, no radioactive mixed waste (RMW) is expected to be generated. Radiologically contaminated asbestos, a Toxic Substance Control Act (TSCA) waste, will be encountered and will be processed as low-level radioactive waste (LLW). In the event a CERCLA hazardous waste is encountered, Bechtel will meet all Environmental Protection Agency (EPA) and disposal site requirements in disposing of this waste. Compliance with these requirements should not adversely impact decommissioning activities and schedules.

- Solid waste will be completely characterized and packaged before leaving the controlled area within the building to be stored in the waste staging or holding facility (Geriatrics 1). The waste packages will be radiologically surveyed prior to leaving the controlled area to confirm that they are within releasable standards as defined by the DOE Rad Con Manual (see Table 1).

Decontamination operations and the disassembly/segmentation and removal of radioactively contaminated items will require the application of contamination control devices and methods. The existing plant air filtration system be maintained, where possible, to provide contamination control coverage. Each system includes rigid ducting directed to specific rooms, areas, and/or pieces of equipment. When the system is no longer needed, the contaminated sections will be dismantled, using its own filtering capability to control the spread of contamination during dismantlement.

The present system may not always provide adequate contamination control for localized uses. Portable HEPA-filtered ventilation units will be used to provide additional contamination-control ventilation, either in conjunction with the facility systems or as independent systems. Portable HEPA-filtered ventilation systems will be used to maintain tented work areas in which airborne radioactivity may be produced at a negative pressure with respect to the surrounding areas. The exhaust from the tented work area will be extracted through two HEPA filters used in series. This redundant use of HEPA filters with 99.9% efficiency (DOS tested prior to use) should assure the surrounding areas will not be adversely impacted because of the work. High-efficiency HEPA filtered vacuum cleaners will also be utilized for small volume contamination control, as well as for loose surface contamination removal operations.

1.2 Level of Contamination

The results of the radiation surveys indicate that the primary sources of radioactive contamination are contained on the inside surfaces of the dog cages and in associated drain and HVAC systems in each building, with beta activity levels up to $>10^6$ dpm/100 cm^2 and alpha activity levels 10,000 dpm/100 cm^2. Localized spots of elevated activity (slightly above unrestricted release criteria) were noted outside of each of the buildings on the roofs, on the walls, and in gutters and downspout. Extensive contamination levels were measured on floors and inside lab equipment in Rooms 209,211,212, and 219 of Building H-219 (AH-1). The primary contaminant is beta (Strontium-90), except in Room 219 which is extensively alpha contaminated (Thorium-228). Most of the contamination is "fixed", with most locations surveyed indicating no removable activity at levels above the criteria for unrestricted release.

The results of the asbestos analysis indicate that asbestos is present in the floor tile and/or mastic backing, wallboard tape and grout, piping insulation, and roofing layers. The asbestos material content is estimate at approximately 600 ft.

2.0 EFFLUENT MONITORING

2.1 Liquid Effluent Monitoring

Liquid and Solid Waste effluent monitoring are not applicable to the D&D activities because it is not expected there will be any solid effluent generated from the D&D activities.

2.2 Air Effluent Monitoring

Based on the discharge source for D&D activities, NESHAP modelling calculations have been done (see Section 7.2 on Dose Calculation for summary). These calculations determined the effluent to be below the criteria in which continuous air sampling, per EPA standards and requirements, is necessary. Air sampling will be conducted either at the release stack or release location from the building (see Figure #2). This periodic sampling fills the requirements of NESHAPS periodic confirmatory sampling requirements. Air samples will be taken periodically for a continuous working period of time (approximately 8 to 10 hours). The air sample will be collected at the discharge points for the buildings ventilation system (AH-1 has two and AH-2 has one) or at HEPA discharge of the tent if work is being performed outside of the building. The samples will be screened at the UC Davis EH&S laboratory or sent for full analysis to an outside laboratory or sent for full analysis to an outside laboratory. Three Allegro A-100 high Volume air samplers will be used to draw samples. The filters that will be used for screening by in-house laboratory are Millipore GS, 0.22 uM pore and Nucleopore with 0.8 uM pores (if other filters are used, these will be fore more accurate analysis). For

samples to be sent to an outside laboratory, the filter for asbestos[1] will be a cellulose filter or equivalent. For the Radionuclides a 2" fiberglass filter supplied by the outside laboratory or an equivalent that is acceptable for analysis. The number of samples to be analyzed is dependent on the length of time that D&D activities last.

The sampling and analysis regime is as follows:

Prior to any effluent being produced by the D&D, two sets of baseline air samples will be taken. The first will be sent to an outside laboratory and the second will be screened at the in-house laboratory.

For the first 2 months, sampling events will take place once a week during the most active time of discharge. If the discharge is expected to be consistent for that week, a day will be selected randomly. Three of the samples in the month will be screened at the in-house lab and one will be sent to outside laboratory for analysis. The screening will consist of analyses for alpha, beta and gamma and will look primarily for Radium 226, Strontium 90, Cesium 137, and Plutonium 241. Screening will be done on the Baird/Accucount Planchet counter, the Wallac 1410 Pharmacia LSC and/or the Beckman LS 1701 LSC. The outside laboratory analysis will consist of gamma spectrum, Strontium 90, Plutonium 241, nuisance dust and asbestos.[1] Because of the absence of any hazardous waste in the buildings, chemical constituents will not be analyzed; however, if any are detected in the process of D&D through health and safety monitoring inside the building, the analyses list will be changed to look for chemical constituents of concern.

An evaluation of air sampling requirements will be performed following the second month. Based on sample results and the work scope, and with the agreement of DOE, sampling will be conducted bi-monthly instead of every week. Sampling may also be reduced if the scope of work is reduced and evaluation indicates that a reduction would be acceptable. Sampling will be continued as done previously; however, sampling will be conducted bimonthly instead of every week. As performed before, three of the samples will be screened by the UC Davis lab and one will be sent to an outside laboratory.

3.0 ENVIRONMENTAL SURVEILLANCE

3.1 Air Monitoring

Since the Effluent emissions modeling indicate that the emissions are HE <.01 (HE equals calculated maximum dose from emissions in a year to Members of the Public) and effluent monitoring will be performed at release point to the environment, the air sampling for

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1 Collection and analysis of asbestos samples will be done during the asbestos removal activities. Asbestos removed from the building will be manifest per the receiving state (Washington) which doesn't recognize it as a hazardous waste.

surveillance will be the same as indicated in the overall Environmental Monitoring Plan (EMP).

3.2 Soil Monitoring

Soil Monitoring will be initiated if effluent air monitoring shows emissions above action levels listed in Table 2 which were derived from the standard of 0.1 mrem/yr. Monthly soil samples will betaken at two (SS-AS-1 and SS-AS-2) of the nine location s indicated in the EMP. The soil sampling locations selection was chosen based on prevailing wind directions (NNE and NW) and measurements from the UC Davis Climatological Station to give the best representation of disposition to survey soils. Surface soil (.25-5 in) samples will be taken using the Lab Safety Backsaver System which includes the backsaver handle 26" backsaver extension, and 12" L zero contamination tubes with liners. Samples will be taken at SS-AS-1 and SS-AS-2 before work begins and retained. These samples will be considered background samples and will be sent along with the first set of soil samples for analyses if soil sampling becomes necessary. The samples will be sent to the outside laboratory. The analyses will consist of gamma spectrum, Strontium 90, and Plutonium 241. Because of the absence of any hazardous waste in the buildings which will undergo D&D, chemical constituents will not be looked for in the analyses; however, if any are detected in the process of D&D through monitoring for health and safety reasons inside the building, the analyses will be changed to look for those chemical constituents.

3.3 Vegetation, Surface and Groundwater Monitoring

Vegetation, surface water, and groundwater monitoring are not applicable to this specific activity but is addressed in the EMP. As indicated in the description, the primary activities will be limited to the inside of the building. No doors or windows will be open during any activities which produce particulate that would escape to the environment. The buildings' existing ventilation system will be used as well as portable two-HEPA filters used in series attached to he tents to contain any contaminants. The effect from the D&D activities would be from air effluent deposition to soil or water with rain creating run off. The air effluent is being monitored and air action levels indicated by air effluent analysis. Soil will be monitored also. Monitoring of the air effluent gives much better indications of any impact to the environment from D&D activities then monitoring for vegetation or surface and groundwater.

3.4 Environmental Dosimetry

Thermoluminescent Dosimeter (TLD) locations are specified on Figure 5 A-C. Several of these locations have been selected to represent the dose to the nearest public population which is the UC Davis employee at the Institute for Toxicology and Environmental Health. These TLDs are kept in the same location. These locations are inspected weekly to verify that the TLDs are in place and intact. If a TLD has been damaged or removed it will be noted in the log and reported. One set of TLDs will be exchanged monthly while the

other will be exchanged quarterly. The exchanges of the TLDs are indicated on the figures (Figures 5 A-C). The TLD schedule will remain constant even without any activities and will allow a background reading to be taken before and after activities.

Attachment 1 is the Radiation Detection Company (RDC) procedure for reading TLDs. RDC is a NVLAP certified lab and complies with the criteria involved with that program. Figure 3 is a copy of the report format received from RDC and Figure 4 is the report format used to report the result in the annual report.

The data is reviewed by the UC Davis Health & Safety Officer and UC Davis lead person for environmental monitoring. After validation and verification, the data is reviewed by EMO staff.

4.0 METEOROLOGICAL MONITORING

DOE Order 5400.1 contains the meteorological requirements for DOE facilities. Site meteorological facilities are intended to support impact assessments, environmental surveillance activities, and emergency response and dose assessment programs. The UC Davis Office of Environmental Health & Safety has required summary information for most of the meteorological data needs for the LEHR site. Meteorological data are also required for the assessment of dose from potential radiological releases from the LEHR facility in compliance with EPA's NESHAP program.

The UC Davis Department of Land, Air and Water Resources operates a National Oceanic and Atmospheric Administration (NOAA) reference Climatological Station for the National Weather Service on the CU Davis Campus. This meteorological monitoring station is located approximately two and on-quarter miles northeast of the LEHR site (See Figure 4.1) and has been in operation since the early 1920's. The State of California Air Resources Board also uses the UC Davis Climatological Station for air quality measurements. Due to the low probability of airborne releases and relatively even terrain of the campus area, the use of this single, off-site monitoring station is considered adequate and all met data will be obtained from this station and included in the Annual Environmental Report.

5.0 QUALITY ASSURANCE

5.1 Field Quality Assurance

The field measurements and sample collection will comply with the UC Davis Quality Assurance Project Plan (WEQAP). This plan meets the requirements of NQA-1 and QAMS 5.

5.2 Laboratory Quality Assurance

The samples screened in the UC Davis laboratory will comply with and follow the UC Davis WEQAP. This plan meets the requirements of NQA-1 and QAMS 5.

The samples analyzed by the outside laboratory will comply with the lab's Quality Assurance plan which meets the requirements of NQA-1 and QAMS 5.

6.0 LABORATORY PROCEDURES

6.1 UC Davis Lab

The UC Davis laboratory will provide screening for radiologic analysis only.

UC Davis will use their Procedure for Sample Collection and Screening for sample collection and preparations.

The operating manual is used in conjunction with documented on the job training of lab workers for the use and operation of the instruments.

The instruments to be used are as follows: Baird/Accucount Planchet counter, the Wallac 1410 Pharmacia LSC and/or Beckman LS1701 LSC.

Sample holding time for radiological samples is 6 months. Samples will be analyzed within 48 hours.

UC Davis Form #12: "Record of Use of Environmental Health and Safety LSC 11/1/92". See Figure 6 for example.

6.2 Outside Laboratory[2]

The primary outside laboratory is Controls for Environmental Pollution (CEP). The secondary or backup laboratory is TMA-Eberline; this laboratory may also be used for quality assurance checks or if for some reason the primary laboratory can not provide the service needed.

Attachment 2 lists the methods CEP uses in their analysis.

The samples will be sent by UPS to the CEP laboratory with in 48 of the day they were taken to avoid missing holding times; however, since there is a six month holding time for both asbestos and radionuclides, there should not be a problem meeting the holding times.

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2 Outside lab may be changed at the discretion of the implementing contractor with concurrence from EMO as long as the new lab meets the requirements of the LEHR Environmental Monitoring Plan and NQA-1.

The "Procedure and Protocol for Packaging and Shipping Samples for Analysis:" will be used for shipping samples to CEP. See Figure 7 for an example of CEP chain of custody.

7.0 DATA MANAGEMENT AND ANALYSIS

Once samples are sent to the lab, the "chain of custody" (COC) should be put in a "pending" or "awaiting results" file. When the COC is placed in the file, the results due date will be printed at the top of the form. This date should be based on the laboratory consultation of lab turn around for each sample or set of samples. A calendar associated with these results should be filled in with the sample number, date sent in and date results are to be received. This calendar is to be checked weekly. If sample results are not received, the laboratory should be contacted about the delay and the date that the sample result should arrive is corrected on the COC and calendar.

All the data will be checked per the UC Davis WEQAP for consistency and applicability. The data will then be entered into a database which will be used to track data. The original results will be maintained in the Battelle EMO LEHR project files. After enough data points have been generated and entered into the database, this information can be used for statistical and trend analyses. FOXPRO is the database software to be used.

7.1 Data Validation

Level III Data Quality Objectives are to be used for this plan, as defined in "Data Quality Objectives for Remedial Response Activities," EPA, March 1987, Appendix A. All QC results for the data (other than radioactivity data) will be checked by UC Davis EH&S staff to see if the results fall within specified limits. All external QC will be evaluated by UC Davis EH&S staff. Notations will be made, to accompany data, expressing the validity and any qualifiers of the data. The person performing the quality validation will initial and date the validation report and return the data report attached to the validation report. EMO will also be notified of all data points which do not fall within the specified limits and what actions are being taken to correct and validate the data.

7.2 Dose Calculation

The NESHAPS calculation summary for the potential release term associated with AH-1/AH-2 D&D activities is as follows. This evaluation was completed using the EPA computer code CAP88.PC. The evaluation considered three release cases from most conservative to more realistic. These cases are:

Case I: Entire radiological source in AH-1 and AH-2 is rendered airborne and discharged through unfiltered building stacks.

Case II: 10% of the source is rendered airborne (conservative since majority of activity is fixed) and discharged through unfiltered building stacks.

Case III: 10% of the source is rendered airborne and discharged through building filtration, with a particulate efficiency of 95%, prior to discharge through the building stacks.

The results of this calculation are compared to the NESHAPS limit of 10 mrem/yr. as follows:

Case	Dose (m/Rem/yr)	% of NESHAPS
I	0.59	~ 6
II	0.059	~ 0.6
III	0.003	~ 0.03

It should be noted that the use of double HEPA filtration (with 99.97% efficiency per stage) on work enclosures inside the building will further reduce the dose consequences to an insignificant level. See Attachment 3 for details of calculations.

8.0 RECORDS AND REPORTS

8.1 Records

Records will be maintained by UC Davis staff per the UC Davis WEQAP, Section 17 which will be updated to comply with DOE 5700.6C by 1Q FY93. These records are copied (at a minimum) annually and the originals are sent to EMO records.

8.2 Reports

Data for this activity will be incorporated into the annual Site Environmental Report.

9.0 COORDINATION WITH ACTIVITIES OF OTHER AGENCIES

9.1 Points of Contact

The following are the points of contact:

DOE/SF	Roger Liddle Ed Ballard	510/273-6439 510/273-7967
Battelle-EMO	Salem Attiga Dawn Mitchell	916/752-5459 916/752-4023
UC Davis	Carl Foreman Christine Judal	916/752-4959 916/752-9591

10.0 REFERENCES

1. Bechtel Environmental, Inc. (BEI). 1991. Characterization Report for Animal Hospital Buildings (AH 1 and AH 2). Prepared for Environmental Management Operations, Richland, Washington.

2. Bechtel Environmental, Inc. (BEI). 1992. Decontamination and Decommissioning Work Plan for the Animal Hospital Buildings (AH 1 and AH 2). Prepared for Environmental Management Operations, Richland, Washington.

3. Chapman, T.E. 1992. Basis Information for the Environmental Monitoring and Surveillance Program for the Laboratory for Energy-Related Health Research. PNL-(DRAFT). Prepared for Environmental Management Operations by Pacific Northwest Laboratory, Richland, Washington.

4. Dames & Moore. 1992. Phase II Site Characterization Report, LEHR Environmental Restoration. Prepared for Environmental Management Operations, Richland, Washington.

5. U.S. Department of Energy (DOE). 1991a. Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance. DOE/EH-0173T. Washington, D.C.

6. U.S. Department of Energy (DOE). 1991b. Quality Assurance. DOE Order 5400.5. Washington, D.C.

7. U.S. Department of Energy (DOE). 1990a. General Environmental Monitoring Program. DOE Order 5400.1. Washington, D.C.

8. U.S. Department of Energy (DOE). 1990b. Radiation Protection of the Public and the Environment. DOE Order 5400.5. Washington, D.C.

9. U.S. Code of Federal Regulations, Title 40, Part 61. 1992. National Emissions Standards for Hazardous Air Pollutants. U.S. Environmental Protection Agency. Washington, D.C.

10. UC Davis Procedure for Sample Collection and Screening.

11. UC Davis Procedure for Packaging and Shipping for Analysis.

Table 1 Summary of Residual Contamination Guidelines

Table 1-1

Summary of Residual Contamination Guidelines

BASIC DOSE LIMITS

The basic limit for the annual radiation dose received by an individual member of the general public is 100 mrem/yr.

SOIL (LAND) GUIDELINES (MAXIMUM LIMITS FOR UNRESTRICTED USE)

Radionuclides	Soil Concentration (pCi/g) above background
Radium-226 Radium-228 Thorium-230	5 pCi/g, averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over any 15 cm thick soil layer below the surface layer
Other radionuclides	Soil guidelines will be calculated on a site-specific basis using derivations given in DOE/CH-8901 (Ref. 4).

STRUCTURE GUIDELINES (MAXIMUM LIMITS FOR UNRESTRICTED USE)

Airborne Radon Decay Products

Generic guidelines for concentrations of airborne radon decay products shall apply to existing occupied or habitable structures on private property that are intended for unrestricted use; structures that may be demolished or buried are excluded. The applicable generic guideline (40 CFR 192) is: In any occupied habitable building, the objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL. In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL. Remedial actions are not required in order to comply with this guideline when there is reasonable assurance that residual radioactive materials are not the cause.

External Gamma Radiation

The average level of gamma radiation inside a building or habitable structure on a site to be released for unrestricted use shall not exceed the background level by more than 20 μR/h.

Table 1 (Continued)

Table 1-1 (continued)

TOTAL 2/3/ NUCLIDE 1/	REMOVABLE 2/4/	FIXED PLUS REMOVABLE 2/
U-nat, U-235, U-238, and associated decay products	1,000 dpm α/100 cm²	5,000 dpm α/100 cm²
Transuranics, Ra-226 Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20 dpm/100 cm²	100 dpm/100 cm²
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200 dpm/100 cm²	1,000 dpm/100 cm²
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission), except Sr-90 and other noted above 5/	1,000 dpm β-γ/100 cm²	5,000 dpm β-γ/100 cm²

1/ Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

2/ As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

3/ The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm² is less than three times the guide values. For purposes of averaging, any square meter of surface shall be considered to be above the activity guide G if: (1) from measurements of representative number n of sections it is determined that $1/n \sum_{i=1}^{n} S_i \geq G$, where S_i is the dis/min-100 cm² determined from measurements of section i, or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm² area exceeds 3 G.

4/ The amount of removable radioactive material per 100 cm² of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. (Note - the use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm² is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. Except for transuranics and Ra-226, Ra-228, Ac-227, Th-228, Th-230, and Pa-231 alpha emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

5/ This category of radionuclides mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

Table 2 Action Levels from Air Effluent Monitoring Which Trigger Soil Sampling

	Stack 1 (Ci/m^3)	Stack 2 (Ci/m^3)	Stack 3 (Ci/m^3)
Sr-90	2.83E-03	7.15E-03	4.35E-05
Ra-226			7.86E-04
Th-228	9.42E-06	2.38E-05	

When any of these action levels are reached, then calculations should be performed to determine projected dose equivalents. If these calculations project that the 0.1 mrem/yr. dose equivalent may be reached, then soil sampling should be initiated.

LEHR Plot Plan

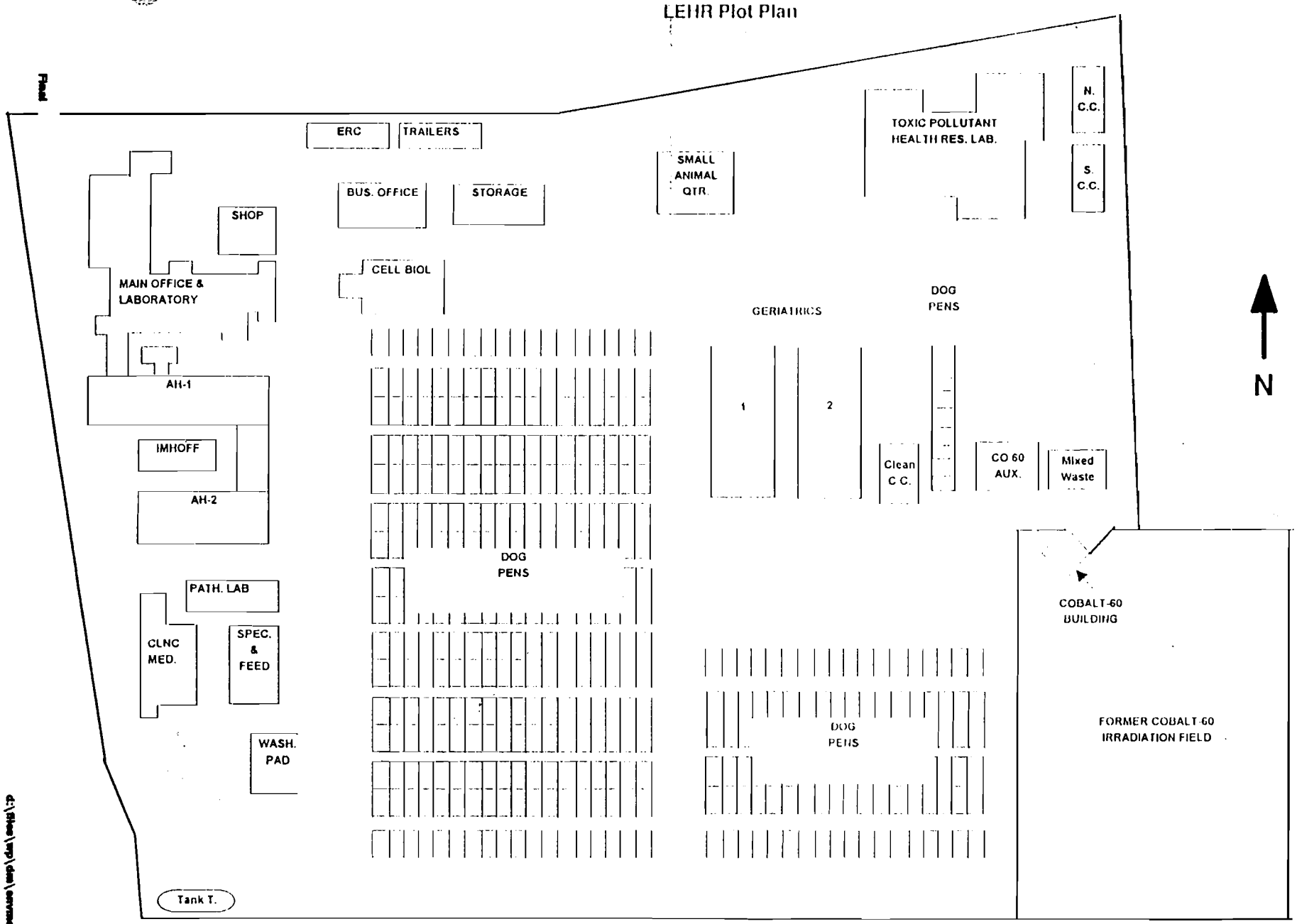

Figure 1 LEHR Plot Plan

NOT TO SCALE

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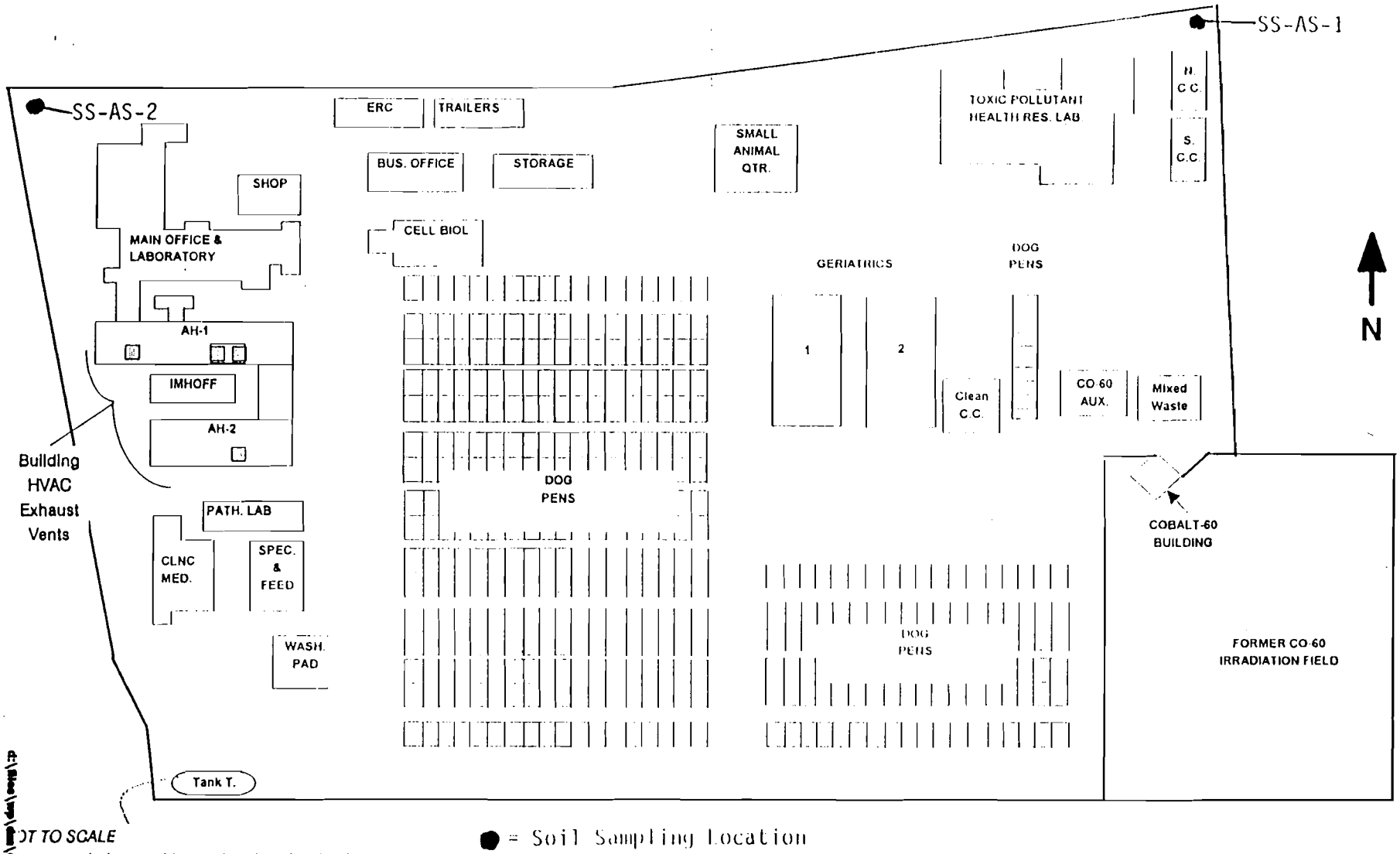
Figure 2 Diagram of Release Stack



NOT TO SCALE

● = Soil Sampling Location

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UNIVERSITY OF CALIFORNIA
ENVIRON HLTH & SAFETY TB30
ATTN VICKI BROWNLEE
CALIFORNIA AVENUE
DAVIS CA 95616

SA

Radiation Detection Company

P.O. BOX 1414 • SUNNYVALE, CALIFORNIA 94088
PHONE (408) 735 8700
FAX: (408) 735 0126

ACCOUNT NUMBER	TASK NUMBER
2035	02

2	4
01/92	30/92

JZ
209

NVLAP

Patrice

DOSIMETRY REPORT

FREQUENCY: MONTHLY

THIS REPORT IS SUBJECT TO STATE OFFICIAL INSPECTION

DOS TD 0	SOCIAL SECURITY NUMBER 1	DATE OF BIRTH 2	NAME OR LOCATION 3	BADGE NUMBER 4	FREQ 5	Deep X-Gamma 6	Deep Neutron 7	Shallow 8	OTHER START DATE 9	Deep 10	Shallow 11	Deep 12	Shallow 13	Deep 14	Shallow 15
01			BULLETIN BOARD	9901		0		0		0	0	0	0	0	0
01			DESK	9902		0		0		0	0	0	0	0	0
01			FREEZER	9903		0		0		0	0	0	0	450	450
01			CALLIBRATOR W	9904		0		0		0	0	0	0	0	0
01			KITCHEN	9905		0		0		0	0	0	0	0	0

Hal M Ross Mgr. Dosimetry Operations

RADIATION WORK CODES ARE DESCRIBED OTHERWISE [illegible]

Figure 3 Example of RDC Report

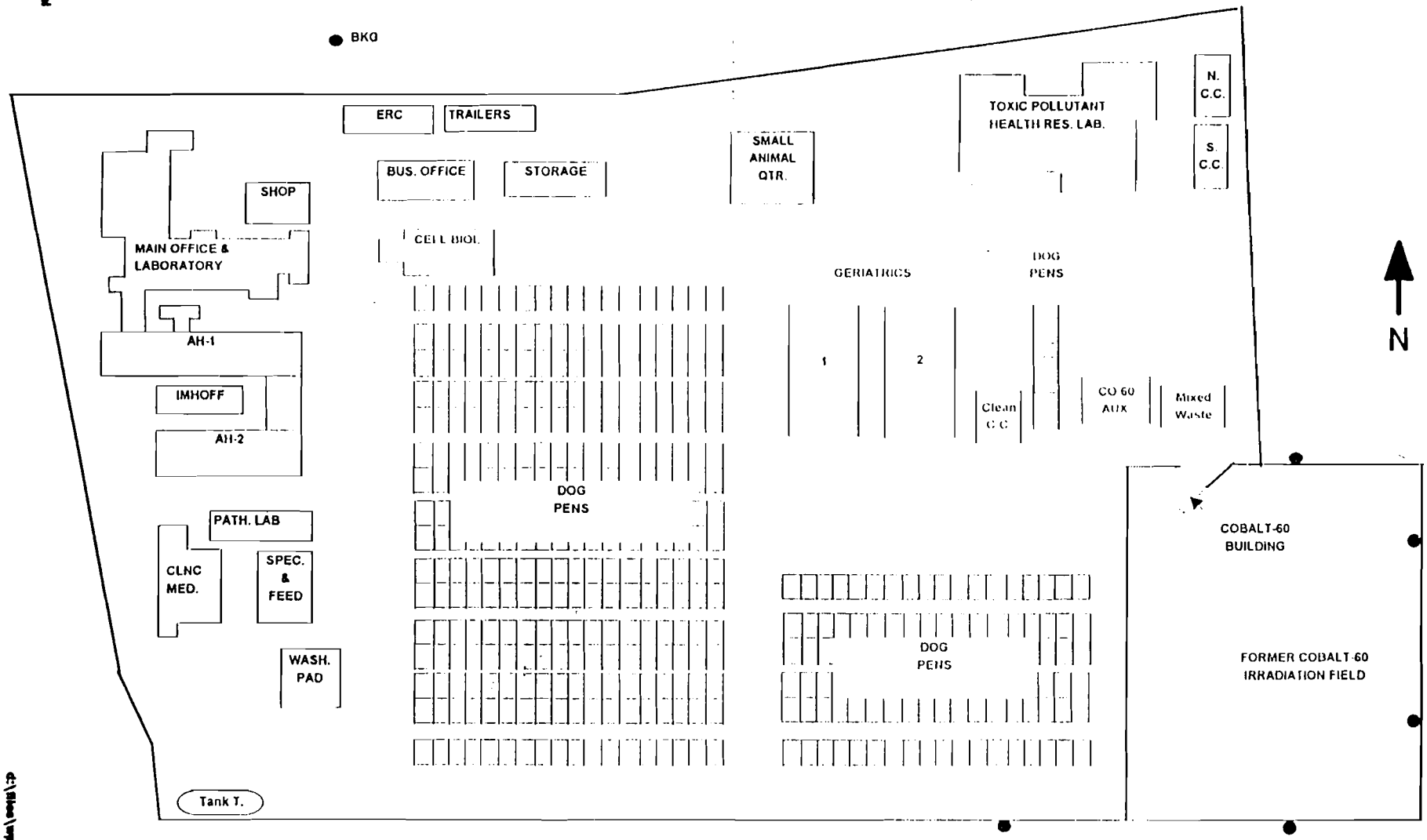
Figure 4 Example of TLD Results in Annual Report

(Results in mrem)

EXPOSURE PERIOD	SEPT 91	OCT 91	NOV 91	DEC 91	TOTAL 1991
AH-2 North	N/A	0	0	0	0.00
Geriatrics I East	0	N/A	0	0	0.00
Geriatrics I North	NE/NW	0	0	0	0.00
Geriatrics I South	0	0	0	0	0.00
Geriatrics I West	0	0	0	0	0.00
Imhoff Fence	--	0	0	0	0.00
Mixed Waste	N/A	0	0	0	0.00
Rad Storage N.E.	N/A	0	0	20	20.00
Rad Storage S.E.	N/A	20	30	25	75.00
S.W. Corner	N/A	0	0	0	0.00
Geriatrics NW*	0	N/A	N/A	N/A	0.00
Geriatrics NE*	0	N/A	N/A	N/A	0.00
Imhoff North*	0	N/A	N/A	N/A	0.00
Imhoff South*	0	N/A	N/A	N/A	0.00
Imhoff West*	0	N/A	N/A	N/A	0.00
Gate*	0	N/A	N/A	N/A	0.00
Pole*	0	N/A	N/A	N/A	0.00
RT[1]	0	N/A	N/A	N/A	0.00
Control	N/A	0	0	0	0.00
Background	0	0	0	0	0.00

* Indicates initial dosimeter sites that were changed or discontinued.
[1] Temp only, not part of the original or continued group.

Figure 5A TLD Locations for Group 63



● = Environmental Dosimeter Location

Exchanged Quarterly

NOT TO SCALE

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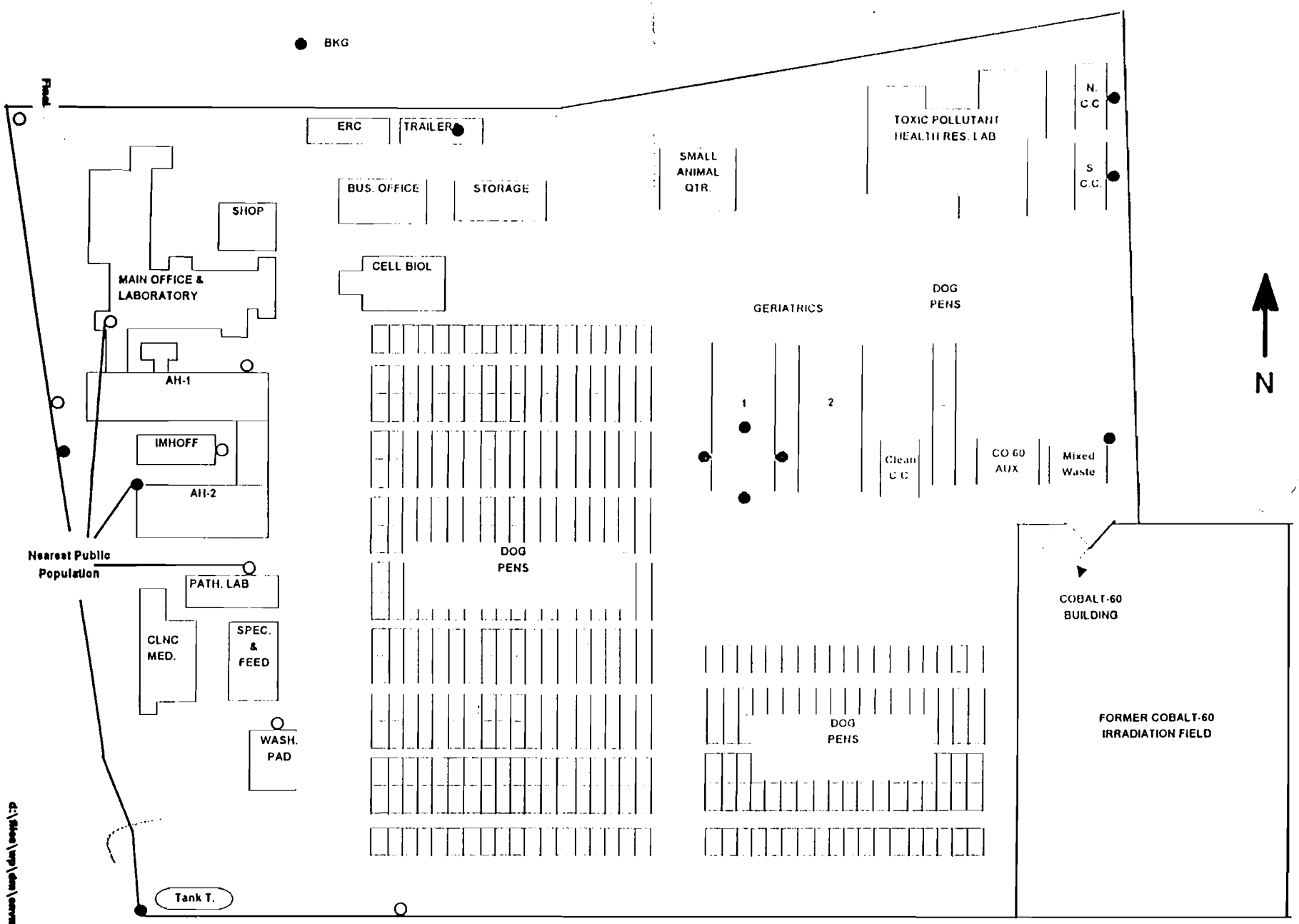

● = Environmental Dosimeter Location

○ = Temporary Dosimeter Location for D&D Work

NOT TO SCALE

Two Sets: One exchanged monthly and the other exchanged quarterly.

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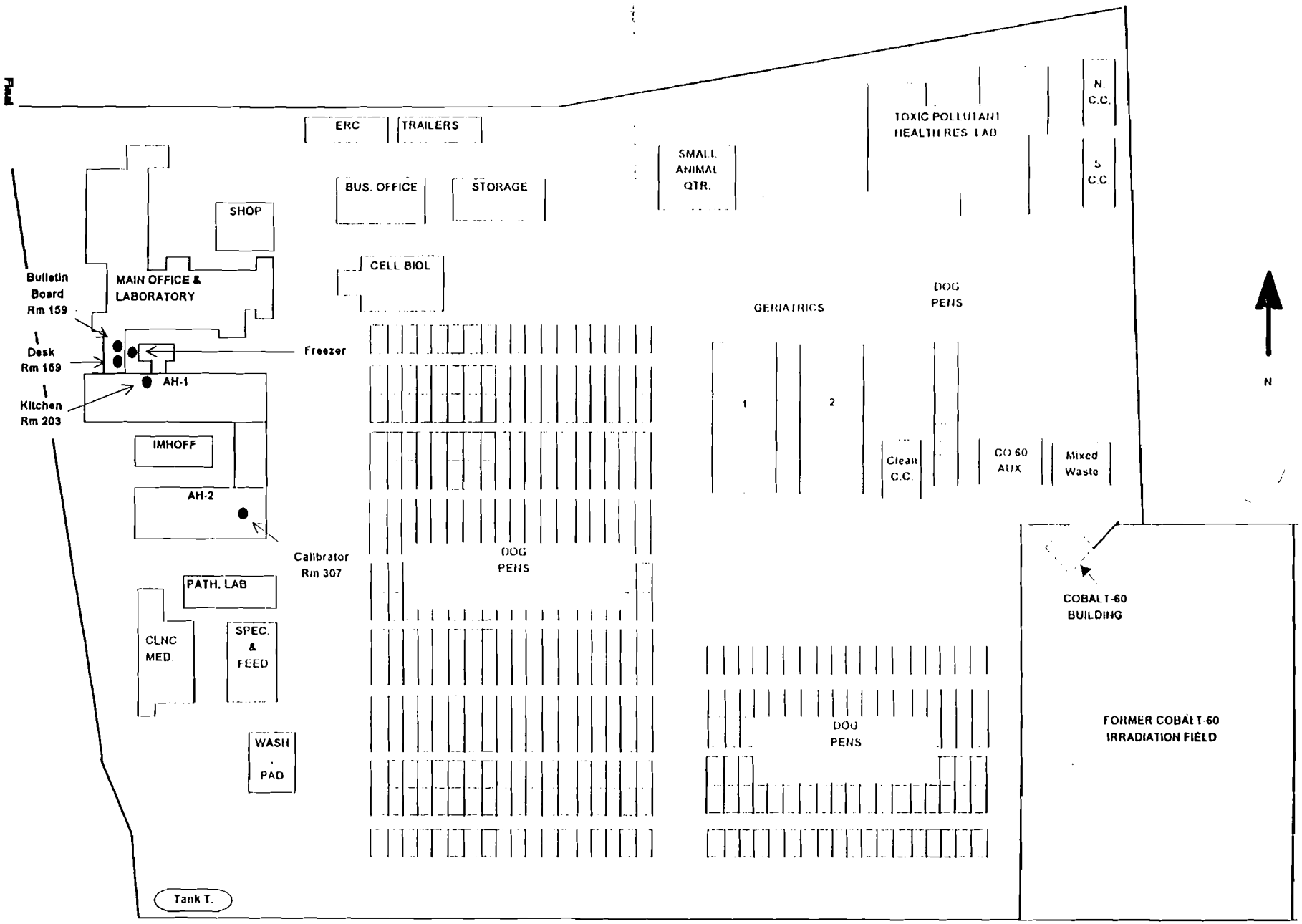
Figure 5B TLD Locations for Group 88

Figure 5C TLD Locations for Group 82 & 83



NOT TO SCALE

● = Environmental Dosimeter Location -Groups 82 and 83

Two Sets: one exchanged monthly and the other exchanged quarterly.

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Figure 6 Record of Use of Environmental Health & Safety LSC

Ver:1 Rev:2 Record of Use of Environmental Health and Safety LSC 11/6/91

Date & Time Taken	::	
Sample Preparer	::	
Requestor	::	
LSC Operator	::	

Sample Type

- ☐ URINALYSIS
- ☐ WATER SAMPLES
- ☐ SOIL SAMPLES

(See HP Procedures & Guidelines.)

☐ OTHER _____

Samples

Swipe #	LSC Bottle # (If known)	Description of Sample Location or Name of Persons if this is a Urinalysis

Work Element Coordinator (print)	Signature	Date
ATTACH MORE SHEETS AS NECESSARY		

FORM#012 1 of __ FORMLSC.XLS

Figure 7 Chain of Custody Record (CEP)

026 5/7/91 Ver:0 Rev:0 D:\forms\excel\coccep.xls

Controls for Environmental Pollution, Inc.
1925 Rosina Street
Santa Fe, NM 87502

CHAIN OF CUSTODY RECORD

PO:	PROJ:	FROM: University of California, Davis Environmental Health & Safety Davis, CA 95616
CONTACT:		

Sample Id Number	Date Sample Taken	Time Sample Taken	A H	P H	Comments	Number of Containers	Analysis						REMARKS

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	REMARKS:	If there are any questions at all, please call Dawn Mitchell (916) 752 4023 or Alice Tackett (916) 752-4563.

TL DOSIMETRY DEPARTMENT PROCEDURES

Proc. 14-1, Rev. 1
April 2, 1990

Reading Lithium Fluoride (LiF) and Calcium Sulfate:Dysprosium ($CaSO_4$:Dy) Dosimeters

Equipment/Supplies

Thermoluminescent dosimeter (TLD) reader
Dry Nitrogen
Nichrome blanchet
Exact-O knife
Wire cutter
Thin rod
Record book
Reader control chart (light output as a function of date)

I) Preliminary Operations

A) Air-conditioning

Keep room temperature at 72°F or below at all times to insure that the photomultiplier tube background noise is minimized. To maintain this temperature, the air conditioner is kept on at all times when TLD is being read.

B) Dry nitrogen

1) Turn on dry nitrogen by rotating the cylinder valve counter clockwise one or two turns.

2) Adjust the reducing valve to 20 psi.

3) Open the small black-handled valve one quarter turn.

NOTE: A new dry nitrogen dewar is ordered bi-weekly as needed. (Any empty cylinders that may be used are to be placed by the receiving door, after labeling them "empty", to be returned to the vendor. Chain full tanks to wall in storage cabinet until needed.)

II) Instrument Calibration

A) Leave instrumentation on at all times.

Richard H. Holden
President

LEHR
RECEIVED
JUL 27 1992

B) Telecyne readers:

1) Set calibration knob to "calibration" position.
2) Adjust "calibrate" knob so reading is between 1000 and 1050.
3) Return calibration knob to "Read No Anneal" position to [illegible] read dosimeters.

Victoreen readers:

1) Move drawer to the left until locked to position the light source
2) Flip "Set Factor Read TLD" switch to the upward position "Set Factor"
3) Adjust the "Adjust Knob" until display shows 1000
4) Flip "Set Factor/Read TLD" switch to the downward position to "Read TLD"

Harshaw readers: No "calibration" procedure.

C) Check and record light source value as follows:

1) Removable light source:

a) Replace planchet with light source.
b) Cycle reader until 3 successive readings are in agreement.
c) Enter reading in record book and on graph of light output as a function of date. (If the recorded reading is outside the limits on the reader control chart, discontinue the calibration process and report the condition to the TLD manager.)

NOTE: The purpose of the reader control chart is to document, on a daily basis, the data from the light source and 1-rem dose equivalent readings to verify the proper performance of the equipment, to watch reader trends, and to determine if maintenance is necessary.

2) Internal light source:

a) Set drawer to light source position. (Victoreen readers: rotate drawer to left to align source with PM tube. Telecyne and Harshaw readers: Pull sample drawer out to light source position.
b) Cycle reader.

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President

c) Enter reading in record book and on graph of light output as a function of date. (If the recorded reading is outside the limits on the reader control chart, report the condition to the TLD manager.)

NOTE: Light source reading limits are provided by the health physicist.

2. Check dark current as follows:

1) Harshaw reader: Cycle reader with empty planchet. The reading should be less than .015 on the digital read-out.

2) Teledyne reader: Cycle reader with empty planchet. The reading should be less than 15 on the digital read-out.

3. Start nitrogen flow to reader (3 SCFH).

4. Irradiated control dosimeters: Read two LiF 1-rem controls from the most recent powder anneal prior to the beginning of the month. The purpose of this procedure is to assure that the machine is responding properly. The average of these values is plotted on the control chart of light output as a function of date. It must remain within the 15% limits indicated on the graph. If the recorded reading is outside the limits on the reader control chart, report the condition to the TLD manager. One-rem controls are prepared by taping together 13 unexposed dosimeters and giving them to the health physics staff for exposure. Dosimeters are read out as follows:

1) With the color code (plugged end) down, use a wire cutter to cut off the tops of the capsules.

2) Deposit the powder from the 1-rem control capsule onto the planchet, distributing it as evenly as possible.

3) Place the planchet in the reader drawer and carefully close the drawer so as not to disturb powder.

4) After allowing a few seconds for nitrogen to flow, cycle the reader.

5) At the end of the cycle, enter the reading in the log book.

6) Repeat for the second capsule and record the average of the two readings. This is the value that is plotted daily on the control chart referred to above.

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President

D) In appropriate container, save used powder for recycling.

E) After lunch and each break, re-check the reader for proper response to 1-rem controls. These readings should also be within the limits of the reader control chart. Take a second reading on these dosimeters. These readings should also be recorded in the record book. If the second reading is more than 5% of the first reading, discontinue the calibration process and consult the TLD manager.

III) <u>TLD-XG Badge Read-out</u>

A) Check the IBM number and the start date on the badge against the Personnel List (PL). Remove IBM label and save.

B) Push capsules out of the badge with a thin rod. Capsules must not be removed from more than 2 badges at one time. If the badge is a powder albedo, open by slitting tape over the cover side and remove capsules.

C) Note color code on both capsules. Utilizing the badge date and color code, obtain the appropriate batch background capsules from the storage cabinet. Since background builds up by a constant amount, when controls for a batch are no longer available, it is possible to approximate background. For returned dosimeters for that baton, background is obtained by multiplying the net monthly scale reading by the number of months following the anneal.

D) Read background capsules by following read-out procedures I,H,1 through I,H,7.

E) At the end of the cycles, enter each reading and the average in the record book and on the PL in the background column.

F) Read first capsule from II,C in the same manner and record the reading on PL exactly as it appears on the digital read-out. If the reading is equivalent to background, in most cases, it is unnecessary to read the second capsule. Otherwise, read the second capsule and record the reading.

G) When average reading exceeds background, read 2 1-rem exposures for the same batch and record the result in the record book and on the PL.

H) Save used badges and powder for recycling.

I) Include an explanation on the PL for missing or anomalous data.

Richard H. Holden
President

Chip Read-out

I) Instrument calibration

A) If not already done, do steps II.A through II.G of Proc. 14-1.

B) Read-out a 1-rem control from the monthly anneal batch specified by the health physics staff. Enter this reading in the record book and plot the value on the reader control chart. If the recorded reading is outside the 15% limits on the chart, report the condition to the TLD manager. The 1-rem controls are prepared by placing chips in an aluminum holder covered by a piece of plastic and given to the health physics staff for exposure. Chips are read out as follows:

1) Handle chips only with tweezers.

2) Press chip firmly onto planchet to ensure good thermal contact.

3) Close the drawer and, after allowing a few seconds for nitrogen to flow, cycle the reader.

4) At the end of the cycle, enter the reading in the record book. This is the value that is plotted daily on the reader control chart.

5) Place used chips in appropriate containers for cleaning and re-annealing.

WARNING: Do not touch chip after it is read out. Chip may still be hot enough to burn skin.

NOTE: Always check used chip container, as different types chips must not be mixed together.

C) After lunch and each break, re-check the reader for proper response to a 1-rem control. Enter this reading in the record book. This reading should be within the limits of the reader control chart. Take a second reading on these dosimeters. If the second reading is more than 5% of the first reading, discontinue the calibration process and consult the TLD manager.

II) Finger ring, TLD-X33 badge, albedo badge and wallet card

A) Check the IBM number and the start date on the badge against the PL.

Richard H. Holden
Richard H. Holden
President

B) Remove chip(s) from dosimeter:

1) If ABB badge, leave label on badge

2) If finger ring, save label and recycle ring

3) If wallet card, save label and recycle card

4) If albedo badge, save label

C) Note color designation on chip cardstock (plastic tape holding chip in place) or marked on albedo chip. Utilizing date and color, obtain appropriate background chips from storage cabinet.

1) Follow procedure IV,A,2,a to IV,A,2,c for chip read-out.

2) At the end of the cycle, record reading in notebook.

3) Repeat for second chip and record the average in the notebook and on the PL in the background column.

4) Place used chips in appropriate container for cleaning and re-annealing.

D) Repeat read-out procedure for badge dosimeter(s).

E) Record reading on PL.

F) When reading exceeds background, read two item control chips for the same batch and record the result in the notebook and on the PL.

G) Place used chips in appropriate container.

H) For each batch, read two corresponding background and item controls (if necessary) and record data in notebook and on PL.

I) For missing or anomalous data, include a written explanation on the PL.

* Formerly Proc. 14-1.IV.

Richard W. Holden
Richard Holden
President

I) Albedo Dosimeter Chip Read-out

A) Remove identification label and white adhesive backing from badge.
B) Remove styrofoam pellets from badge wells and turn badge upside to release chips from holder.
C) Read TLD-600 chip (inscribed in red) according to procedures 14-1a,I thru 14-1a.II; If there is no positive reading, recover the TLD-700 chip (inscribed in blue) and place it in the appropriate container; If there is a positive reading on the TLD-600 chip, read the TLD-700 chip and then place it in the appropriate container for cleaning and recycling.

NOTE: All chips are read for control badges.

II) Albedo plus Chip TLD-100/TLD-700 Card Read-out

A) For albedo components, follow procedures IA through IC above.
B) Flip chip card to non-labeled side; remove and read TLD-100 chip (non-inscribed, color-coded with striped bandaid).
C) If albedo and TLD-100 chip have no positive reading, recover the TLD-700 chip from the card and place it in the appropriate container for cleaning and recycling.
D) If either albedo or TLD-100 chip have a positive reading, read the TLD-700 chip.

NOTE: All chips are read for control badges.

Lithium Fluoride/Calcium Sulfate:Dysprosium Environmental Dosimeter Read-out

I) Reader Calibration and Response Documentation

A) Check light source response.

1) Set drawer to light source position.
2) Cycle reader.
3) Enter reading in record book and on graph of light output as a function of date. (If the recorded reading is outside the limits on the reader control chart, report condition to the dosimetry manager. Limits are provided by the health physics staff.)

B) Start nitrogen flow to reader (3 SCFH).

C) Check dark current by cycling reader with an empty planchet. The reading should be less than 15 on the digital read-out.

D) Irradiated control dosimeters: Read two Lithium Fluoride (LiF) 1-Roentgen (1-R) Cs-137 exposure controls from the most recent powder anneal prior to the beginning of the month. The purpose of this procedure is to assure that the machine is responding properly. The average of these values is plotted on the control chart of light output as a function of date. It must remain within the 15% limits indicated on the graph. If the recorded reading is outside the limits on the reader control chart, report the condition to the dosimetry manager. One-R controls are prepared by taping together 10-12 unexposed dosimeters and giving them to the health physics staff for exposure. Dosimeters are read out as follows:

1) With the color code (plugged end) down, use a wire cutter to cut off the tops of the capsules.
2) Deposit the powder from the 1-R control capsule onto the planchet, distributing it as evenly as possible.
3) Place the planchet in the reader drawer and carefully close the drawer so as not to disturb powder.
4) After allowing a few seconds for nitrogen to flow, cycle the reader.
5) At the end of the cycle, enter the scale reading in the record book.
6) Repeat 1) through 5) for the second capsule and record the average of the two readings. This is the value that is plotted daily on the control chart referred to above.
7) In appropriate containers, save used capsules and powder for recycling.

E) After lunch and each break, re-check the reader for proper response to 1-R controls. These readings should also be within the limits of the reader control chart. Take a second reading on these dosimeters. If the second reading is more than 5% of the first reading, discontinue the calibration process and consult the manager of dosimetry operations.

II) Read-out of Lithium Fluoride Dosimeters

A) Check the IBM number and the start date on the environmental packet against the Personnel List (PL).

B) Remove capsules from envelope and save envelope. Capsules must not be removed from more than 2 envelopes at one time.

C) Note color code on both capsules. Utilizing the dosimeter date and color code, obtain the appropriate batch background capsules from the storage cabinet. (Since background builds up by a constant amount, it can be approximated when controls are no longer available. This is done by multiplying the net monthly scale reading by the number of months following the anneal.)

D) Read two background capsules by following read-out procedures I,D,1 through I,D,5. (Intersperse the reading of the remaining background capsules evenly throughout the readings of the client capsules to ensure proper reader response.)

E) At the end of the cycles, enter each scale reading and the average in the record book and the average reading on the PL in the background column.

F) Read two control capsules by following read-out procedures I,D,1 through I,D,5. (Intersperse the reading of the remaining control capsules evenly throughout the readings of the client capsules to ensure proper reader response.)

G) Read the two capsules from C, above, in the same manner as the background capsules and record both readings on the PL exactly as they appear on the digital read-out.

H) In appropriate containers, save capsules and powder for recycling.

III) Read-out of Calcium Sulfate:Dysprosium ($CaSO_4$:Dy) Dosmeters

A) Check the IBM number and the start date on the environmental packet against the Personnel List (PL).

B) Remove capsules from envelope and save envelope. Capsules must not be removed from more than 2 envelopes at one time.

C) Utilizing the account number and dosimeter date, obtain the appropriate batch background capsules and 30 mR (for monthly accounts) or 100 mR (for quarterly accounts) Co-60 exposure controls from the cadmium-lined storage container.

D) Read two background capsules by following read-out procedures I,D,1 through I,D,5. (Intersperse the reading of the remaining background capsules evenly throughout the readings of client capsules to ensure proper reader response.)

E) At the end of the cycles, enter each scale reading and the average reading on the PL.

F) Read two control capsules by following read-out procedures I,D,1 through I,D,5. (Intersperse the reading of the remaining control capsules evenly throughout the readings of the client capsules to ensure proper reader response.)

G) Read the two capsules from B, above, in the same manner as the background capsules and record both readings on the PL exactly as they appear on the digital read-out.

H) In appropriate containers, save capsules and powder for recycling.

Richard H. Holdeß
President

Attachment 2 · Memorandum from CEP

MEMORANDUM

VIA FAX: 916/752-6918

TO: DAWN MITCHELL
BATTELLE ENVIRONMENTAL MANAGEMENT OPERATIONS
UNIVERSITY OF CALIFORNIA

FROM: JAMES J. MUELLER
CONTROLS FOR ENVIRONMENTAL POLLUTION, INC.

DATE: JULY 24, 1992

Dawn:

As per your FAX dated July 24, 1992 addressed to Gail Griego, regarding Methods and Instruments used for the named Nuclides on CEP's licensure, the following is the information:

	Methods	Instrumentation
Carbon 14	HASL 300	LS5801 Liquid Scintillation Counting System (Beckman Instrument)
Gamma Spec Analysis	HASL 300	Nuclear Data Genie Model ND9900 Gamma Spectrometer
Gross Alpha & Beta	HASL 300	Berthold 10 Channel Low Level Planchet Counting System
Isotopic Plutonium	HASL 300	Alpha Spectrometer, Canberra Model 7404 Quad Alpha Spectrometer connected to ND 9900 System
Radium 226 & 228	HASL 300	Nuclear Data Genie Model ND9900 Gamma Spectrometer
Total Radium	HASL 300	Nuclear Data Genie Model ND9900 Gamma Spectrometer

Attachment 2 Memorandum from CEP (cont.)

	Methods	Instrumentation
Radon 222*	EPA	Ludlum Low Background Scintillation System
Strontium 89 and 90	HASL 300	Numelec NU20 Low Background Counting System
Isotopic Thorium	HASL 300	Alpha Spectrometer, Canberra Model 7404 Quad Alpha Spectrometer connected to ND 9900 System
Tritium	HASL 300 - Azeotropic Distillation	LS6801 Liquid Scintillation Counting System (Beckman Instrument)
Strontium 85	HASL 300	Nuclear Data Genie Model ND9900 Gamma Spectrometer
Asbestos	This can be run by Light Microscopy or TEM.	

*Note: It is very difficult to perform Radon on a filter paper as it is a gas; it should be collected on a charcoal trap.

Hoping this answers your questions. As Gail is out of the office this afternoon, I thought it best to expedite the response.

cc: Gail Griego

1.0 PURPOSE

The purpose of this calculation is to determine the if the D&D of AH-1 and AH-2 complies with the 40 CFR 61, National Emission Standards for Hazardous Air Pollutants (NESHAPS).

2.0 DISCUSSION

40 CFR 61.93(a) provides the methods that are to be used to determine compliance with the NESHAPS standard for radionuclides. One of the methods listed is the use of the CAP-88 computer model to calculate the effective dose equivalent values to members of the public. EPA has recently released a version of the CAP-88 model for IBM/PC compatible (CAP88-PC, see Ref. 3.4). CAP88-PC was used for calculation.

The input parameters for CAP88-PC include:

- facility wind data
- weather data (temperature, rainfall, etc)
- number of stacks
- stack parameters (height, diameter, flow rate)
- source term for each stack
- agricultural production data

The wind data provided with CAP88-PC for Sacramento, CA. was selected because LEHR is only about 40 miles from Sacramento.

The following weather data was taken from Ref. 3.9 for Davis, CA:

- annual precipitation: 17.14 inches = 43.5 cm
- average temperature: 60.1 °F = 15.6 °C

The mixing height was taken from Ref 3.8 for the central California valley as the average of the annual morning (400 m) and annual afternoon mixing heights (1200 m) to be 800 m.

The source term for each of the discharge points, stacks, is presented in the following table. This table was developed using the source term for AH-1 and AH-2 calculated in Reference 3.7 and the stack information found in Reference 3.2. Only 3 stacks are considered in this calculation because 3 of the 5 stacks of AH-1 (Room 211, 212, 219) will be closed off and their blowers de-energized during D&D operations. The source term for AH-1 was equally divided between stacks 1 and 2. The source term for each stack is presented in the following table:

Source Term for Each Stack (Ci)

Radionuclide	Stack 1 AH-1, Rm 209	Stack 2 AH-1, Rm 200	Stack 3 AH-2, Rm 310
Sr-90	5.385×10^{-3}	5.385×10^{-3}	25×10^{-6}
Ra-226			481×10^{-6}
Th-228	15.8×10^{-6}	15.8×10^{-6}	
H-3	5.4×10^{-6}	5.4×10^{-6}	
C-14	5.4×10^{-6}	5.4×10^{-6}	
Pu-241	5.4×10^{-9}	5.4×10^{-9}	

The following presents the determination of the parameters for each stack:

Stack 1 (AH-1, Rm 209):

Height of roof edge above ground (Ref 3.5): 9' 1.5" = 2.78 m
Height of stack exhaust point above roof (Ref 3.5): 4' 3" = 1.30 m
Slope of roof (Ref 3.2): 11.5°
Distance from edge of roof to stack (Ref 3.1): 16.5' = 5.03 m
Rise from edge of roof to base of stack:

rise = (5.03 m) sin(11.5°) = 1.00 m

Height of exhaust above ground:

2.78 m + 1.30 m + 1.00 m = 5.08 m

Stack cross section (Ref 3.5): 2' 3.5" x 1' 2.5"
= 0.699 m x 0.368 m
= 0.257 m²

Equivalent stack diameter:

$$d = 2\sqrt{\frac{A}{\pi}} = 2\sqrt{\frac{0.257 m^2}{\pi}} = 0.572 \text{ m}$$

Exhaust flow rate (Ref 3.1): 2432 cfm = 4.46 m³/s

Stack 2 (AH-1, Rm 200):

Height above ground (Ref 3.5): 28' 6" = 8.69 m

Stack diameter (Ref 3.5): 24.2" = 0.615 m

Stack cross section:

$$A = \pi r^2 = \pi \left[\frac{0.615}{2}\right]^2 = 0.297\ m^2$$

Flow rate specified for each cage (Ref 3.3): 37.5 cfm

Number of cages in Rm 200: 160

Exhaust flow rate:

$$\frac{37.5\ cfm/cage \times 160\ cages}{60\ s/m \times 0.297\ m^2 \times 35.31\ ft^3/m^3} = 9.54\ m/s$$

Stack 3 (AH-2, Rm 310):

Height above ground (Ref 3.5): 28' 6" = 8.69 m

Stack diameter (Ref 3.5): 24.2" = 0.615 m

Stack cross section:

$$A = \pi r^2 = \pi \left[\frac{0.615}{2}\right]^2 = 0.297\ m^2$$

Flow rate specified for each cage (Ref 3.3): 37.5 cfm

Number of cages in Rm 310: 200

Exhaust flow rate:

$$\frac{37.5\ cfm/cage \times 200\ cages}{60\ s/m \times 0.297\ m^2 \times 35.31\ ft^3/m^3} = 11.92\ m/s$$

The agricultural setting was selected to be RURAL which has pre-determined vegetable, milk, and beef production rates.

Three dose assessments were made for AH-1/AH-2 which differed only in the amount of radioactivity assumed released. The assumptions are as follows:

- Entire source term becomes airborne and is released. This is unrealistic because the contamination is fixed, but provides the maximum possible dose.
- 10% of the source term becomes airborne during demolition and packaging is released. This is conservative and does not include the installed or planned exhaust filtration.
- 10% of the source term becomes airborne and passes through a 95% efficient filter before being released. This is the most realistic assumption but is still conservative.

3.0 REFERENCES

3.1 UCD/LEHR Drawing M-2 (File No. 5724), 5/12/58

3.2 UCD/LEHR Drawing A-3 (File No. 5914-4), 2/8/62

3.3 UCD/LEHR Drawing M-5 (File No. 5914-4), 2/8/62

3.4 EPA, User's Guide for CAP88-PC, Version 1.0, EPA 520/6-91/022, December 1991.

3.5 Paul Zianno, facsimile from UCD EHS, 5/18/92, CCN 537

3.6 BEI/LEHR calculation R-002, Validation of CAP88-PC

3.7 BEI/LEHR calculation R-003, NESHAPS - Source Term: AH-1/AH-2

3.8 EPA, Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States, AP-101, January 1972

3.9 James Ruffner, Climates of the States, Third Edition, Vol 1, 1985

4.0 RESULTS

The results of the dose assessments indicate that the maximum dose is expected to be received at 75 meters North Northeast of AH-1/AH-2. The dose for each of the release assumptions for the maximally exposed individual is listed in the following table:

Assumed Release	Commited Dose Equivalent (mrem/year)	Percent of NESHAPS Dose Limit
Full Inventory	5.86E-01	5.86
10% of Inventory	5.86E-02	0.59
10% of Inventory Through 95% Efficient Filter	3.15E-03	0.03

The above results show that D&D operations in AH-1/AH-2 comply with the NESHAPS dose limits even with extremely conservative limits.

5.0 PROGRAM OUTPUT

The CAP88-PC output for all three release assumptions starts on the next page. Only the first set of output includes the weather output and dose conversion factors output as these are the same for all three cases.

Attachment 4 Acronyms and Abbreviations Used

AEC	Atomic Energy Commission
AH-1	Animal Hospital 1
AH-2	Animal Hospital 2
CEP	Controls For Environmental Pollution
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
Ci	Curie
cm, cm2	Centimeters, Centimeters squared
CMDW	Cydney Marshall Domestic Well
Co-60	Cobalt 60
cpm	Counts per Minute
CPT/HP	Cone Penetrometer Testing/Hydropunch
CrVI	Hexavalent Chromium
CWDW	Chris Watkins Domestic Well
D&D	Decontamination and Decommissioning
DDD	Dichlorodiphenyl Dichloroethane
DDE	Dichlorodiphenyl Ethane
DDT	Dichlorodiphenyl Trichloroethane
DHS	Department of Health Services
DOE	Department of Energy
dpm	Disintegrations per Minute
EIP	Environmental Implementation Plan
EMO	Environmental Management Operations
EPA	Environmental Protection Agency
ER	Environmental Restoration
ERC Group	Environmental Restoration and Cleanup Group
IHDW	Irene Hamel Domestic Well
LEHR	Laboratory for Energy-Related Health Research
M&O	Management & Operations
MARDW	Martinelli Domestic Well
MARIW	Martinelli Irrigation Well
MCL	Maximum Concentration Level
mg/l	Milligrams per liter
MIW	Miller Irrigation Well
mrem	Millirems
nCi	Nanocuries
NDW	Nishi Domestic Well
NE or N.E.	Northeast
NEPA	National Environmental Protection Act
NESHAPS	National Emmission Standards for Hazardous Air Pollutants
NIW	Nishi Irrigation Well
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NQA	National Quality Assurance

NW or N.W.	Northwest
OHDW	Owen Hamel Domestic Well
OMB	Office of Management & Budget
ORPS	Occurence Reporting & Processing System
PA	Preliminary Assessment
PCB	Poly-chlorinated Biphenyl
PCD	Putah Creek Downstream
pCi	Picocurie
PCU	Putah Creek Upstream
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manual
Ra-226	Radium 226
Rad	Radiation
RDC	Radiation Detection Company
RDW	Roth Domestic Well
RUSDW	Rust Domestic Well
RWQCB	Regional Water Quality Control Board
SPCC	Spill Prevention Controls & Countermeasures
Sr-90	Strontium 90
SSDC	System Safety & Development Center
STPO	Wastewater (Sewage) Treatment Plant Outfall
SWAT	Solid Waste Water Quality Assessment Test
TLD	Thermo Luminescent Detector
TMA	Thermo Analytical, Inc.
UC Davis	University of California, Davis
UCD	University of California, Davis
ug/kg	Microgram per kilogram
ug/l	Microgram per liter
UR	Unregulated
VOC	Volatile Organic Compound
RCRA	Resource Conservation & Recovery Act
CAA	Clean Air Act
CWA	Clean Water Act
HRS	Hazardous Ranking System
NPL	National Priorities List
HSU	Hydrostratigraphic Unit

DOCUMENT REVIEW RECORD (DDR)

Document No. : Document Title: : Revision No/Draft Date
Reviewed By: Carl Foreman

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
1	Page 1-5, Figure 1.2	The map shows two mixed waste storage units. One three compartment mixed waste storage unit exists at this location.		Figure revised.	
2	Page 2-1, Section 2.1.1, 2nd par.	The stormwater collection system at LEHR is not connected to the sanitary sewer system.		UC Davis, Department of Physical Plant drawing 18933-8, sheet 8 of 34 shows catch basins connected to sanitary lines on the LEHR site. Please advise if the drawing provided is out-of-date.	
3	Page 2-4, Section 2.2.1.6	The Co-60 Auxiliary Building (a.k.a. Annex) is being used as a research lab by a nonDOE researcher.		Section revised.	9/14/92
4	Page 3-1, Section 3.1, 2nd par.	The first sentence is unclear.		Sentence revised for clarity.	
5	Page 3-8, Table 3.5	UCD-2 monitoring will status should be noted, i.e., abandoned.		Table revised.	
6	Page 3-11, Figure 3.3	Please indicate "north" on the map.		Corrected.	
7	Page 3-15, Table 3-9	Move heading to next page.		Corrected.	Concur
8	Page 4-1, Section 4.0, 2nd par.	The meteorological station is located to the northwest of the LEHR site.		Corrected.	No response

DOCUMENT REVIEW RECORD (DDR)

Document No. : Document Title: : Revision No/Draft Date
Reviewed By: Carl Foreman

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
9	Page 5-2, Section 5.2.2, 2nd par.	The training records for each technician are maintained at which location or site. Please specify.		Section revised.	Concur 9/14/92 No response

DOCUMENT REVIEW RECORD (DDR)

Document No. : Document Title: : Revision No/Draft Date
Reviewed By: Christine Judal

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
1	Page 2-1, 4th par.	Add to the end of this paragraph: "The specific effluent monitoring program necessary to assure D&D activities provide adequate protection to the environment will be defined in an addendum to this plan before D&D begins." (I know you have stated this elsewhere, but it would add assurance here).		Section revised (specific suggested language was modified).	3/14/92
2	Page 3-15, 4th par. and Table 3.10	The second sentence of this paragraph indicates that dosimeters "located in areas where radiation doses could exceed 100 mrem per year" are analyzed monthly, while others are analyzed quarterly. Some dosimeters in Table 3.10 do not fit this pattern. For example, historical (and expected) dose rates for clean office areas have shown no reportable doses yet some are on a monthly schedule (i.e. TLDs 3, 33 & 34). Please consider the following alternatives: Add a statement to reflect increased frequency of analysis in work areas for personnel protection, modify the schedule and/or further clarify frequency of analysis criteria.		Section revised to clarify process period requirements.	9/14/92 Concur No response

DOCUMENT REVIEW RECORD (DDR)

Document No. : Document Title: : Revision No/Draft Date
Reviewed By: Christine Judal

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
3	Page 8-2, 2nd par.	Change the third sentence to read, "If an employee on the LEHR site observes an 'abnormal situation' which could effect personnel safety and/or the environment, he or she is required to call emergency response services at 911 and notify the Project Manager or Project Health and S Officer."		Section revised (Note that "911" was intentionally omitted, because this document is not an emergency response document).	8/14/92
4	Page 1-8, 3rd par.	Third sentence should say Animal Hospital-2 (rather than Animan).		Corrected.	
5	Page 3-1, 3rd par.	Insert the word "to" before "monitor the effects".		Corrected.	
6	Page 6-2, 2nd par.	Change "tame" to "same" in the third sentence.		Corrected.	Concur No suspense
7	Page 6-3, 2nd par.	Change "attaches" to "attach" in the fourth sentence.		Corrected.	

DOCUMENT REVIEW RECORD (DDR)

Document No. : Document Title: : Revision No/Draft Date
Reviewed By: Patrice Rodgers

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
1	Page 1-6 Section 1.2.1, 2nd par.	The statement that "the study was terminated in 1985; however the radioactive source remains in place" implies that the Co-60 source was not used after 1985. The source was used (for interior exposures) until the radiation use authorization was terminated in 1987-1988. Suggest adding a statement to that effect.		Section corrected.	9/14/92 No response
2	Page 1-12, Section 1.2.5, 1st par.	The technical name for the climate in the Davis area is "Mediterranean," which is more precise that "temperate."		Corrected.	9/14/92
3	Page 3-5	Is there a written procedure for vegetation sampling? How will the samples be taken? A mention should be made that procedures have been or will be written. Also, vegetation samples have not yet been taken at the LEHR site. It would be better to use future tense to avoid confusion.		The UC Davis EH&S staff will be responsible for developing sampling procedures. The section has been revised for clarity.	Accepted
4	Page 3-15	Why are more locations for environmental dosimetry being added? Some justification should be given. Lack of explanation may make the historical results seem wanting, and, therefor, unreliable.		Dosimeters are being added based upon the technical judgement of the author and peer review staff of Pacific Northwest Laboratory.	

DOCUMENT REVIEW RECORD (DDR)

Document No. : Document Title: : Revision No/Draft Date
Reviewed By: Patrice Rodgers

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
5	Page 3-15, Sentences 4,5	The dosimeters for the Co-60 field are located at various heights more than 2 meters above the ground, for the reasons mentioned above. The individual heights of these dosimeters are documented in the ER Group Files.		Section revised.	
6	Page 3-16, Table 3.7.2	Which of these are old locations, which proposed new locations.		Table has been revised to show "old" and "new" locations.	9/14/92
7	Page 3-18, Figure 3.5	It would be useful to separate, on this figure, the old locations from the proposed new locations.		The figure was not revised for sake of clarity.	
8	Page 5-2, Section 5.2.1	The UC Davis EH&S Laboratory is also used by EH&S personnel, in addition to ER project personnel. Some of these personnel may help process samples from the LEHR site.		Section revised.	concur
9	Page 3-1, Section 3.1, 2nd par.	Missing word "to" between "performed" and "monitor."		Corrected.	
10	Page 3-4, Section 3.3, 2nd to last	Missing the "n" in "been performed in the past."		Corrected.	

DOCUMENT REVIEW RECORD (DDR)

Document No. : Document Title: : Revision No/Draft Date
Reviewed By: Patrice Rodgers

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
11	Page 3-5, Section 3.3.2 & 3.3.3	Collection frequency, and type of analysis for vegetation samples is shown in Table 3.4, not 3.5.		Corrected.	9/4/92
12	Page 3-11, Figure 3.3	The well locations on the map shown are difficult to read (perhaps the map could be slightly enlarged to show detail a bit more clearly). A compass arrow would also be useful.		The map was revised for clarity.	Concur No suggestion
13	Page 5-2, Section 5.2.2, 2nd par.	Change "a" to "an" in the first sentence.		Corrected.	

DOCUMENT REVIEW RECORD (DDR)

Document No. na : Document Title: **Enviromental Monitoring Plan, Add. 1** : Revision No/Draft Date 0
Reviewed By: Tim Chapman

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
1	4, bullet 7	I believe the reference to CERCLA should be RCRA.		Corrected	TEC 9-21-92
2	6, sec. 2.1, last sent.	The reference to DOT standards does not add anything and I would suggest removing it.		Deleted in document	TEC 9-21-92
3	6, sec. 2.2, last par.	It would be a good idea to reference that this sampling fulfills the requirements of NESHAPS for periodic confirmatory sampling.		Added to document	TEC 9-21-92
4	7, sec. 3.3.	It may be beneficial to expand on the vegetation sampling. Since you are taking soil samples "just in case" it would be nice to state that vegetation sampling is not needed because that data would not provide any useful information in a timely manner. The explanation for surface water sampling would benefit from a sentence restating that no liquid effluents will be discharged from the buildings.		The discussion about soil vegetation and surface and groundwater sampling has been expanded.	TEC 9-21-92
5	7, sec. 3.4.	The location of temporary TLDs for the D&D activity do not seem to take into account the closest population of "public," the UC Davis staff and students at ITEH. It would be nice to give a little more information on the selection of the locations.		Explanation added in document and figures.	TEC 9-21-92

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DOCUMENT REVIEW RECORD (DDR)

Document No. na : Document Title: **Enviromental Monitoring Plan, Add. 1** : Revision No/Draft Date 0
Reviewed By: Tim Chapman

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
6	8, sec. 4.0, par. 1	Figure 4.1 is not included.		Figure 4.1 included	TEC 9-21-92
		GENERAL COMMENTS; TYPOGRAPHICAL ERRORS			TEC 9-21-92
7	general	A reference section should be added to the document.		Added to document	TEC 9-21-92
8	general	Several acronyms are used without being spelled out at first use. Some nonstandard abbreviations are used.		Add an acronym page	TEC 9-21-92
9	general	Capitalization needs to be checked throughout.		Hopefully, capitalization has been corrected.	TEC 9-21-92

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DOCUMENT REVIEW RECORD (DDR)

Document No. na : Document Title: **Addendum 1, Environmental Monitoring Plan** : Revision No/Draft Date : Rev.0 8/26/92
Reviewed By:

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date

General Comments:

There is some lack of consistency between the environmental monitoring plan and the addendum insofar as the introductory details of the LEHR site go. For example, the plan states that the LEHR facility is located 1.5 miles south of the campus (p. 1-3, section 1.2), but the addendum says 1 mile south (p. 4-38, section 1.1, 3rd ¶).

Another example is the date given for the beginning of research at LEHR: the plan states that UC Davis has conducted radiological research at LEHR since the early 1960's (p. 1-6, section 1.2), but the addendum states that DOE has funded UC Davis to investigate low-level ionizing radiation since 1951 (p. 4-38, section 1.1, 2nd ¶). I believe that the actual starting date was 1958.

The plan states that the LEHR facility consists of "several one- and two-story...facilities." The addendum states that the facility "consists of 16 buildings." These descriptions make LEHR sound like 2 different facilities.

RESPONSE: This issue has been resolved and will be the same in both documents. PR

Technical Comments:

1	Page 5, Section 1.2, 1st ¶	Specify briefly where outside of the buildings contamination was found.	PR 9-21-92	Briefly stated.	PR
2	Page 6, Section 2.2, 4th ¶	Since screening for asbestos will not be done at the in-house laboratory, will one analysis per month for asbestos (the one at an outside lab) be sufficient? Should some other provision be made?	PR	Asbestos abatement is not being done and only a few areas will have to have it removed. If larger amount of asbestos is encountered, more sampling can be done. The plan just lays out the minimum	Still have concerns

DOCUMENT REVIEW RECORD (DDR)

Document No. na : Document Title: **Addendum 1, Environmental Monitoring Plan** : Revision No/Draft Date : Rev.0 8/26/92
Reviewed By:

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
3	Page 9, Section 6.2 4th ¶	States that holding time problems should not be done at the in-house laboratory, will one analysis per month for asbestos (the one at an outside lab) be sufficient? Should some other provision be made?	PK	Chemicals are not being sampled for because they aren't expected and if they are sampled, proper holding times for those chemicals or analysis will be used.	PK
4	Page 6, Section 2.2, 1st ¶	Use "are" instead of "is" in the sentence "The filters that will be used for screening by in-house laboratory is..."	PK	Changed	PK
5	Page 6, Section 2.2, 2nd ¶	Should be "The sampling and analysis regime is as follows:"	PK	Changed	PK
6	Page 6, Section 2.2, 4th ¶	In last sentence, add a "d" to "change."	PK	Changed	PK
7	Page 8, Section 5.2, 2nd ¶	Remove the "y" from "they" in last sentence	PK	Changed	PK
8	Page 9, Section 6.2	The last sentence is a repeat of the second sentence	PK	Changed	PK
9	Page 17, Figure 5A	The control dosimeter location (in the east trailer) is missing from this map.	PK	Changed	PK

DOCUMENT REVIEW RECORD (DDR)

Document No. na : Document Title: **Addendum 1, Environmental Monitoring Plan** : Revision No/Draft Date : **Rev. 0 8/26/92**
Reviewed By: **Carl Foreman**

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
1	Page 5, Para. 3	The portable HEPA-filtered ventilation systems need to be DOE tested at the site to check for leaks.		The HEPA filter will be DOS tested before use.	CF 9/17/92
2	Page 6, Sect. 2.2, Para. 1	Delete the referenced air flow for the Allegro A-100 high volume samplers: "(2-3 liters/min)".		Deleted	CF 9/17/92
3	Page 7, Sect. 3.2	The soil in this area contains approximately 1% Chrysotile asbestos. Testing the soil for gamma, beta and alpha emission would be sufficient.		Changed in document	CF 9/17/92
4	Page 8, sect. 5.2, Para. 2	The second sentence is unclear to exactly which plan meets NQA-1 and QAMS 5. Their plan should meet NQA-1 and QAMS 5 requirements.		Clarified in document. Their outside lab's plan meets NQA-1 and QAMS-5.	CF 9/17/92
5	Page 9, Sect. 6.2	The last sentence in this section is a repeat of the second sentence in the first paragraph.		Changed in document	CF 9/17/92

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DOCUMENT REVIEW RECORD (DDR)

Document No. na : Document Title: **Addendum 1, Environmental Monitoring Plan** : Revision No/Draft Date : **Rev. 0 8/26/92**
Reviewed By: **Christine Judal**

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
1	Section 1.1 last para, 5th sentence	Installation of the HEPA filters can have a significant effect on the system filtration efficiency. We recommend that once the portable filtration system is in place, the system should be tested through the Dioctyl Phthalate (DOP) testing method. UCD has the capability to accomplish this test. Test accomplishment would effect your statement in the 5th sentence of this paragraph, which should then read: "The filtration system will be evaluated through DOP (Dioctyl Phthalate) testing to assure the 99.9% HEPA filter efficiency is maintained and that surrounding area receives no adverse impact due to the work performed.		The HEPA filters will be DOS tested before use because DOP is listed waste in the State of Washington. This has been clarified in the document.	CJ 9-22-92
2	Section 2.2, paragraph 1	Remove the words "(2-3 liters/min.)" from the 6th sentence. This airflow rate is below the normal rate for this type of sampling on the high volume pumps.		Deleted	CJ 9-22-92
3	Section 2.2, paragraph 1	Insert after 2nd sentence: "The selected sampling location will be the building ventilation discharge point receiving HEPA filtered air from the area of most extensive contamination abatement currently in progress."		Added	CJ 9-22-92
4	Sect 2.2, paragraph 4	Insert after 5th sentence: "MDAs will be calculated for each sample."		Added	CJ 9-22-92
5	Section 3.2	The 6th and 7th sentences indicate both plural and singular subjects (they should agree) concerning whether both background samples will be sent to outside lab for analysis.		Clarified in document. Both background soil samples will be sent to outside labs.	CJ 9-22-92

DOCUMENT REVIEW RECORD (DDR)

Document No. na : Document Title: **Addendum 1, Environmental Monitoring Plan** : Revision No/Draft Date : **Rev. 0 8/26/92**
Reviewed By: **Christine Judal**

Comment Number	Page/Para.	Comments and Rationale	Peer Reviewer's Initial's and Date	Resolution	Concurrence: Reviewer Initials/Date
6	Section 3.4	"Figure 5.5 A-C" reference in first sentence should read "Figures 5A-5C."		Changed in document	CJ 9-22-92
7	Section 3.4	Second sentence is unnecessary because first sentence designates location of TLD's.		Changed in document	CJ 9-22-92
8	Section 3.4	Delete 4th sentence and insert: "Inspection records will be maintained which will include corrective action taken to resolve conditions which could adversely effect the monitoring activity."		Changed in document	CJ 9-22-92
9	Section 3.4	In 5th sentence, insert the words "for analysis" after the word monthly.		Changed in document	CJ 9-22-92
10	Section 5.1	Replace first sentence with the following: "Environmental monitoring activities accomplished under this addendum, including field measurements and sample collection, will comply with the UCDavis Work Element Quality Assurance Plan."		Changed in document	CJ 9-22-92
11	Section 7.2, Paragraph 3	Add after last sentence of paragraph: "Air sampling and the monitoring of results will provide further assurance that acceptable release levels are maintained."		Changed in document	CJ 9-22-92
12	Figure 5A	The location of the TLD shown on the fence south of the old dog pens is incorrect in this figure. It actually is located on the southwest area of Co-60 field fence.		Figure revised	CJ 9-22-92

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DDR.FRM

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January 20, 1993

Christine Judal
Carl Foreman
Patrice Rodgers
Tim Chapman
Dawn Mitchell
Ed Ballard

Subject: Addendum 2, Environmental Monitoring Plan, LEHR Site

Enclosed please find the subject document. Please attach it to your Environmental Monitoring Plan and sign and return the enclosed Controlled Document Transmittal Record form.

If you have any questions, please call me at (916) 752-4023.

Sincerely,

Dawn Mitchell
LEHR Project

Enclosures

cc: Salem Attiga

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Addendum 2
Environmental Monitoring Plan

Laboratory for Energy-Related Health Research
University of California, Davis

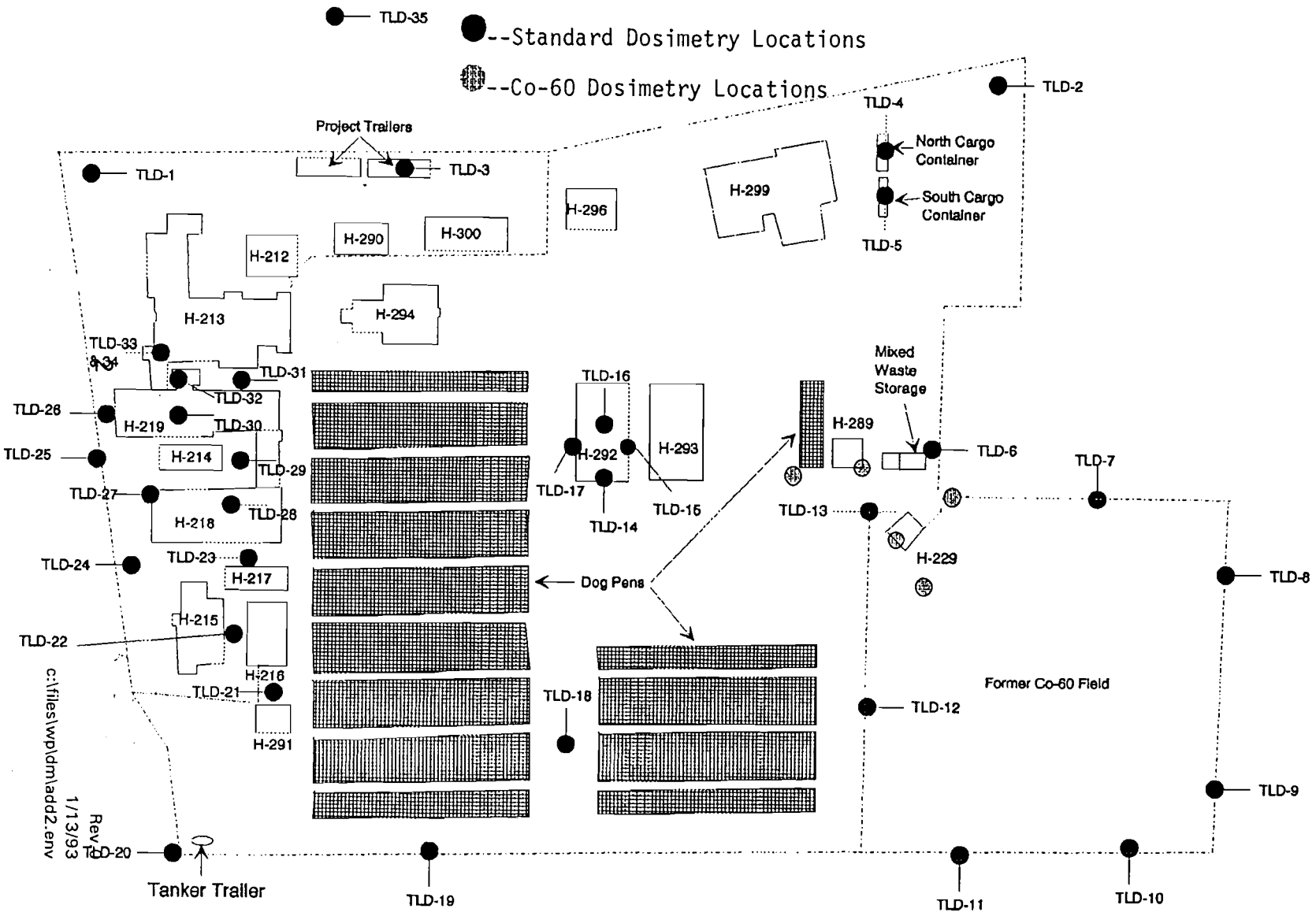
Description of Activities and Additional Monitoring

The $\approx$100 Ci Co^{60} irradiator source and irradiator house assembly will be removed from the roof of Building H-229 and placed in a Type B shipping cask for shipment to the General Electric Vallecitos Nuclear Center located in Pleasanton, California. The transporter of the source is a licensed transporter.

The dose rate on contact of the weather tight housing ranges from 8-20 mR/hr. The area of work will be roped off to prohibit entrance to anyone other than the workers involved with the removal activity and a notice and fact sheet will be circulated informing staff on-site of the activity and to avoid the area. All work will be performed in accordance with work plans, rigging plans, unit work instructions, and hazardous work permits.

In order to verify that the public does not receive a dose above 100 mR/yr, TLDs or film badges will be placed in strategic locations as indicated on Figure A.

Any emergencies will be handled in accordance with the Emergency Response Plan.



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Addendum 2
Environmental Monitoring Plan
DOE/LEHR 17523

Addendum 3
Environmental Monitoring Plan

Laboratory for Energy-Related Health Research
University of California, Davis

Institution of Bi-Monthly Air Sampling

Air Sampling which is conducted to monitor the air effluent from current D&D activities will be performed on a bi-monthly basis for the remainder of the D&D project, beginning in April 1993.

In accordance with Addendum 1, Section 2.2 of the Environmental Monitoring and Surveillance Plan for the Laboratory for Energy-Related Health Research Environmental Restoration Project, air sampling will be reduced to a bi-monthly level following an evaluation of sample results. Air monitoring results collected on a weekly basis since the beginning of D&D activities have revealed that radiological effluent releases are generally within background levels and no sample was found to exceed the derived concentration guides defined in DOE 5400.5.

In order to assure that the air monitoring program provides necessary information regarding effects of D&D activities on the environment, additional air sampling will be conducted during any scheduled activity which is determined to have a potential for release of radiological effluent regardless of when samples were last taken.

Addendum 4
Environmental Monitoring Plan

Laboratory for Energy-Related Health Research
University of California, Davis

Termination of Bi-Monthly Air Sampling

Periodic external air effluent monitoring of the ventilation systems which was conducted during Decontamination and Decommissioning (D&D) of the Animal Hospitals has been terminated due to the removal of the monitored ventilation systems. Progress of D&D work monitored under Addendum 1, Section 2.2 has advanced to the point that planned activities have been completed and the ventilation systems dismantled and checked for contamination. The Final Survey is now in progress to verify the success of the decontamination efforts.

Any further D&D activities conducted within the buildings will be isolated through negative pressure, with ventilation directed to a dedicated HEPA-filtered unit and monitored as it leaves the work area. Air samples will be changed weekly and analyzed for levels of alpha, beta, and gamma activity. The analysis will look primarily for radium-226, strontium-90 and cesium-137. Airborne concentrations reaching 10% of the limits defined in DOE Order 5400.5 will be investigated to determine the cause. An evaluation of engineering controls will be performed if airborne radioactivity exceeds 50% of the concentrations in DOE 5400.5. Because of the absence of any hazardous waste in the buildings, chemical constituents will not be analyzed; however, if any are detected in the process of D&D through health and safety monitoring inside the building, the analyses list will be changed to look for chemical constituents of concern. If additional engineering controls are incorporated for the prevention of contaminant release, they will be defined in an additional addendum to this monitoring plan.

ADDENDUM 5

ENVIRONMENTAL MONITORING AND SURVEILLANCE PLAN
LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH

September 1994

1.0 INTRODUCTION

This addendum specifies the environmental monitoring and surveillance activities that will be done during the decontamination and decommissioning (D&D) of the Imhoff facility (Building H-214).

1.1 Description of Activities

The key aspects of the D&D activities for the Imhoff facility are as follows:

- The D&D will involve complete demolition of the Imhoff building. This will include dismantlement, removal, and off-site disposal of contaminated equipment, components, and structures. Also, post-decontamination radiation and contamination surveys will be done to verify compliance with DOE and State of California criteria for release for unrestricted use.

- Renovation activities will be limited to those needed to ensure any remaining structures are in a safe condition.

- All D&D activities performed by contractors and subcontractors will be according to approved written procedures, specifications, and work instructions.

- D&D activities will be conducted according to the California Division of Industrial Safety Construction Safety Orders, Title 8, Subchapter 4, of the California Code of Regulations.

- All radioactive waste generated during D&D is expected to be disposed of at DOE's Hanford site.

- Since there is no hazardous waste, as defined by the Resource Conservation and Recovery Act (RCRA) it is anticipated that no mixed waste (MW) will be generated. Radiologically contaminated asbestos, a Toxic Substance Control Act (TSCA) waste, will be encountered and will be processed as low-level radioactive waste (LLW).

- Solid waste will be characterized and packaged before leaving the controlled area within the containment tent or waste reduction area. Waste will be stored in the waste staging facility (Geriatrics 1). The waste packages will be radiologically surveyed prior to leaving the controlled area to confirm that any residual contamination is within accepted standards.

Disassembly, segmentation, and removal of radioactively contaminated items will require the application of contamination control devices and methods. A containment structure will erected around the building. A HEPA-filtered air exhaust system will be installed and maintained to provide airborne contamination control. In that, the containment tent will be maintained at negative pressure relative to the outside atmosphere. The negative pressure HEPA-filtered system combined with the total containment tent will provide protect the environment from accidental releases of radioactive or hazardous materials.

2.0 EFFLUENT MONITORING

2.1 Liquid and Solid Waste Effluent Monitoring

Liquid and solid waste effluent streams are not expected to be generated during the D&D of the Imhoff facility.

2.2 Air Effluent Monitoring

2.2.1 Imhoff Building

NESHAP modelling calculations show the radioactive content of the effluent to be below the criteria in which continuous air sampling is necessary. Air sampling will be conducted at the stack exits. This sampling meets the requirements of 40 CFR for periodic confirmatory sampling. Air sampling systems will monitor effluent continuously while the ventilation system is in operation.

Air effluent sampling is the responsibility of the PNL subcontractor completing the Imhoff demotion, IT Corporation. Prior to the ventilation system handling any potentially contaminated effluent, two sets of background air samples will be taken. The samples will be screened on-site and then sent to an off-site laboratory for analysis (see below for analysis requirements).

The containment tent enclosure will have three separate filtered exhaust plenums to the environment. Each exhaust point will be monitored using a probe and air sampler designed to obtain isokinetic sampling downstream of the HEPA filtration. Air sampler filters will be removed at a minimum of every week. Air effluent samples will be screened on-site and then sent to an off-site laboratory for analysis.

The samples will be analyzed for radioactive material content. At a minimum the off-site laboratory shall analyze the samples for Sr-90, Ra-226, gross beta-gamma, and gross alpha radiation. On-site screening is used to provide an early warning of any possible degradation of the HEPA filters. An abnormally high radioactive material content on a sample filter would be a key indicator of such a failure.

During any periods where work is conducted where the containment tent's exhaust system is used for asbestos abatement, the air sample filters shall be analyzed for asbestos content (i.e., a fiber count) by a California-approved laboratory or qualified individual. No other hazardous materials requiring air effluent sampling are expected during the demolition of the Imhoff building. In the event that hazardous materials are encountered in quantities that require permitting or environmental monitoring this addendum will be revised accordingly.

2.2.2 Data Review and Reporting

Analytical results from laboratory analyses are reviewed for accuracy when received. IT Corporation, the subcontractor responsible for the sampling, shall be responsible for this. The analytical results are then tabulated and reviewed for trends by UC Davis (the subcontractor responsible for environmental monitoring reporting for the site). Standard statistical methods are used in the determination of accuracy and trending. Should any analytical result show an abnormally high or low result or exceed an action level, an investigation will be promptly initiated to validate the result and/or learn the cause of the abnormal result.

3.0 ENVIRONMENTAL SURVEILLANCE

3.1 Air Monitoring

Air effluent emission modeling shows that the calculated maximum dose in a year the public is less than 0.1 mrem. Therefore, additional air sampling for surveillance purposes is not required.

3.2 Soil Sampling

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed surrounding the containment enclosure in addition to daily inspections on work days of containment tent integrity. This will ensure that any potential releases to the environment are detected.

3.3 Vegetation Sampling

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed surrounding the containment enclosure in addition to daily inspections on work days of containment tent integrity. This will ensure that any potential releases to the environment are detected.

3.4 Groundwater Monitoring

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed surrounding the containment enclosure in addition to daily inspections on work days of containment tent integrity. This will ensure that any potential releases to the environment are detected.

3.5 Surface Water Monitoring

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed surrounding the containment enclosure in addition to daily inspections on work days of containment tent integrity. This will ensure that any potential releases to the environment are detected.

3.6 Nonroutine Sampling

See section 3.6 of the main body of this plan for details.

3.6 Environmental Dosimetry

No additional environmental dosimeters will be needed to support this work effort. However, TLD-29 will be relocated from the Imhoff Building Wall to the outside of the containment structure. Following completion of the Imhoff building demolition, this TLD will be returned to the approximate position it occupied on the Imhoff building.

UC Davis shall be responsible for documenting the dates and locations of the TLD movements for inclusion in the annual site environmental report. No other special reporting will be required.

ADDENDUM 6

ENVIRONMENTAL MONITORING AND SURVEILLANCE PLAN
LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH

May 1995

1.0 INTRODUCTION

This addendum specifies the environmental monitoring and surveillance activities that will be done during the decontamination and decommissioning (D&D) of the Cobalt-60 Building (Building H-229).

1.1 Description of Activities

The key aspects of the D&D activities for the Cobalt-60 Building are as follows:

- The D&D will involve complete decontamination of the Cobalt-60 Building. This will include dismantlement, removal, and off-site disposal of contaminated equipment and components, as well as decontamination of structural surfaces. Also, post-decontamination radiation and contamination surveys will be done to verify compliance with DOE and State of California criteria for release for unrestricted use.

- Renovation activities will be limited to those needed to ensure any remaining structures are in a safe condition.

- All D&D activities performed by contractors and subcontractors will be according to approved written procedures, specifications, and work instructions.

- D&D activities will be conducted according to the California Division of Industrial Safety Construction Safety Orders, Title 8, Subchapter 4, of the California Code of Regulations.

- All radioactive waste generated during D&D is expected to be disposed of at DOE's Hanford site.

- Since there is no hazardous waste, as defined by the Resource Conservation and Recovery Act (RCRA), it is anticipated that no mixed waste (MW) will be generated. Radiologically contaminated asbestos, a Toxic Substance Control Act (TSCA) waste, may be encountered and will be processed as low-level radioactive waste (LLW). Asbestos containing material that is not radiologically contaminated will only be removed if needed to provide access to other areas requiring remediation.

- Solid waste will be characterized and packaged before leaving the controlled area. Waste will be stored in the waste staging facility (Geriatrics 1) until transported for off-site disposal. The waste packages will be radiologically surveyed prior to leaving the controlled area to confirm that any residual contamination is within accepted standards.

Disassembly, segmentation, and removal of radioactively contaminated items will require the application of contamination control devices and methods. The interior of the Cobalt-60 Building will serve as the primary contamination control barrier. A HEPA-filtered air exhaust system will be installed and maintained to provide airborne contamination control. In that, the building will be maintained at negative pressure relative to the outside atmosphere. The negative pressure HEPA-filtered system combined with the building's concrete walls and ceiling will provide protection for the environment from accidental releases of radioactive or hazardous materials. Releases to the environment will be quantified as discussed in Section 2.2.

2.0 EFFLUENT MONITORING

2.1 Liquid and Solid Waste Effluent Monitoring

Liquid and solid waste effluent streams are not expected to be generated during the D&D of the Cobalt-60 Building.

2.2 Air Effluent Monitoring

2.2.1 Cobalt-60 Building

NESHAP modelling calculations show the radioactive content of the effluent to be below the criteria in which continuous air sampling is necessary. Air sampling will be conducted at the stack exits. This sampling meets the requirements of 40 CFR for periodic confirmatory sampling. Air sampling systems will monitor effluent continuously while the ventilation system is in operation.

Air effluent sampling is the responsibility of the PNL subcontractor completing the Cobalt-60 D&D. Prior to the ventilation system handling any potentially contaminated effluent, two sets of background air samples will be taken. The background samples will be screened on-site and then sent to an off-site laboratory for analysis (see below for analysis requirements).

The Cobalt-60 Building will have one filtered exhaust plenum to the environment. Each exhaust point will be monitored using a probe and an air sampler designed to obtain isokinetic sampling downstream of the HEPA filtration. Air sample filters will be removed at a minimum of every week. Air effluent samples will be screened on-site and then sent to an off-site laboratory for analysis.

The samples will be analyzed for radioactive material content. At a minimum, the off-site laboratory shall analyze the samples for Sr-90, Ra-226, U-232, Th-228, gross beta-gamma, and gross alpha radiation. On-site screening is used to provide an early warning of any possible degradation of the HEPA filters. An abnormally high radioactive material content

(e.g., above instrument minimum detectable activity) on a sample filter would be a key indicator of such a failure.

During any periods where work is conducted where the exhaust system is used for asbestos abatement, additional (separate) air samples will be taken and analyzed for asbestos content (i.e., a fiber count) by a California-approved laboratory or qualified individual. No other hazardous materials requiring air effluent sampling are expected during the D&D of the Cobalt-60 Building. In the event that hazardous materials are encountered in quantities that require permitting or environmental monitoring this addendum will be revised accordingly.

2.2.2 Data Review and Reporting

Analytical results from laboratory analyses are reviewed for accuracy when received. The subcontractor responsible for the sampling shall be responsible for this evaluation. The analytical results are then tabulated and reviewed for trends. Standard statistical methods are used in the determination of accuracy and trending. Should any analytical result show an abnormally high or low result or exceed an action level, an investigation will be promptly initiated to validate the result and/or learn the cause of the abnormal result.

3.0 ENVIRONMENTAL SURVEILLANCE

3.1 Air Monitoring

Air effluent emission modelling (CAP88PC) shows that the calculated maximum dose in a year to the public is less than 0.1 mrem from the D&D of the Cobalt-60 Building. Therefore, additional air sampling for surveillance purposes is not required.

3.2 Soil Sampling

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed on the pavement surrounding the building in addition to daily inspections on work days of contamination boundary (building) integrity. This will ensure that any potential releases to the environment are detected.

3.3 Vegetation Sampling

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed on the pavement surrounding the building in addition to daily inspections on work days of contamination boundary (building) integrity. This will ensure that any potential releases to the environment are detected.

3.4 Groundwater Monitoring

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed on the pavement surrounding the building in addition to daily inspections on work days of contamination boundary (building) integrity. This will ensure that any potential releases to the environment are detected.

3.5 Surface Water Monitoring

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed on the pavement surrounding the building in addition to daily inspections on work days of contamination boundary (building) integrity. This will ensure that any potential releases to the environment are detected.

3.6 Nonroutine Sampling

See section 3.6 of the main body of this plan for details.

3.7 Environmental Dosimetry

No additional environmental dosimeters will be needed to support this work effort. No additional reporting will be required.

1.0 INTRODUCTION

This addendum specifies the environmental monitoring and surveillance activities that will be implemented during the decontamination and decommissioning (D&D) of Room 201 in Animal Hospital-1 (AH-1).

1.1 Description of Activities

The key aspects of the D&D activities for Room 201 are as follows:

- The D&D will involve complete decontamination of Room 201. This will include dismantlement, removal and disposal or on-site storage of contaminated equipment and components as well as decontamination of structural surfaces. Also, post-decontamination radiation and contamination surveys will be performed to verify compliance with DOE and State of California criteria for release for unrestricted use.

- All D&D activities performed by contractors and subcontractors will be in accordance with written procedures, specifications and work instructions.

- D&D activities will be conducted according to the California Division of Industrial Safety Construction Safety Orders, Title 8, Subchapter 4, of the California Code of Regulations.

- All radioactive waste generated as the result of D&D activities is expected to be disposed of at DOE's Hanford site.

- Since there is no hazardous waste, as defined by the Resource Conservation and Recovery Act (RCRA), it is anticipated that no mixed waste (MW) will be generated. Radiologically contaminated asbestos, a Toxic Substance Control Act (TSCA) waste, if encountered will be processed as low level radioactive waste (LLW). Asbestos containing material that is not radiologically contaminated will only be removed if needed to provide access to other areas requiring remediation.

- Solid waste will be characterized and packaged before leaving the controlled area. Waste will be stored in the waste staging facility (Geriatrics-1) until transported for off-site disposal. The waste packages will be surveyed for radioactivity prior to leaving the controlled area to confirm that any residual contamination is within accepted standards.

- Disassembly, segmentation, and removal of radioactively contaminated items will require the application of contamination control devices and methods. The interior of Room 201 will act as the primary contamination control barrier. A HEPA-filtered air exhaust system will be installed and maintained to provide airborne contamination control. The interior of the building will be maintained at a negative pressure relative to outside atmosphere. The negative pressure HEPA system combined with the room's walls and ceiling will provide protection for the environment from accidental releases of radioactive or hazardous materials. Releases to the environment will be quantified as discussed in Section 2.2.

2.0 EFFLUENT MONITORING

2.1 Liquid and Solid Waste Effluent Monitoring

Liquid and solid waste effluent streams are not expected to be generated during the D&D of Room 201.

2.2 Air Effluent Monitoring

2.2.1 Room 201

NESHAP modelling calculations show the radioactive content of the effluent to be below the criteria in which continuous air sampling is necessary. Air sampling will be conducted at the stack exit. This sampling meets the requirements of 40 CFR for periodic confirmatory sampling. Air sampling systems will monitor effluent continuously while the ventilation system is in operation.

Air effluent sampling is the responsibility of the PNNL subcontractor completing the Room 201 D&D. Prior to the ventilation system handling any potentially contaminated effluent, two sets of background air samples will be taken. The background samples will be screened on-site and then sent to an off-site laboratory for analysis see below for analysis requirements).

The room 201 ventilation system will have one filtered exhaust plenum to the environment. This exhaust point will be monitored using a probe and an air sampler designed to obtain isokinetic sampling downstream of the HEPA filtration. Air sample filters will be exchanged at a minimum of every week except when short work weeks have provided to small a sample volume to achieve the required minimum detectable activity (MDA). In these cases the sample filter shall remain installed for the following week.

The samples will be analyzed for radioactive material content. At a minimum, the off-site laboratory will analyze the samples for Sr-90, Ra-226, gross beta-gamma, and gross alpha radiation. On-site screening is used to provide an early warning of any possible degradation of the HEPA filters. An abnormally high radioactive material content(e.g., above instrument minimum detectable activity) on sample filter would be a key indicator of such a failure.

During any periods where work is conducted where the exhaust system is used for asbestos abatement, additional (separate) air samples will be taken and analyzed for asbestos content (i.e., a fiber count) by a California-approved laboratory or other qualified individual. No other hazardous materials requiring air effluent sampling are expected during the D&D of Room 201. In the event that hazardous materials are encountered in quantities that require permitting or environmental monitoring this addendum will be revised accordingly

2.2.2 Data Review and Reporting

Analytical results from laboratory analysis are reviewed for accuracy when received. The subcontractor responsible for the sampling shall be responsible for the evaluation. The analytical results are then tabulated and reviewed for trends. Standard statistical methods are used in the determination of accuracy and trending. Should any analytical result show an abnormally high or low result or exceed an action level, an investigation will be promptly initiated to validate the result and/or learn the cause of the abnormal result.

3.0 ENVIRONMENTAL SURVEILLANCE

3.1 Air Monitoring

Air effluent emission modelling (CAP88) shows that the maximum dose in a year to the public is less than 6E-9 mrem from the D&D of Room 201. Therefore, additional air sampling for surveillance purposes is not required.

3.2 Soil Sampling

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed on the pavement in front of the Room 201 access doors in addition to daily inspections on work days of contamination boundary (building) integrity. This will ensure that any potential releases to the environment are detected.

3.3 Vegetation Sampling

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed on the pavement in front of the Room 201 access doors in addition to daily inspections on work days of contamination boundary (building) integrity. This will ensure that any potential releases to the environment are detected.

3.4 Groundwater Monitoring

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed on the pavement in front of the Room 201 access doors in addition to daily inspections on work days of contamination boundary (building) integrity. This will ensure that any potential releases to the environment are detected.

3.5 Surface Water Monitoring

No additional sampling will be needed to support this work effort. Routine weekly contamination surveys will be performed on the pavement in front of the Room 201 access doors in addition to daily inspections on work days of contamination boundary (building) integrity. This will ensure that any potential releases to the environment are detected.

3.6 Nonroutine Sampling

See section 3.6 of the main body of this plan for details.

3.7 Environmental Dosimetry

No additional environmental dosimeters will be needed to support this work effort. No additional reporting will be required.

1.0 INTRODUCTION

This addendum specifies the environmental monitoring and surveillance activities that will be implemented during the Limited Field Investigation, (LFI) at the LEHR Site.

1.1 Description of Activities

The key aspects of the LFI activities are as follows:

- Exploratory trenches, soil borings, and shallow soil sampling in the Southwest Trench Area, at the Southwest corner of the LEHR facility.
- Exploratory trenches, soil borings, and shallow soil sampling in the vicinity of the Radium and Strontium tanks and associated leach fields.
- Exploratory trenches, soil borings, and sediment sampling in the vicinity of the Domestic Septic Tanks.
- LFI activities will be conducted according to the California Division of Industrial Safety Construction Safety Orders, Title 8, Subchapter 4, of the California Code of Regulations; as well as Title 29 of the Code of Federal Regulations, Part 1910.120 Hazardous Waste Operations and Emergency Response.

2.0 EFFLUENT MONITORING

2.1 Liquid and Solid Waste Effluent Monitoring

Liquid and solid waste effluent streams are not expected to be generated during LFI activities.

2.2 Air Effluent Monitoring

Environmental air samples will be collected from downwind of each work area for the entire work day during excavation and trenching activities. These samples will be obtained using a regulated air sampler, sampling at the rate of 1 cubic foot per minute (cfm), through a 47 mm. glass fiber filter. These samples shall be field counted using and integrated alpha-beta-gamma scalar and the sample indicating the highest level of activity will be sent for off-site analysis. One sample will be chosen from each worksite for laboratory analysis.

The samples will be analyzed for radioactive material content. At a minimum, the off-site laboratory will analyze the samples for Sr-90, Ra-226, gross beta, gamma spec., and gross alpha radiation. On-site screening is used to provide an early warning of any possible airborne radioactive materials resulting from the scheduled work. In the event that hazardous materials are encountered in quantities that require permitting or environmental monitoring this addendum will be revised accordingly.

2.2.1 Data Review and Reporting

Analytical results from laboratory analysis are reviewed for accuracy when received. The subcontractor responsible for the sampling shall be responsible for the evaluation. The analytical results are then tabulated and reviewed for trends. Standard statistical methods are used in the determination of accuracy and trending. Should any analytical result show an abnormally high or low result or exceed an action level, an investigation will be promptly initiated to validate the result and/or learn the cause of the abnormal result. Results of laboratory counting of the sample filters will be used to verify that no airborne radioactive materials, in excess of the Derived Concentration Guidelines (DCG), were released during the performance of LFI activities.

3.0 ENVIRONMENTAL SURVEILLANCE

Routine daily contamination surveys will be performed within the LFI work zones in addition to daily inspections of the work area. Contamination surveys of personnel and material/equipment exiting the exclusion zone will be performed. This will ensure that any potential releases to the environment are detected.

3.1 Air Monitoring

No additional monitoring will be needed to support this work effort.

3.2 Soil Sampling

No additional sampling will be needed to support this work effort.

3.3 Vegetation Sampling

No additional sampling will be needed to support this work effort.

3.4 Groundwater Monitoring

No additional sampling will be needed to support this work effort.

3.5 Surface Water Monitoring

No additional sampling will be needed to support this work effort.

3.6 Nonroutine Sampling

See section 3.6 of the main body of this plan for details.

3.7 Environmental Dosimetry

No additional environmental dosimeters will be needed to support this work effort.