DOE/EIS-0133-D

File Copy

DRAFT

ENVIRONMENTAL IMPACT STATEMENT

Decontamination and Waste Treatment Facility for the Lawrence Livermore National Laboratory Livermore, California

JUNE 1988

UNITED STATES DEPARTMENT OF ENERGY

DOE/EIS-0133-D

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

Decontamination and Waste Treatment Facility for the Lawrence Livermore National Laboratory Livermore, California

JUNE 1988

UNITED STATES DEPARTMENT OF ENERGY

COVER SHEET

DRAFT ENVIRONMENTAL IMPACT STATEMENT

DECONTAMINATION AND WASTE TREATMENT FACILITY, LAWRENCE LIVERMORE NATIONAL LABORATORY, LIVERMORE, CALIFORNIA

a) Lead Agency: U.S. Department of Energy (DOE)

b) Proposed Action: to construct and operate a Decontamination and Waste Treatment Facility (DWTF) for nonradioactive (hazardous and nonhazardous), mixed, and radioactive wastes at Lawrence Livermore National Laboratory.

c) For additional copies or further information on this statement and program, please contact:

Mr. William Holman
Environmental Branch
Environment, Safety and Quality Assurance Division
Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612
Telephone: (415) 273-6370

For general information on DOE's Environmental Impact Statement (EIS) process, please contact:

Ms. Carol M. Borgstrom
U.S. Department of Energy
Office of NEPA Project Assistance
1000 Independence Avenue, SW
Washington, DC 20585
Telephone: (202) 586-4600

d) Designation: Draft EIS (DEIS)

e) Abstract

This statement assesses the environmental impacts of alternatives proposed for the management of waste generated by the Lawrence Livermore National Laboratory (LLNL). The four primary waste management strategy alternatives that were initially evaluated are: 1) no action (i.e., continued use of the present hazardous waste management [HWM] facilities), 2) increased off-site treatment and disposal, 3) upgrading the existing on-site HWM facilities, and 4) development of new on-site treatment and storage facilities. Upgrading existing HWM facilities and the increased use of off-site treatment and disposal facilities were found to be unfeasible alternatives. The development of new on-site facilities was considered the most reasonable strategy and consists of two design alternatives and three site alternatives in the LLNL area. The environmental effects of the reasonable alternatives and the no-action alternative are evaluated relative to seismicity and to construction and operation impacts for soils, hydrology, air quality, occupational and public health, vegetation and wildlife, socioeconomics and land use, noise, transportation, and cultural resources. The preferred alternative is to construct and operate the most versatile design at the best available site (i.e., a Level II facility at Site D).

f) Public comments on the DEIS must be received by DOE no later than 45 calendar days after a Notice of Availability is published in the Federal Register. After consideration of public comments on the DEIS, a Final EIS (FEIS) will be prepared. A Record of Decision will be published in the Federal Register no sooner than 30 days after issuance of the Notice of Availability for the FEIS.

FOREWORD

This Draft Environmental Impact Statement (DEIS) is issued by the U.S. Department of Energy (DOE) in accordance with the National Environmental Policy Act of 1969 (NEPA), as implemented by the regulations promulgated by the Council on Environmental Quality (CEQ) (40 CFR 1500-1508, November 1978) and DOE's implementing guidelines (45 FR 20695, March 28, 1980, as amended through April 25, 1986, 51 FR 15625). A Notice of Intent to prepare this DEIS was issued March 18, 1987, and a public scoping meeting to determine the major issues and scope of the DEIS was held on April 30, 1987. DOE has prepared this DEIS to provide environmental input to the decision on the proposal to construct and operate a Decontamination and Waste Treatment Facility (DWTF) for nonradioactive (hazardous and nonhazardous), mixed, and radioactive wastes generated by Lawrence Livermore National Laboratory (LLNL) programs. The DWTF would replace the existing Hazardous Waste Management (HWM) facilities located in the southeast corner of LLNL. After considering all comments on this DEIS, DOE will issue a Final EIS (FEIS). DOE will then issue a Record of Decision, stating the Department's decision regarding this proposal and identifying all alternatives considered, no sooner than 30 days after issuance of the FEIS.

Chapter 1.0 documents the purpose and need for the DWTF. Chapter 2.0 summarizes and compares alternatives and predicted environmental impacts. Chapter 3.0 summarizes the affected environment. Chapter 4.0 provides detailed information on analyses of the environmental consequences of the various alternatives considered. Chapter 5.0 presents the environmental permits, regulations, and approvals associated with the DWTF. Chapter 6.0 lists the references used to prepare this DEIS. Chapter 7.0 presents a glossary of terms used in this document. Chapter 8.0 presents the names and professional qualifications of the persons responsible for preparing the statement. Chapter 9.0 contains the mailing list of persons and organizations who will receive a copy of this DEIS.

[THIS PAGE INTENTIONALLY LEFT BLANK]

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

[THIS PAGE INTENTIONALLY LEFT BLANK]

LIST OF ACRONYMS AND ABBREVIATIONS

ACFCWCD - Alameda County Flood Control and Water Conservation District

ACGIH - American Conference of Governmental Industrial Hygienists

ALARA - As low as reasonably achievable

ARB - California Air Resources Board

BAAQMD - Bay Area Air Quality Management District

CAAQS - California Ambient Air Quality Standards

CAM - Continuous Air Monitor

CBAS - Computerized Building Automation System

CCR - California Code of Regulations

CEQ - Council on Environmental Quality

CEQA - California Environmental Quality Act

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

cfm - Cubic feet per minute

CFR - Code of Federal Regulations

CHARM® - Complex Hazardous Air Release Model

ci/yr - Curies per year

CO - Carbon monoxide

CTC - Carbon tetrachloride

dBA - Decibels on the A scale

DBA - Design Basis Accident

DBE - Design Basis Earthquake

DCA - Dichloroethane

DCE - Dichloroethylene

DCG - Derived Concentration Guides

DEIS - Draft Environmental Impact Statement

DHS - California Department of Health Services

DOE - U.S. Department of Energy

DOT - U.S. Department of Transportation

DRE - Destruction and removal efficiency

DWTF - Decontamination and Waste Treatment Facility

EIS - Environmental Impact Statement

EPA - U.S. Environmental Protection Agency

FEIS - Final Environmental Impact Statement

FR - Federal Register

ft - Feet

g - Grams

gal - Gallons

gal/yr - Gallons per year

GLC - Ground level concentration

gpm - Gallons per minute

HCl - Hydrogen chloride

HEPA - High efficiency particulate air (filter)

HSWA - Hazardous and Solid Waste Amendments to RCRA

HVAC - Heating, ventilation and air conditioning

HWCA - California Hazardous Waste Control Act

HWM - Hazardous Waste Management

HWMF - Hazardous Waste Management Facility

hz - Hertz

ICRP - International Commission on Radiological Protection

ID - Induced draft

IDLH - Immediately Dangerous to Life and Health

ISCST - Industrial Source Complex - Short Term

ISD - Interim Status Document

km - Kilometers

l - Liter

lb - Pound

Ldn - Day/night average noise level

LLNL - Lawrence Livermore National Laboratory

LLW - Low-level wastes

m - Meters

mg/m^3 - Milligrams per cubic meter

mph - Miles per hour

m/s - Meters per second

NA - Not available

NAAQS - National Ambient Air Quality Standards

nCi/gram - Nanocuries per gram

NDDB - Natural Diversity Data Base

NE - Northeast

NEPA - National Environmental Policy Act

NESHAP - National Emission Standard for Hazardous Air Pollutants

NO_2 - Nitrogen dioxide

NRC - Nuclear Regulatory Commission

NTS - Nevada Test Site

NW - Northwest

ORNL - Oak Ridge National Laboratory

OSHA - Occupational Safety and Health Administration

PCB - Polychlorinated biphenyls

PCE - Perchloroethylene

PG and E - Pacific Gas and Electric

PM - Particulate matter

PM_{10} - Particulate matter less than 10 microns in diameter

PMS - Process Monitoring System

ppm - Parts per million

rem - Roentgen equivalent in man

RCRA - Resource Conservation and Recovery Act

S - South

SNLL - Sandia National Laboratory at Livermore

SO_2 - Sulfur dioxide

TCE - Trichlorethylene

TLV - Threshold Limit Value

TRU - Transuranic

TSCA - Toxic Substances Control Act

UBC - Uniform Building Code

ug/l - Microgram per liter

VOC - Volatile organic compounds

VMT - Vehicle miles travelled

°F - Degrees Fahrenheit

[THIS PAGE INTENTIONALLY LEFT BLANK]

SUMMARY

This Draft Environmental Impact Statement (DEIS) was prepared to assess the potential environmental impacts associated with the proposed construction and operation of a new Decontamination and Waste Treatment Facility (DWTF). This facility would be designed to treat, process, and store nonradioactive (hazardous and nonhazardous), mixed, and radioactive wastes generated by activities of Lawrence Livermore National Laboratory (LLNL), located in Livermore, California. The proposed DWTF would replace and consolidate the existing Hazardous Waste Management (HWM) facilities at LLNL. The proposed DWTF is needed to reduce off-site transportation and treatment of LLNL nonradioactive, mixed, and radioactive wastes; to provide facilities with enhanced safety and environmental protection; and to assure compliance with increasingly stringent air, water quality, and waste management regulations.

This DEIS was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and to satisfy the requirements of the California Environmental Quality Act (CEQA) and state permitting regulations. A public scoping process was conducted by the U.S. Department of Energy (DOE) to determine the significant issues to be analyzed in depth regarding the alternatives. The four primary waste management strategy alternatives that were initially evaluated are: 1) no action (i.e., continued use of the present hazardous waste management [HWM] facilities, 2) increased off-site treatment and disposal, 3) upgrading the existing on-site HWM facilities, and 4) development of new on-site treatment and storage facilities. Upgrading existing HWM facilities and the increased use of off-site treatment and disposal facilities were found to be unfeasible alternatives. The development of new on-site facilities, which consists of two design alternatives and three site alternatives in the LLNL area, was considered to be the most reasonable strategy. The site alternatives are Site D in the northeast corner of LLNL, Site F in the western LLNL buffer zone, and Site I in the southwestern buffer zone, as shown in Figure 2.5-1. Both the Level I and Level II design alternatives would include new and separate radioactive and nonradioactive liquid waste treatment systems, a solidification unit, a new decontamination facili-

ty, reactive materials storage and treatment areas, a radioactive waste storage area, a receiving and classification area, and a uranium burn pan. Additionally, the Level I design would include a controlled-air incinerator system, and the Level II design would include a rotary kiln incinerator system. From these site and design alternatives, a preferred alternative was identified: construction and operation of the Level II design on Site D.

The no-action alternative was also examined. This alternative is defined as a no-change action with continued reliance on the existing HWM facilities. Disadvantages to this alternative include continued inefficiencies with operation of LLNL's decentralized waste management facilities, continued use of a decreasing number of acceptable off-site treatment and disposal facilities to receive increasing quantities of waste due to progressively more stringent regulations, and continued transportation of large volumes of liquid wastes over public roads. The no-action alternative merely defers the action of developing a new waste treatment facility.

The no-action alternative includes continued use of the existing incinerator. This incinerator, because of its lack of air emission controls, can only treat a limited number of waste types. These wastes make up only 4 percent of the combustible low-level radioactive solids and 10 percent of the combustible radioactive and hazardous liquids generated at LLNL each year. The Level I design alternative includes the use of a controlled-air incinerator that would be equipped with off-gas treatment equipment to control acid gas emissions resulting from the combustion of halogenated solvents. An incinerator of this type would treat 97 percent of the combustible liquids generated at LLNL, but would have limitations similar to the current incinerator in the range of low-level radioactive solids that could be incinerated. The Level II design alternative rotary kiln incinerator would treat all the combustible liquids and combustible low-level radioactive solids generated at LLNL. Pollution abatement controls for the rotary kiln incinerator would include a venturi scrubber, packed-bed absorber, mist eliminator, and a high efficiency particulate air (HEPA) filtration system.

As concluded in Chapter 4.0, there would be no significant impacts to the public or the environment associated with any of the alternatives. An air quality impact analysis showed that maximum ambient concentrations of air pollutants would be within federal, state, and local standards for all alternatives (see Table 4.2-4).

The potential health risks associated with nonradioactive and radioactive emissions resulting from normal operations were evaluated. The worst-case risk of developing cancer at the location of maximum impact over a continuous 70-year period is estimated to be 3.1 in a million for the Level II design alternative, 6.2 in a million for the Level I design, and 10.9 in a million for the no-action alternative. These risks are significantly lower than cancer risk associated with commonplace activities (see Table 4.2-8). Cancer burden estimates indicate there would be no increased cases of cancer due to operation of any of the alternatives.

The proposed DWTF would be designed and constructed to meet LLNL Seismic Safety Criteria. In addition, the operations of the decontamination building and the incinerator liquid waste storage area, which would have a greater potential of impacting the environment, would be designed to meet more stringent safety criteria. The possibility of fire or accidental spills of hazardous material was also considered in the design of the DWTF. Mitigation and control measures would be implemented in the design of all DWTF facilities to assure a low risk operation with minor on-site and negligible off-site impacts to the public and the environment. An accident analysis was performed to evaluate the potential consequences of postulated accidents at the proposed DWTF. The analysis concluded that the impacts from these postulated events would be insignificant.

For each design alternative, wastes that could not be treated on site would be packaged in U.S. Department of Transportation-approved containers and shipped to off-site treatment, storage, and disposal facilities. Under the no-action alternative, 82 percent of LLNL wastes, which are listed in Table 1.2-1, would require off-site treatment and disposal. Approximately 9 percent and 6 percent of LLNL wastes would require off-site treatment or disposal from the Level I and Level II design alternatives, respectively. The potential for transportation accidents to occur would also be reduced by over 70 percent if the Level I or Level II design alternatives were selected, as discussed in Section 4.2.8.

Analysis of the alternatives indicates that the overall environmental impacts of the Level I and Level II design alternatives would be similar. Both of these design alternatives would result in beneficial environmental impacts compared to the no-action alternative in terms of treatment processing, and storage of nonradioactive, mixed, and radioactive wastes. Site D would result in the lowest overall environmental impacts compared to Site F and Site I. There would be no significant cumulative or growth-inducing impacts resulting from selection of the preferred alternative (i.e., Level II design on Site D).

Some environmental groups have expressed opposition to hazardous waste incineration projects. Consistent with DOE and state policy, the proposed DWTF would treat nonradioactive (hazardous and nonhazardous), mixed, and radioactive wastes on site in a properly designed facility to minimize potential liability and risk to public health from off-site treatment and disposal.

CHAPTER 1.0

PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1 Purpose of the Proposed Action

The proposed action is intended to achieve a long-term solution for managing wastes generated at Lawrence Livermore National Laboratory (LLNL) by the construction and operation of a new Decontamination and Waste Treatment Facility (DWTF). This DWTF would provide centralized treatment, processing, and storage of nonradioactive (hazardous and nonhazardous), mixed, and radioactive wastes generated by LLNL in a manner that is consistent with federal, state, and local environmental regulations and U.S. Department of Energy (DOE) orders. Facilities for decontaminating equipment and materials would also be included in the DWTF. Specifically, the proposed DWTF would replace existing Hazardous Waste Management (HWM) facilities with safer, more efficient, and environmentally enhanced facilities; comply with increasingly stringent environmental regulations; and reduce the toxicity and volume of waste requiring transportation for off-site treatment and disposal.

1.2 Need for Action

1.2.1 Introduction

LLNL is a multiprogram laboratory operated by the University of California for the DOE. Defense and nondefense programs are conducted at LLNL, including Defense Systems, Laser Isotope Separation, Magnetic Fusion Energy, Biomedical and Environmental Research, and Energy and Resources. Research programs have been conducted at the LLNL site for 35 years. The 819-acre LLNL site is in Alameda County adjacent to the eastern boundary of the City of Livermore.

This Environmental Impact Statement (EIS) addresses the need to treat, process, and store waste materials generated by LLNL. A number of the facilities and operations supporting LLNL programs generate nonradioactive, mixed, and radioactive waste materials. These wastes include:

- Nonradioactive liquid and solid wastes, which include hazardous, nonhazardous, and classified materials.

  - Hazardous wastes are defined by the Resource Conservation and Recovery Act (RCRA) (40 CFR 261) and the Toxic Substance Control Act (TSCA) (40 CFR 761), which are administered by the U.S. Environmental Protection Agency (EPA); and Title 22, Division 4, Chapter 30 of the California Code of Regulations (CCR), which is administered by the California Department of Health Services (DHS). Throughout this document, nonradioactive hazardous waste is termed "hazardous" waste.

  - Nonhazardous liquid wastes are defined as nonradioactive wastes not defined as hazardous but requiring pretreatment only prior to discharge to the City of Livermore sanitary sewer to comply with the City of Livermore Ordinance No. 1134 and the Clean Water Act effluent standards (40 CFR 401, 413, 433, and 469).

  - Classified wastes include documents and photographs that contain security information requiring destruction.

- Mixed wastes are radioactive wastes that also contain hazardous materials listed in 40 CFR 261.

- Radioactive wastes, such as low-level wastes (LLW) and transuranic (TRU) wastes. LLW is defined as any radioactive waste not classified as high-level waste, transuranic (TRU) waste, spent nuclear fuel, or by-product material. LLWs contain less than 100 nCi/gram of radium sources and/or alpha-emitting transuranium nuclides with half-lives greater than 20 years. TRU wastes are materials contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/gram.

1.2.2 Waste Quantities from LLNL Operations

The estimated quantity of waste that would be processed in the DWTF is presented in Table 1.2-1. These waste types and volumes would generally be representative of routine operations from LLNL, Site 300, and satellite LLNL operations at the Livermore airport. The annual quantities and the types of wastes shown in Table 1.2-1 were used in designing the DWTF processes and take year-to-year waste flow fluctuations into account. A description of the current waste streams associated with specific operations at LLNL, Site 300, and other satellite LLNL sites is included in the Environmental Impact Report, Operation and Management of LLNL (University of California, 1986).

The largest quantity of wastes generated by LLNL operations would be hazardous liquid wastes consisting primarily of waste oils, solvents, metal finishing and electroplating solutions, and a wide variety of laboratory wastes in small containers. Most of the mixed waste would be in liquid form and would be composed of solvents, oil, and rinsewater containing radionuclides. All liquid radioactive waste streams would also contain hazardous constituents and would be defined as a mixed waste. Nonradioactive, mixed, and radioactive solid wastes would be composed of contaminated containers, plastic, rags, animal biological waste from the LLNL biomedical research program, laboratory waste, and protective clothing. TRU wastes are being packaged and certified at the point of generation and would be stored at the proposed DWTF when completed, prior to shipment to DOE disposal facilities.

TABLE 1.2-1. LLNL WASTE TYPES TO BE PROCESSED AT THE PROPOSED DWTF[a]

	Liquid Waste[b]		Solid Waste	
Waste Type	Materials	Design Quantity[c] (Pounds/Year)	Materials	Design Quantity (Pounds/Year)
Nonradioactive (includes hazardous and nonhazardous)	Organic solvents, oils and greases, plating solution, acids, rinsewater, organic and inorganic sludges	7,237,600[d]	Paper, rags, plastic film, animal biological waste[e]	83,000
Mixed	Solvents, rinsewater, oils and greases, scintillation fluids	1,319,700[f]	Vials and miscellaneous laboratory waste	4,000
Radioactive	None normally generated	0	Protective clothing (gloves, boots), paper, plastic, laboratory waste, noncombustible LLW and TRU waste, contaminated containers	666,000
TOTAL		8,557,300[g]		753,000

Source: Radian, 1988a.

[a] Includes waste from LLNL main site, Site 300, and LLNL Airport Operations.
[b] Includes sludge wastes.
[c] Based on a weighted average density of 8.3 lb/gallon.
[d] 872,000 gallons/yr.
[e] Included in this total are nonhazardous (classified) solid wastes (e.g., documents, photographs).
[f] 159,000 gallons/yr.
[g] Equivalent to 1,031,000 gallons/yr.
LLW - Low-level waste
TRU - Transuranic waste

Laundry and equipment that are decontaminated and returned to service are not listed in Table 1.2-1. These flows are estimated to be approximately 23,000 pounds per year of laundry and 5,000 cubic feet per year of contaminated equipment.

In accordance with the RCRA Reauthorization Amendments of 1984, LLNL is developing a waste minimization program to reduce the quantity and toxicity of waste generated by LLNL operations. The initial objectives are to obtain detailed, process-specific information and to rank order the generating facilities by type and volume of waste generated. Implementation of the program will continue with education, dissemination of pertinent information to the generators and managers, and specific recommendations on how to minimize waste genertion. Improved housekeeping, product substitution, process modification, and recycling are also part of this long-term program. Large generators with the greatest potential for waste reduction will be targeted first in order to assure the largest benefit/cost ratio in the shortest time.

The projected impact of the waste minimization program based on source reduction and recycling (not including reductions due to treatment) on liquid waste volumes from all categories is provided in Table 1.2-2. Projected rates with and without waste minimization are given to the year 2000. The proposed DWTF is expected to become operational in 1992 and would have an expected lifetime of at least 25 years. The design basis for treatment capacity of the DWTF was determined in 1985 and updated in 1986 to be one million gallons per year. This capacity remains valid at this date, taking into account projected growth and the impact of waste minimization as indicated in Table 1.2-2. It is expected that the effects of waste minimization would be fully realized by the year 2000. LLNL growth beyond the year 2000 is possible, but not predictable at this time.

The waste quantities listed in Table 1.2-1 represents wastes, which are generated by normal activities, that would be processed through the proposed DWTF. The LLNL and Site 300 nonhazardous wastes discharged to the

TABLE 1.2-2. PROPOSED LLNL WASTE MINIMIZATION PROGRAM

Year	Estimated DWTF Waste Flow without Minimization (10^3 gal/yr)	Estimated DWTF Waste Flow with Minimization (10^3 gal/yr)
1986	670	670
1987	737	737
1988	811	811
1989	892	852
1990	919	822
1992	975	795
1994	1,034	779
1996	1,097	768
1998	1,164	759
2000	1,235	752

Source: LLNL, 1988a.

sanitary sewer are not included in these tables. Secondary wastes resulting from waste treatment processes (e.g., scrubber brinewater, laundry water, and ash from incineration) are not included in these tables. The proposed DWTF design would provide the capacity to treat these secondary wastes. In addition, radioactively contaminated clothing and equipment that are decontaminated and reused are not included in these tables.

1.2.3 Need for a Centralized Decontamination and Waste Treatment Facility at LLNL

Federal and state regulations currently restrict a large number of hazardous materials from being disposed of in landfills as untreated waste. Additional hazardous materials are under study by EPA and may also be banned from landfill disposal in 1990 in accordance with the RCRA Hazardous and Solid Waste Amendments of 1984 (40 CFR 268).

Consistent with its nationwide policy to reduce waste volumes and toxicity and to improve methods for managing nonradioactive, mixed, and radioactive wastes, DOE has reviewed various alternatives for managing wastes generated by LLNL. As a result of this review, DOE proposes to construct and operate a centralized DWTF at LLNL. The proposed DWTF would provide state-of-the-art treatment, processing, and storage for the nonradioactive (including hazardous), mixed, and radioactive wastes generated by LLNL. New decontamination facilities would also be provided in the proposed DWTF. The proposed DWTF, which would replace the HWM liquid and solid waste processing facilities, decontamination facility, and incinerator currently in use at LLNL, would be housed in an seven-building complex with a total of 87,800 square feet of covered area (see Figure 2.8-1). The design and arrangement of the buildings and equipment would optimize the efficient handling of wastes while minimizing the hazards associated with handling these wastes.

Existing liquid waste processing facilities can treat only about 22 percent of the 689,000 gallons of aqueous metal solutions generated each year by LLNL. RCRA regulations will impose bans on the landfilling of many of these metal solutions unless they are reduced in volume and solidified. The proposed DWTF liquid waste processing facility would allow LLNL to treat aqueous metal solution waste streams on site instead of dealing with increasingly difficult off-site disposal issues.

Because of its lack of particulate and acid gas control, the existing HWM incinerator is severely constrained in the types of wastes that it can incinerate. Only about 4 percent of the 159,000 pounds of combustible low-level radioactive solids produced annually by LLNL may be burned in the existing incinerator. This is because LLNL has implemented limitations on the daily and annual radioactive throughput of the incinerator. Liquids containing halogens also cannot be treated in the existing incinerator; thus, only 10 percent of the 114,000 gallons of combustible liquid wastes generated each year by LLNL can be incinerated. The proposed DWTF incinerator would be designed to burn essentially all of the combustible liquid and low-level solid wastes generated by LLNL in an environmentally safe manner.

Existing HWM decontamination operations would be moved from their current location in Building 419 to the proposed DWTF. The additional facilities would allow more extensive and cost-effective decontamination of tools and equipment. Airlock doors and double-filtered exhaust air from the proposed DWTF would assure a more environmentally safe operation.

Completed in October 1987, Building 693 was specifically built and permitted to store LLNL's hazardous waste. The building provides 9,600 square feet of enclosed storage space and incorporates design features for safe storage of hazardous wastes, including spill containment, incompatible waste segregation, and an automatic fire suppression system. The building was constructed under an Interim Status Document (ISD) granted by the DHS and EPA. An ISD gives initial approval for construction and operation of a hazardous waste facility while final permit approval is still under review.

Presently, mixed and radioactive wastes are stored outdoors in drums and other approved containers in the Area 612 paved yard. The proposed DWTF would provide 4,800 square feet for safe, enclosed storage of mixed and radioactive waste. An additional 4,800 square feet of enclosed storage space would be provided to store normally clean containers and supplies; however, the additional space could be converted for storage of either radioactive or hazardous wastes, since all safety and environmental measures required to store such wastes would be incorporated.

The existing receiving and classification area, located in the Area 612 yard, would continue to be used until the new DWTF receiving and classification area was completed. This area would provide 6,045 square feet of enclosed storage space, which would be used for both full containers awaiting treatment and empty containers. The DWTF would also include 6,400 square feet of outside storage space for parking tank trailers and portable tanks. Rainwater retention, spill containment measures, and segregation of incompatible wastes would be incorporated in this area.

The proposed DWTF would meet the waste management needs at LLNL for a 25-year period, consistent with the design waste quantities presented in Table 1.2-1. The DWTF would provide increased capabilities for managing diverse LLNL waste streams in a safer and more environmentally sound manner, thus reducing dependence on off-site treatment and disposal facilities.

In support of this waste management need and the public interest, this DEIS is intended to ensure that the potential impacts associated with construction and operation of the proposed DWTF are addressed. This DEIS has been prepared according to the requirements of the National Environmental Policy Act of 1969 (NEPA) guidelines and the requirements of the California Environmental Quality Act of 1976 (CEQA). The purpose of this DEIS is to provide environmental input to the decision-making process regarding the proposed action and the issuance of permits.

[THIS PAGE INTENTIONALLY LEFT BLANK]

CHAPTER 2.0

DESCRIPTION OF ALTERNATIVES

2.1 Introduction

The U.S. Department of Energy (DOE) has identified several potential strategies for managing nonradioactive (hazardous and nonhazardous), mixed, and radioactive wastes generated by the Lawrence Livermore National Laboratory (LLNL). These strategies were evaluated to identify reasonable project-specific engineering alternatives for detailed study. Figure 2.1-1 illustrates the strategies and alternatives considered. The four main hazardous waste management strategies identified by DOE are listed below and described in detail in the following sections:

1) No action (i.e., continued use of the existing waste management facilities);

2) Increasing off-site waste treatment and disposal at commercial or DOE facilities;

3) Upgrading the existing hazardous waste management (HWM) facilities; and

4) Developing new on-site facilities (considering alternative on-site locations and alternative technologies).

Project-specific engineering alternatives selected from within these strategies for detailed study are also discussed in greater detail in the following sections. The discussion in Section 2.6 compares the alternative hazardous waste management strategies and identifies the preferred strategy (development of new on-site facilities).

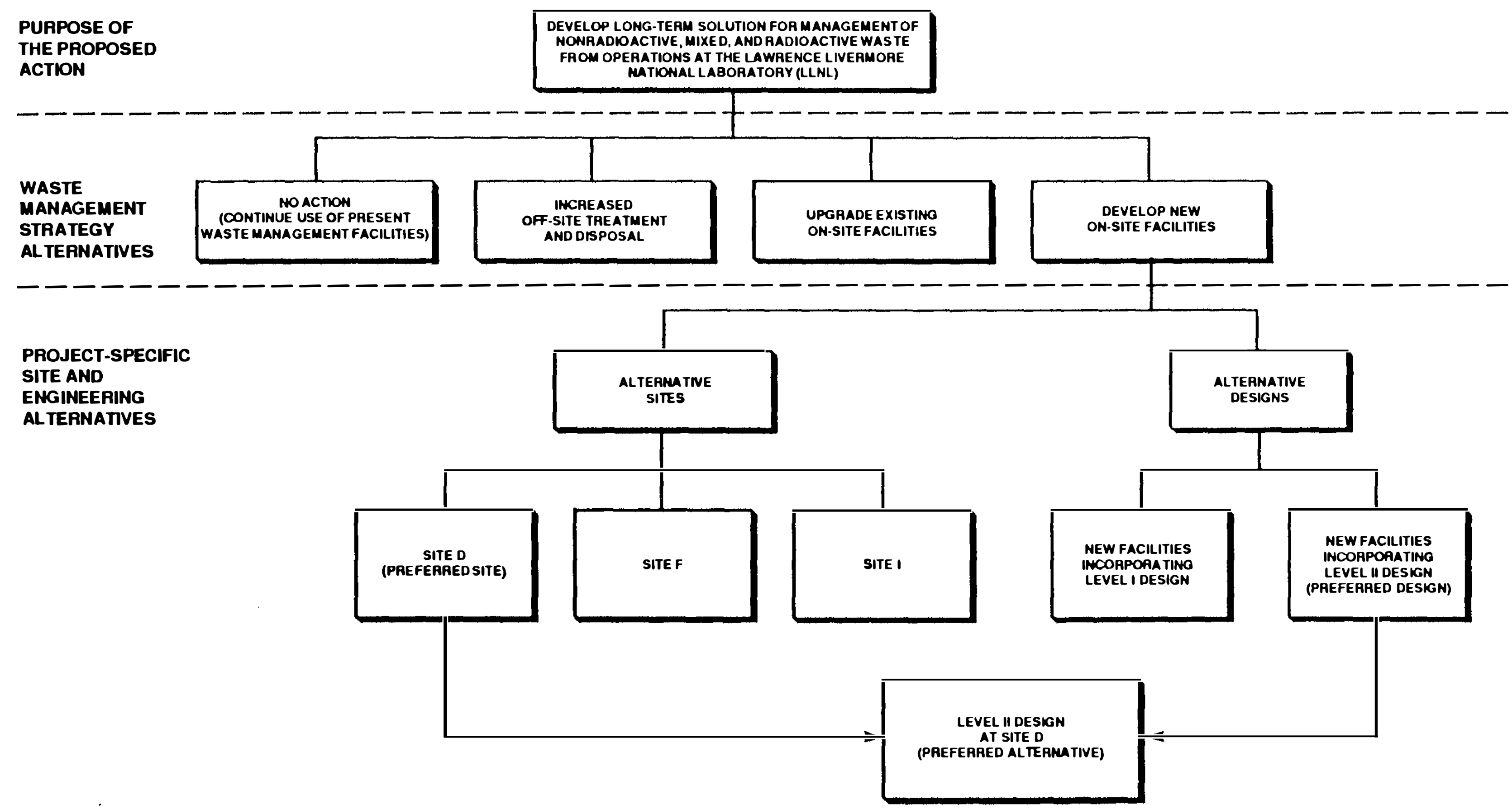


Figure 2.1-1. LLNL Waste Management Alternatives

0288-023-1

2.2 No Action

Continued use of the existing HWM facilities constitutes the no-action strategy. By definition, the no-action strategy represents no change from the current approach for managing wastes and protecting the environment at LLNL.

Continued use of the existing waste management approach would involve minimum on-site and maximum off-site treatment; on-site indoor storage of hazardous (nonradioactive) waste, and radioactive and mixed wastes; and the transportation of large volumes of wastes to off-site disposal facilities. The HWM Division of LLNL's Environmental Protection Department is responsible for collection, storage, treatment, and off-site shipment of nonradioactive, mixed, and radioactive wastes generated by LLNL (University of California, 1986). Table 2.2-1 presents the waste quantities processed at the existing HWM facilities in the fiscal year 1986.

As illustrated in Figure 2.2-1, the present waste management facilities include the decontamination facility (Building 419), the liquid waste treatment and solidification facilities (Buildings 514 and 513), other waste processing facilities (Buildings 612 and 624), and a hazardous waste storage facility (Building 693). Some liquid and solid wastes are incinerated in Building 624. Separate storage areas for mixed and radioactive wastes are maintained outdoors in the Building 612 yard. Radioactive materials are stored in Building 614 and polychlorinated biphenyls (PCBs) are stored in Building 625. These existing facilities, however, lack the space, safeguards, or capabilities to provide the on-site treatment required to meet future environmental regulations.

2.2.1 Existing Decontamination Facility

The existing decontamination facility, located in Building 419, is used to decontaminate both radioactive and nonradioactive equipment, parts, and supplies. The methods used for decontamination include acid baths, shot blasters, ultrasonic tanks, hydro finishing, chemical treatments, soap and water rinses, and degreasing operations using solvents, sandblasting, and

TABLE 2.2-1. LLNL WASTE PROCESSED AT EXISTING HWM FACILITIES IN FISCAL YEAR 1986[a]

Waste Type	Liquid Waste: Materials	Liquid Waste: Quantity (Pounds/Year)	Solid Waste: Materials	Solid Waste: Quantity (Pounds/Year)
Nonradioactive (includes hazardous and nonhazardous)	Organic solvents, oils and greases, plating solution, acids, rinsewater, organic and inorganic sludges[c]	4,876,940	Paper, rags, plastic film, animal biological waste	37,800
Mixed	Solvents, rinsewater, oils and greases, scintillation fluids	682,700	Vials and miscellaneous laboratory waste	3,000
Radioactive	None normally generated	0	Protective clothing (gloves, boots), paper, plastic, laboratory waste, noncombustible LLW and TRU waste, contaminated containers	442,000
TOTAL		5,559,640		482,800

Source: Hoyt, personal communication, 1988.

[a] Includes waste from LLNL main site, Site 300, and LLNL Airport Operations. Not included in this table are contaminated soils resulting from cleanup operations not associated with normal laboratory activity.

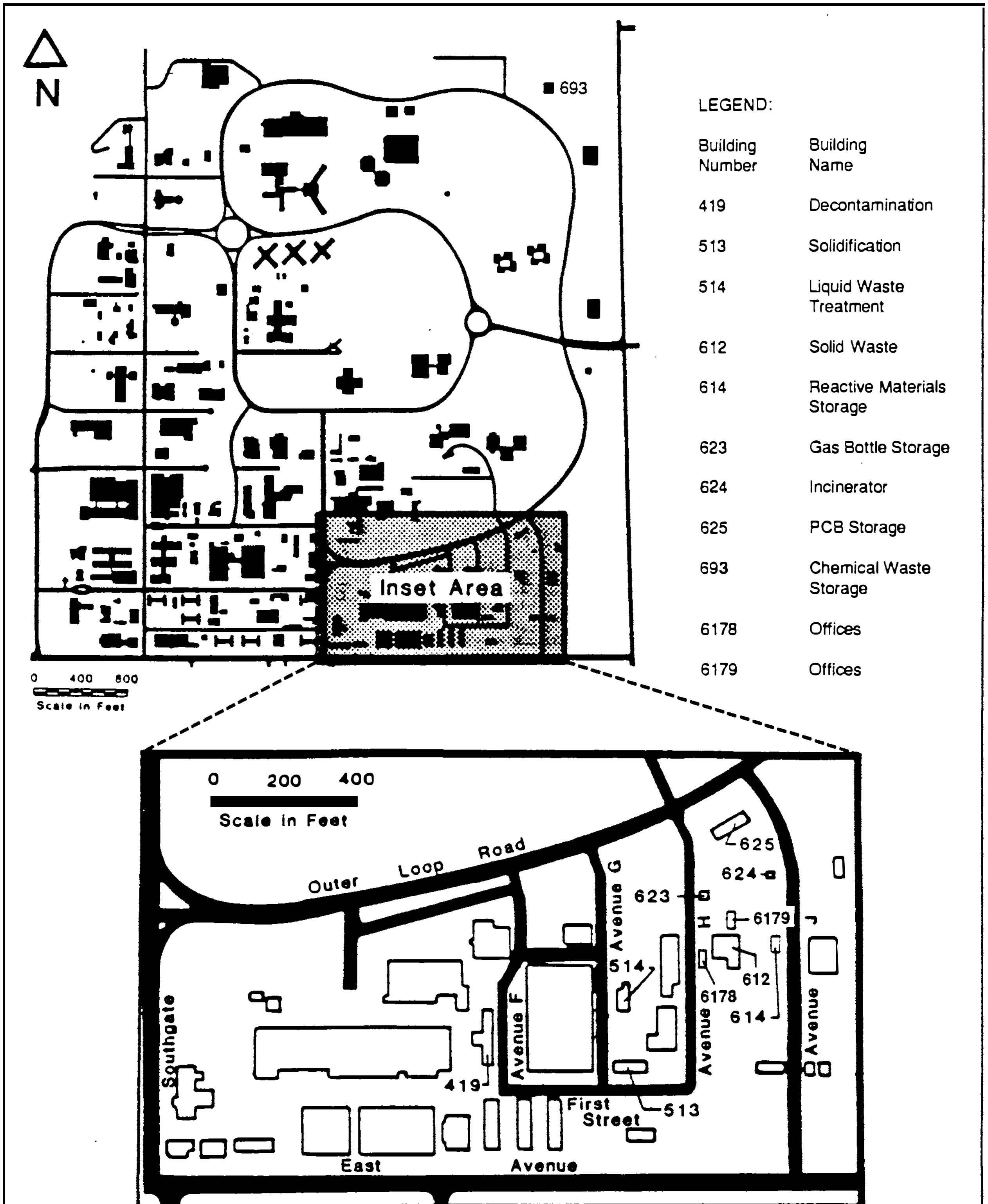


Figure 2.2-1. Present LLNL Waste Management Facilities

0288-023-7

baking. Size reduction operations are also conducted in the decontamination facility.

2.2.2 Existing Liquid Waste Treatment Facility

Liquid waste and wastewater are collected in retention tanks, carboys, or drums at the respective source locations throughout LLNL. There, the collected materials are sampled and analyzed, and the determined waste contaminant levels are compared to LLNL and City of Livermore discharge limits. If the levels of contaminants are below the regulatory limits, the material is released to the sanitary sewer. If contaminant levels are above regulatory limits, the material is labeled, placed in drums and portable tanks, and taken to Building 514 (the present liquid waste treatment facility) for treatment or transported off site for treatment or disposal. Approximately 62 percent of the liquid wastes are currently treated off site. The remaining 38 percent are treated on site.

Treatment options for liquid wastes and wastewaters include: 1) on-site treatment by methods such as precipitation or solidification; 2) on-site incineration; or 3) preparation for shipment and off-site disposal. Radioactive liquid wastes are currently treated by solidifying the precipitate and discharging the complying liquid effluent to the sanitary sewer. The solidified precipitate is transported for disposal at DOE's Nevada Test Site (NTS) near Mercury, Nevada. Dilute, hazardous (nonradioactive) liquid wastes are treated to remove contaminants before they are discharged to the sewer. Liquid hazardous and nonhazardous wastes that are not amenable to on-site treatment are transported off site in containers or tank trucks to appropriate commercial waste treatment, disposal, or recycling facilities.

2.2.3 Existing Waste Processing Facility

The facilities that presently process solid waste are located in Building 612. These facilities include equipment for solid waste packaging and compaction. Wastes that cannot be treated or incinerated on site are packaged in containers in compliance with U.S. Department of Transportation (DOT) and U.S. Nuclear Regulatory Commission (NRC) regulations. The packaged wastes are then transported to off-site disposal facilities. Radioactive wastes are shipped to NTS for disposal, and hazardous wastes are sent to DOE-approved commercial treatment, disposal, or recycling facilities. Mixed wastes are currently stored on site at LLNL, pending approval for NTS to accept mixed waste.

Solid waste receiving and classification are currently performed in a small open shed, which has limited space, in a yard adjacent to Building 612. Mixed and radioactive wastes are stored in drums and other approved containers in a paved and bermed area outside Building 612 that has a storage capacity of 16,000 square feet. In an effort to improve its hazardous waste storage capabilities, and in response to California Department of Health Services' (DHS) concerns about outdoor storage of hazardous waste, LLNL has constructed an enclosed hazardous waste storage building on the northeast corner of the LLNL site. The building contains 9,600 square feet of storage space and will store only nonradioactive hazardous waste, excluding reactive wastes. The facility contains four cells, separated by partitions, which are further subdivided into staging areas in a grid-like fashion that is composed of four rows containing ten columns. In order to ensure that incompatible wastes are segregated, each column is labeled according to the type of waste that could be placed within it.

Construction of this facility, which has been designated as the Chemical Waste Storage Building 693, was approved by DHS and the U.S. Environmental Protection Agency (EPA) under an Interim Status Document (ISD) in September 1986. The documents submitted by LLNL for this ISD are still under DHS and EPA review for final permit approval.

2.2.4 Existing Incinerator

The existing incinerator, located in Building 624, is a dual-chamber, controlled-air incinerator. It is used to reduce the toxicity and volume of a diverse mix of nonradioactive, mixed, and radioactive solid and liquid wastes. Liquid wastes are injected midway along the primary chamber of the incinerator. The nominal liquid waste injection rate is approximately 0.5 gallons per minute (gpm). A mechanical ram charging system feeds solid and containerized wastes through the end of the primary chamber. The maximum load capacity for solid and containerized waste is 25 kilograms. The design of this incinerator will constrain LLNL's future use of incineration as a method for waste destruction and volume reduction. The present incinerator is limited in the type of waste that it can burn (i.e., it cannot incinerate halogenated waste or large solid materials) due to the design of the incinerator (i.e., the size of the ram feed), and to comply with air pollution regulations (since the incinerator contains no pollution control equipment). Because the types of wastes that are burned by the incinerator are restricted, the facility complies with Resource Conservation and Recovery Act (RCRA) and Bay Area Air Quality Management District (BAAQMD) regulations for radionuclide and hazardous constituent emissions. Current operation of the incinerator is authorized by an ISD pending approval of a final permit. Without this permit, the incinerator cannot burn hazardous waste after November 8, 1989. A trial burn will be conducted to verify compliance with emission limitations prior to issuance of that permit.

2.2.5 Summary

The no-action alternative would involve the continued use of the present HWM facilities and would not meet the long-term needs of LLNL. The current facilities cannot meet these long-term needs because:

- The facilities are physically constrained in the size and volume of wastes they can handle;
- Large volumes of waste must be treated and disposed of off site;
- The facilities are outmoded and dispersed in several locations, resulting in inefficient operations;

- Facilities do not provide weather protection for mixed and radioactive wastes currently stored outdoors;

- Existing spill prevention control and containment in the outdoor storage area are marginal; and

- Facilities currently do not exist to process reactive wastes.

These constraints limit LLNL's ability to meet more stringent future regulations or to reduce the types and quantities of wastes shipped off site. In view of the above constraints, the no-action alternative is not considered a long term solution for managing LLNL's wastes.

2.3 Increasing Off-Site Waste Treatment and Disposal at Existing Commercial and DOE Facilities

Another strategy alternative considered for managing wastes generated by LLNL is increased off-site waste treatment and disposal. As indicated in the discussion of the no-action strategy, existing operations already include a considerable amount of off-site treatment and disposal. Currently, 82 percent of the wastes generated at LLNL is treated and disposed of off site, requiring 287 truck trips per year. The off-site treatment and disposal strategy differs from the no-action strategy in that on-site treatment and storage would be purposely minimized, and off-site treatment and disposal would be maximized. LLNL on-site HWM facilities would focus on providing services for waste receiving, packaging, classifying, and off-site shipping, and would provide a minimal amount of waste treatment on site. Radioactive and mixed liquid waste would require treatment and solidification prior to off-site shipment. Under the off-site treatment and disposal strategy, approximately 86 percent of the LLNL waste would be treated and disposed of off site.

2.3.1 Commercial Treatment and Disposal Facilities

DOE allows off-site treatment and disposal of hazardous (nonradioactive) wastes only at suitable facilities that have been permitted to operate by EPA or state regulatory agencies (Walker, 1986). The fundamental purpose of this DOE policy is to minimize potential risks to public health and the environment and potential government liability for future cleanup costs. Responsible on-site waste treatment is fully consistent with this policy (Davis, 1986).

However, there are two significant limitations to using off-site facilities for land disposal. First, due to environmental contamination, many existing sites in the United States have been required to cease operations and close. As a result, the available capacity for hazardous waste disposal in California and other states is becoming increasingly constrained. Further, disposal of hazardous waste will become even more difficult in the future as existing commercial disposal sites approach capacity. The available land disposal options in the United States are severely constrained, as indicated below. These options include (Davis, 1987):

- Two burial cells at U.S. Pollution Control Inc.'s facility at Grassy Mountain, Utah;

- One burial cell at Chemical Waste Management's Kettleman Hills facility in Central California;

- One double-lined cell at Envirosafe's Idaho landfill; and

- One double-lined cell at the Chem Securities facility near Arlington, Oregon.

Several other commercial land disposal facilities are located in the western United States; however, these facilities do not conform to the DOE off-site disposal policy for hazardous wastes for the following reasons (Davis, 1987):

- Casmalia Resources hazardous waste facility in Santa Barbara County, California does not have a double-lined landfill.

- Petroleum Waste Industries, located near Bakersfield, California, has a triple-lined pit, but the synthetic liners do not conform to EPA thickness standards.

- International Technology Corporation (IT) facilities (in Imperial, Benicia, and Martinez, California) are all out of compliance; therefore, they are ineligible to receive hazardous wastes generated at a DOE facility.

Table 2.3-1 identifies all of the currently permitted, interim permitted, and proposed commercial incinerators located in the western United States. This table also identifies the types of wastes that these incinerators will not accept. Facilities using only liquid injection incineration are capable of destroying liquid hazardous wastes; the other incinerators can handle both liquids and solids. A majority of the facilities do not accept mixed or radioactive solid wastes. Radioactive and mixed wastes generated from DOE facilities are required to be disposed of at DOE-approved sites.

The second significant limitation concerning off-site land disposal involves constraints imposed by federal and state regulations prohibiting or limiting the types and amounts of untreated hazardous materials that may be disposed of on land. Recent regulatory amendments to the Resource Conservation Recovery Act (RCRA) (Hazardous and Solid Waste Amendments of 1984; Public Law 98-616, Section 1; 40 CFR 268.30 es.), coupled with existing state law (22 California Code of Regulations Section 66,900 es.), show a strong bias against land disposal of waste. Wastes that have been or will be banned from land disposal by July 8, 1989 include PCBs, halogenated solvents, strong acids, wastes containing halogenated organics, and liquids containing cyanides or various other metals at specific concentrations. These prohibitions are illustrated by hazardous material type and concentration in Table 2.3-2.

TABLE 2.3-1. PERMITTED, INTERIM STATUS, AND PROPOSED COMMERCIAL HAZARDOUS WASTE INCINERATORS IN THE WESTERN UNITED STATES THAT ACCEPT OFF-SITE WASTE

Company	Location	Permit Status	Incinerator Design	Wastes Not Accepted
ENSCO	El Dorado, AR	IS	Rotary kiln, liquid injection	Waste with high heavy metal content, dioxins, explosives
Stauffer Chemical	Martinez, CA	Proposed	Liquid injection	PCBs, explosives, radioactive wastes, solids
CTTS	Vernon, CA	Proposed	Liquid injection	Solids, PCBs, explosives, radioactive wastes, dioxins
Rollins Environmental Services	Baton Rouge, LA	IS	Liquid injection and rotary kiln	Explosives, radioactive wastes, dioxins, halogenated wastes (Cl, F)
Stauffer Chemical	Baton Rouge, LA	Proposed	Liquid injection	PCBs, explosives, radioactive wastes, solids
Rollins Environmental Services	Deer Park, TX	IS	Rotary kiln	Radioactive wastes, explosives, dioxins

(Continued)

TABLE 2.3-1. (Continued)

Company	Location	Permit Status	Incinerator Design	Wastes Not Accepted
Stauffer Chemical	Houston, TX	Permitted	Liquid injection	PCBs, explosives, radioactive wastes, solids (prefer high sulfur content waste streams)
Stauffer Chemical	Bay Town, TX	IS	Liquid injection	PCBs, explosives, radioactive wastes, solids

Source: Personal communications with R. Beckwith, F. Fontus, W. Bahm, S. Baxter, D. Erickson, and A. Rege (1988).

IS = Interim Status

TABLE 2.3-2. LAND DISPOSAL PROHIBITION BY HAZARDOUS MATERIAL TYPE AND CONCENTRATION

Effective Date of Land Disposal Prohibition	State Regulations[a]	Federal Regulations[b]
Either currently prohibited or will be prohibited by July 8, 1989	• Liquids containing: - Free cyanides (≥ 1,000 mg/l) - Arsenic (500 mg/l) - Cadmium (100 mg/l) - Chromium (500 mg/l) - Lead (500 mg/l) - Mercury (20 mg/l) - Nickel (134 mg/l) - Selenium (100 mg/l) - Thallium (130 mg/l) - PCBs (≥ 50 ppm)	• Liquids: same as state prohibitions
	• Liquids: - pH ≤ 2.0	
	• Wastes containing halogenated organics: - Liquid wastes (≥ 1,000 mg/kg) - Organic sludges (≥ 1,000 mg/kg) - Organic solids with halogenated organic compounds (≥ 1,000 mg/kg)	• Wastes containing halogenated organics: same as state prohibitions
Prohibition by November 8, 1988		• Dioxin-containing wastes
Currently prohibited		• Solvents
May 8, 1990[c]		• All other hazardous wastes listed in EPA regulations

[a] 22 California Code of Regulations 66,900 es.

[b] Hazardous and Solid Waste Amendments (1984), Public Law 98-616, 40 CFR 268.10-12; 40 CFR 268.30, 268.31.

[c] By May 8, 1990, EPA will review approximately 150 hazardous material wastes to determine whether individual substances should be banned from land disposal. Failure to review these substances by certain prescribed deadlines will result in the prohibition of as few as 50 and as many as 150 substances from land disposal.

The federal government has taken a further step toward eliminating the land disposal option by charging EPA with the responsibility of reviewing a list of hazardous wastes, which is representative of all other hazardous materials regulated by the EPA, by May 8, 1990. Congress has established this program such that if EPA fails to make its determination, land disposal of these designated wastes will be prohibited entirely.

Those hazardous materials generated at LLNL that are currently prohibited from land disposal, as well as those materials that could likely be prohibited (either by EPA determination or EPA failure to review under the provision discussed above) are:

- Acetone;
- Acetonitrile;
- Benzene;
- Benz(a)anthracene;
- Chloroform;
- Dibutyl phthalate;
- Ethylene dibromide;
- Ethylene dichloride;
- Fluorotrichloromethane;
- Methyl ethyl ketone;
- Methanol;
- Methylene chloride;
- Perchloroethylene;
- Tetrachloroethane;
- Tetrahydrofuran;
- Toluene;
- Trichloroethane;
- Trichloroethylene;
- Various heavy metals;
- Xylene; and
- 1,1,2-Trichloroethane.

Land disposal restrictions for hazardous waste solvents has encouraged the development of alternative hazardous waste treatment and disposal technologies. Numerous commercial incinerators are in the planning and developmental stages throughout California and the United States. The availability and compatibility of these planned incinerators with the hazardous wastes generated at LLNL are unknown. However, Table 2.3-1 indicates that commercial incinerators typically do not accept mixed or radioactive wastes. Increased use of off-site commercial treatment facilities would result in increased transportation costs and an increase in potential risk and liability since wastes would not be controlled by LLNL or DOE (see Table 4.2-12).

2.3.2 DOE Facilities

DOE does not currently operate facilities that dispose of hazardous or mixed wastes, but DOE does operate six major waste disposal facilities for radioactive wastes. These DOE waste disposal facilities are: Hanford Reservation near Hanford, Washington; Idaho National Engineering Laboratory near Idaho Falls, Idaho; Nevada Test Site (NTS) near Mercury, Nevada; Los Alamos National Laboratory near Los Alamos, New Mexico; Savannah River Plant near Aiken, South Carolina; and Oak Ridge National Laboratory near Oak Ridge, Tennessee. LLNL currently ships radioactive waste for disposal to the NTS facility. Mixed waste generated by LLNL is currently and will continue to be stored at LLNL until appropriate on-site treatment and off-site disposal options are available. When the proposed DWTF is operational, treated mixed wastes would be shipped off site to NTS on a continuing basis for disposal. The NTS facility has submitted a permit application to the State of Nevada requesting authorization to accept mixed waste. NTS is expected to receive authorization to accept mixed waste by 1990 (Roberts, 1988).

2.3.3 Summary

The off-site treatment and disposal strategy would involve increased reliance on off-site waste treatment and disposal facilities. The disadvantages associated with using these facilities are listed below:

- Currently, existing off-site facilities (especially landfills) have limited capacities. Increased shipments to these facilities would place added stress on their disposal capabilities.

- Transport on public highways of larger quantities of untreated waste increases the risks associated with accidents and spills.

- EPA, DOE, and state policy encourages the development of alternative waste treatment options at the point of generation, and discourages traditional land disposal methods.

- Stringent federal and state regulations currently restrict a large number of hazardous materials from being disposed of on the land as untreated waste. Many more hazardous materials that are currently under study may be banned by the EPA by 1990.

- Transporting waste materials off site for treatment and disposal would result in greater risks to the environment from improper treatment or disposal and greater liability to DOE.

For these reasons, the increased off-site treatment and disposal strategy is not considered to be feasible and will not be considered for further analysis in this EIS.

2.4 Upgrading the Existing HWM Facilities

Upgrading the existing on-site facilities at LLNL is another strategy alternative considered for managing LLNL wastes. The on-site facilities that manage wastes at LLNL that would be upgraded under this alternative are described below.

2.4.1 Existing Facility Modifications

Specific changes to upgrade the existing HWM facilities for treating, processing, and storing waste, and decontaminating equipment at LLNL would include the following:

1) Decontamination Facility. New and improved equipment (e.g., ventilation, air locks, and electrical system) would be added to improve operator safety, reduce the potential for atmospheric emissions, and overcome operational difficulties, such as physical limitations on the size of equipment that can be decontaminated. More space is needed to expand or reconstruct decontamination capabilities.

2) Liquid Waste Facility. Unloading and treatment areas would be upgraded to contain accidental spills and leaks. Operations would be modified to reduce personnel exposures and direct handling. Tanks open to the atmosphere would be replaced. Capabilities would be expanded to allow treatment of large percentages of generated waste volumes and to allow compliance with more stringent regulatory requirements. Modifications are needed to separate radioactive and hazardous waste treatment processes and equipment. In addition, the existing solidification facility would be replaced to provide waste confinement and segregation capabilities.

3) Solid Waste Facility. Close-capture ventilation and access control would be added to provide positive containment of radioactive emissions. The radioactive wastes storage area would be improved to provide proper segregation, weather protection, and spill prevention and containment measures. The compaction and drum crushing areas would be upgraded to ensure prevention of accidental emissions and to improve personnel safety.

4) Incineration. The design of the existing incinerator restricts LLNL's capability and flexibility for waste destruction and volume reduction. This incinerator has been upgraded to meet RCRA requirements through the addition of continuous emissions monitoring and waste feed cutoff systems. However, further means of upgrading the existing incinerator for incinerating a wider variety of liquid and solid radioactive wastes are limited. A new larger incinerator with the required pollution control systems could be installed if approved by regulatory agencies.

5) Storage. Hazardous wastes are stored in Building 693. New indoor storage would be required for mixed and radioactive wastes presently stored outdoors in the yard adjacent to Building 612. Receiving and classification areas are also limited in capacity and would require a major upgrade.

A combination of modifying the existing Area 612 facilities and constructing decontamination, solidification, receiving/classification, and liquid waste treatment facilities in the vicinity of the existing Area 612 would be required to provide a centralized and efficient upgrading of existing HWM facilities. This would constitute a major upgrade, which is not feasible as discussed below.

2.4.2 Existing HWM Site

The necessary upgrades to facilities, consolidation of facilities, or both, would constitute a major modification at the existing HWM site. This modification would require a new hazardous waste facility permit and compliance with facility location seismic standards dictated by RCRA and the State of California.

In 1985, a crack in the pavement was discovered east of Building 618 near the HWM area (Building 612). LLNL and consulting geologists for the State of California conducted a seismic investigation of the newly discovered crack. The investigation concluded that it would be costly and difficult, if not impossible, to conclusively prove compliance with state and federal seismic location standards and to verify that the crack was not fault induced (Geomatrix, 1985a). This verification is a requirement for permitting major modifications to or new construction of a hazardous waste facility (40 CFR 264.18[a] and CCR Title 22, Chapter 66391[a][11][A]). Under the federal regulations, new hazardous waste treatment, storage, and disposal facilities must not be within 200 feet of a fault that has had displacement in recent geologic time (the Holocene period, which is the last 10,000 to 12,000 years). California seismic location standards require that new hazardous waste facilities or a hazardous waste facility undergoing substantial modification, which are located within 3,000 feet of a fault that has had displacement within the Holocene period or has lineations that suggest the presence of such a fault, must undergo a comprehensive geologic investigation to demonstrate that the facility is not located within 200 feet of a fault. The existing HWM facilities are approximately 1,400 feet from the Las Positas Fault (see Figure 3.2-3).

An LLNL evaluation (Godwin, 1987) indicated that the design capacity of the existing 25,000-gallon storage tanks would have to be decreased due to limitations of berm storage in the event of a spill.

2.4.3 Summary

The existing LLNL facilities that manage wastes include those for decontamination, liquid waste processing, solid waste processing, storage, incineration, size reduction, and packaging for off-site transport. All existing HWM facilities, with the exception of the Chemical Waste Storage Building 693, would require a major upgrade to provide adequate storage and treatment systems for the long-term management of hazardous, mixed, and radioactive waste at LLNL. Without considering any other limitations, such as lack of available space or dispersed location of facilities, the major problem with performing a major upgrade of the existing HWM facilities is the difficulty of proving compliance with the RCRA and state seismic location standards. Geotechnical experts have concluded that it would be very difficult, if not impossible, to conclusively prove compliance with the standards and, therefore, a permit modification for a major upgrade could not be issued.

2.5 Developing New On-Site Facilities

The development of new hazardous waste management facilities at LLNL is another strategy considered for managing LLNL waste. In evaluating this strategy, both alternative sites and alternative designs were reviewed. Alternative sites, including the preferred site, are discussed in Section 2.7. Design alternatives, including the preferred design, are discussed in Section 2.8.

The development of new hazardous waste management facilities would offer several opportunities to avoid many of the problems associated with the current waste management practices at LLNL or with the alternative waste management strategies that would be modifications of current practices. From an operational viewpoint, a new facility could be designed that would provide LLNL with more flexibility in treating a wider variety of wastes than is currently possible. This would reduce the amount of waste material that has to be transported off site for treatment or disposal. Planning a new hazardous waste management facility would also allow LLNL to consolidate all hazardous waste management activities into one location on a new site, making it easier to manage and control this activity. From an environmental viewpoint, a new facility could be designed to take advantage of the best available technology for containing, controlling, and treating wastes with minimal environmental impact. A new facility could also be constructed on a new site that would comply with the seismic location standards of RCRA and the state for siting hazardous waste facilities.

2.5.1 Summary

The development of new on-site facilities would provide LLNL with modern, safer, and more environmentally acceptable facilities to treat and store LLNL's hazardous, mixed, and radioactive wastes on an acceptable site that would meet regulatory seismic location standards.

2.6 Comparison of Alternative Hazardous Waste Management Strategies

As shown in Figure 2.1-1 and discussed above, four strategies were evaluated for managing wastes generated at LLNL:

1) No action;
2) Increasing off-site waste treatment and disposal;
3) Upgrading existing hazardous waste management facilities; and
4) Developing new on-site facilities.

Table 2.6-1 provides a comparison of environmental impacts associated with each of these basic strategies. In summary, the no-action strategy was rejected because it does not provide the safeguards or capabilities needed for on-site treatment required by future regulations. The no-action strategy prolongs existing waste management practices that need to be improved to meet future environmental standards. The strategy of increasing off-site waste treatment and disposal was rejected because EPA, DOE, and state policy discourages waste management strategies that require off-site disposal, particularly when that disposal is by traditional landfilling. Upgrading the existing hazardous waste management facilities was rejected because the existing facilities cannot be upgraded to the standards desired and because it cannot be proved conclusively that the existing site complies with the seismic location standards required for new or substantially modified facilities.

The preferred hazardous waste management strategy is the development of new on-site facilities. Several project-specific engineering alternatives for implementing this strategy have been proposed and subjected to environmental analysis. These include nine alternative project sites within the LLNL boundaries and two alternative incinerator designs. These site and engineering design alternatives are described below.

TABLE 2.6-1. COMPARISON OF THE ENVIRONMENTAL IMPACTS ASSOCIATED WITH EACH OF THE HAZARDOUS WASTE MANAGEMENT STRATEGIES

Impact	No Action	Increased Off-Site Treatment and Disposal	Upgrade Existing On-Site Facilities	Develop New On-Site Facilities (preferred strategy)
Air Quality	No significant air quality impacts.	Small, but insignificant improvement in local air quality due to reduce use of existing incinerator. Degradation of air quality along transportation corridors.	Small, but insignificant degradation of local air quality due to additional incineration activity.	Small, but insignificant degradation of local air quality.
Health Effects	No significant health effects from continued operation of HWM facility.	Reduction in health risk in the vicinity of LLNL would be offset by increases in health risk along transportation corridors and at the ultimate disposal location.	Health risk might increase if the existing incinerator could not be retrofitted with additional controls to offset the increased throughput.	ALARA release design would minimize radionuclide and hazardous chemical effects.
Seismic	The existing HWM facility is not required to comply with the State of California Hazardous Waste Control Act (HWCA) and RCRA and state siesmic location standards.	An off-site disposal location could present less seismic risk than the LLNL site.	Cannot be proved conclusively that existing HWM site would comply with state or federal seismic location standards for new hazardous waste management facilities. Therefore, a major upgrade at existing on-site facilities is not feasible.	A detailed seismic trenching investigation was performed to verify that compliance with state and federal seismic location standards. Absence of liquefaction was also verified.
Ground Water/Surface Water	Outdoor storage of waste drums. Relative to other alternatives, there is a higher risk of surface and ground-water contamination due to potential spills and leaks of waste.	Reduction in risk of contamination of ground/surface waters at LLNL. Increased risk of surface water contamination due to spills along transportation corridors.	Adequate spill prevention and weather protection would be difficult to achieve at this site. This, along with seismic risk, increases the likelihood that spills at this site could contaminate surface and ground water.	No adverse ground water/surface water impacts expected. Spill containment systems designed for essentially zero or ALARA releases.
Vegetation and Wildlife	No impacts.	No impacts.	No impacts.	No impacts.
Cultural Resources	No impacts.	No impacts.	No impacts.	No impacts.
Socioeconomics	No impacts.	No impacts.	No impacts.	No impacts.
Noise	No impacts.	Increased truck noise along transportation corridors.	No significant impacts.	No significant impacts.

(Continued)

TABLE 2.8-1. (Continued)

Impact	No Action	Increased Off-Site Treatment and Disposal	Upgrade Existing On-Site Facilities	Develop New On-Site Facilities
Accidents/Occupational Risks	No significant impacts. Facility safety procedures and operational safety procedures are in place. Preliminary safety reports have been prepared.	No increased risk of accident at LLNL, but some increase in risk of transportation accidents.	Physical space constraints and cumbersome waste handling requirements increase risk of occupational exposure.	No significant impacts. Design features and mitigation would reduce the probability of releases to extremely low levels.
Waste Disposal Transportation	Waste transport to disposal sites requires 287 truck trips per year with a significant amount of waste being shipped untreated due to limitations and capacity of existing HWM facilities. An accident would be expected to occur every 1.2 years.	Waste disposal transport off site would require 328 truck trips per year. An accident would be expected to occur every 1.1 years.	Waste disposal transport off site would be reduced, but not eliminated because the existing facility cannot be upgraded to treat all wastes since a major upgrade would not be permitted due to seismic location standards. Would require at least 81 truck trips per year.	Transport of treated waste for disposal would require 85-91 truck trips per year. An accident would be expected to occur every 4.1 - 4.4 years. A traffic accident would be expected to result in a lower chance of impacts on health as compared to the no-action alternative. This is due to the increased treatment and solidification of the waste prior to shipment.
Off-Site Treatment and Disposal Sites	High toxicity waste would be transported off site for treatment and disposal. Eighty-two percent (about 7.8 million lb/yr) of LLNL waste would be treated and disposed off site; however, off-site treatment facilities for the types of wastes generated at LLNL may not be available.	One hundred percent (9.3 million lb/yr) of high toxicity waste would be transported off site for treatment and disposal. However, the treatment and disposal capacity of existing sites is limited. Landfilling designated hazardous chemicals will be banned by federal law. Therefore, this alternative is not feasible.	At least 35 percent (3.3 million lb/yr) of high toxicity waste would be transported off site for treatment and disposal.	A smaller volume of low toxicity waste would result from incineration and liquid waste treatment. Radioactive solid waste not incinerated would be shipped to NTS. Seven to nine percent of LLNL waste would be treated and disposed off site.
City of Livermore Sewage Treatment Plant	A minor potential for accidental release exists. Catchment basins are currently in place for all liquid storage tanks. In case of an accident, the sewer system has diversion and retention capability to intercept any waste if given sufficient notification. No change in wastewater discharge to City of Livermore Sewage Treatment Plant.	Some reduction in the potential for accidental releases. Small reduction of LLNL total wastewater discharge to City of Livermore Sewage Treatment Plant.	No increases in the potential for accidental releases. Four percent increase in total LLNL wastewater discharge to City of Livermore Sewage Treatment Plant.	A negligible potential for accidental release exists since all treated waste would be retained in dedicated monitoring tanks until analysis verifies compliance with discharge standards. Catchment basins would also be designed into the system. Four percent increase in total LLNL wastewater discharge to City of Livermore Sewage Treatment Plant.

ALARA = as low as reasonably achievable.

2.7 Alternative Sites

Nine alternative sites were identified as potential DWTF sites. The nine sites (designated A through I) are illustrated in Figure 2.7-1. Sites A through D are located within the LLNL historical boundary. Sites E through I are located in the DOE buffer zone (illustrated in Figure 2.7-1), which provides additional physical security for LLNL operations. Of the nine sites, three (A, B, and C) were eliminated because of conflicts with future LLNL program plans, and three others (E, G, and H) were dropped because they would be more difficult to adapt to the proposed DWTF configuration than other sites located in the same general area. Three alternative sites were identified as reasonable for detailed study. The following criteria were considered in developing a list of potential alternative sites:

- Potential for seismic acceptability (i.e., complying with federal and state seismic standards);
- Consistency with the LLNL Development and Facility Utilization Plan;
- Site availability;
- Proximity to residential areas;
- Additional costs (utilities, relocation or demolition of existing facilities); and
- Security concerns (requirements for special security handling and DOE approval).

These three sites (D, F, and I) were examined in detail (LLNL, 1985). The results of this detailed site analysis, which are presented in Table 2.7-1, indicate that Site D, located in the northwest corner of the LLNL site, is the preferred site. The specific advantages to this site are listed below.

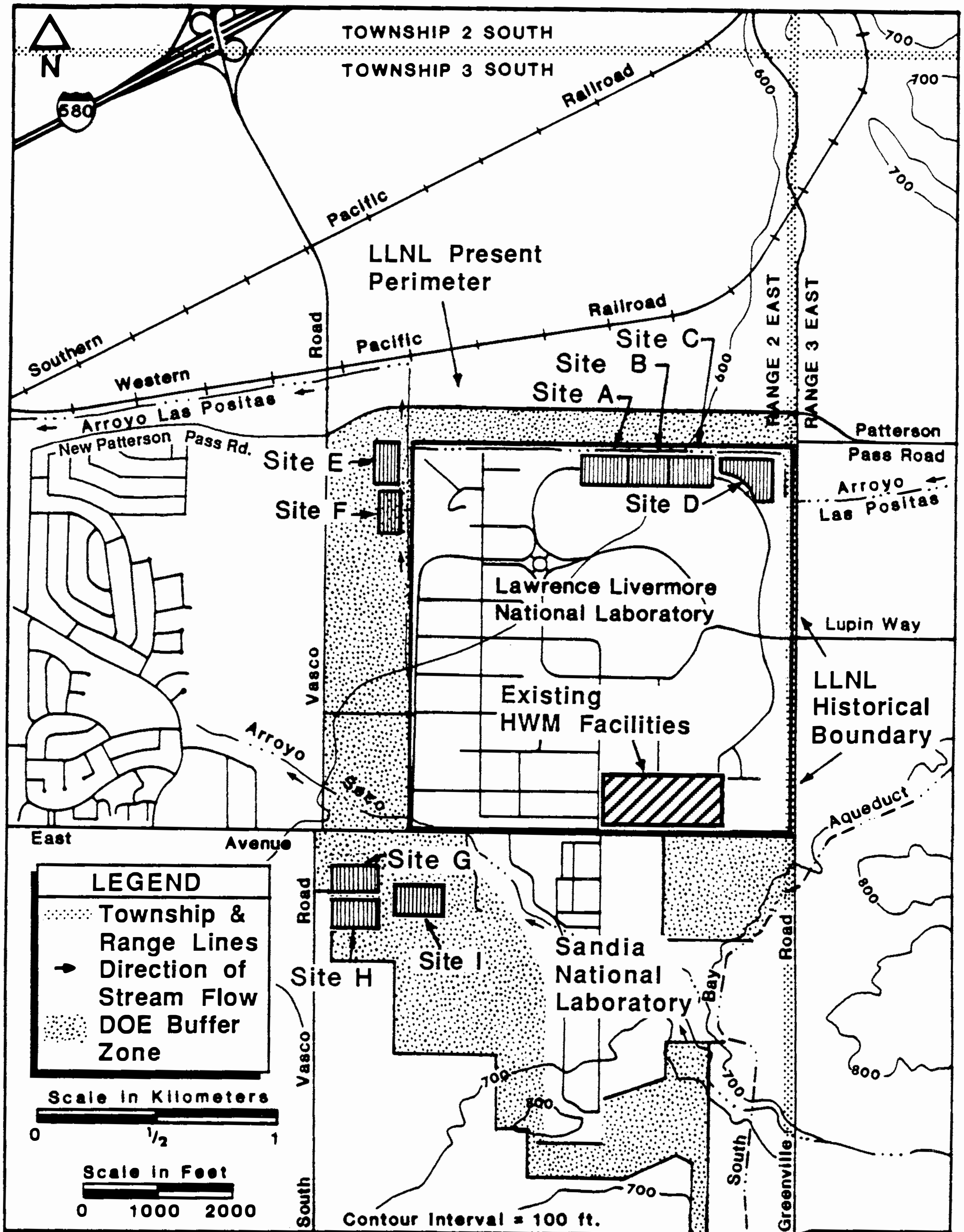


Figure 2.7-1. Potential DWTF Sites

0288-023-3

TABLE 2.7-1. SITE SELECTION ANALYSIS

Site Selection Criteria	Site D (NE Area)	Site F (NW Area)	Site I (S of East Ave)
Potential Seismic Acceptability	2	1	4
Site Development Consistency	1	2	4
Site Availability	1	3	4
Proximity to Concentrated Residential Areas	1	3	2
Site Development Costs	3	1	2
Proximity to Sensitive LLNL Facilities	1	2	2
Security Concerns	1	2	3
TOTAL	10	14	20

Scale: 1 = Most desirable
4 = Least desirable

Source: LLNL, 1985.

- The location is most consistent with LLNL Site Development Plan criteria.

- The site is available within the LLNL historical boundaries.

- The site is located away from concentrated residential areas.

- The site is not adjacent to sensitive LLNL facilities.

The utility services for the proposed DWTF at Site D would be connected to the current utilities extension, which is to be routed along the Outer Loop Road. This extension would service planned facilities including the DWTF in the northeast quadrant of LLNL.

LLNL also conducted an extensive geotechnical investigation to determine the seismic acceptability of Site D and its compliance with the location standards in 40 CFR 264.18 and Title 22, Chapter 30, Section 66391 (a) (11) (A) of the California Code of Regulations. A trench that is 1,300 feet long, at least 12 feet deep, and 3 feet wide was excavated and logged in late 1985. The investigation, performed in conjunction with periodic field visits by state geologists, concluded that the Site D location was acceptable for siting a new hazardous waste facility (Weiss Associates, 1985; Towse and Carpenter, 1986).

2.8 Alternative Designs

In 1984, an extensive hazardous waste management study was undertaken to determine the best way to improve the management of nonradioactive (hazardous and nonhazardous), mixed, and radioactive waste generated by the LLNL programs (Arthur D. Little, Inc., 1984). Treatment technologies applicable to the hazardous waste categories at LLNL were evaluated. The study presented several treatment options that would assure compliance with environmental regulations. In 1985, a process review examined and validated the treatment technologies proposed in the study. Two levels of design, Level I and Level II, are the resulting viable design alternatives that incorporate the latest technologies to treat the wide range of LLNL generated wastes. Level II, the preferred alternative, is discussed first.

2.8.1 Level II Design

Level II, the preferred design, would replace the existing liquid and solid waste processing and treatment facilities, incinerator, decontamination facility, and outdoor waste storage currently in use at LLNL. Building 625 (PCB Storage) and the recently completed Building 693 (Chemical Waste Storage) are the only existing HWM facilities that would remain operational under this preferred alternative. The existing controlled air incinerator would be closed as a hazardous waste unit, but would remain in place for potential future use to incinerate nonhazardous material such as paper and classified documents. The Level II design would enhance waste management at the laboratory through the addition of a new, centralized, six-acre facility providing waste treatment, processing, and storage. The preferred site plan is illustrated in Figure 2.8-1.

The Level II design would consist of five new buildings and equipment that would consolidate the management of LLNL nonradioactive (hazardous and nonhazardous), mixed, and radioactive waste operations. The major facilities included in the Level II design are discussed below.

2.8.1.1 Solid Waste Processing and Waste Receiving/Classification Building

This building would provide a covered unloading area for tank trucks and containers, and would function as a receiving and classification area for incoming containerized waste. Additional operations performed in this facility would include rinsing empty chemical waste drums, rinsing tank trucks, crushing empty radioactive and hazardous waste drums, and compacting solid waste in drums. The waste receiving/classification area of this building would be used for temporary storage of waste coming into the facility until it was classified and routed for treatment or storage. This area would also hold any overflow of solid waste to be incinerated. Two separate bermed areas in the building would segregate incompatible waste. The dimensions of this

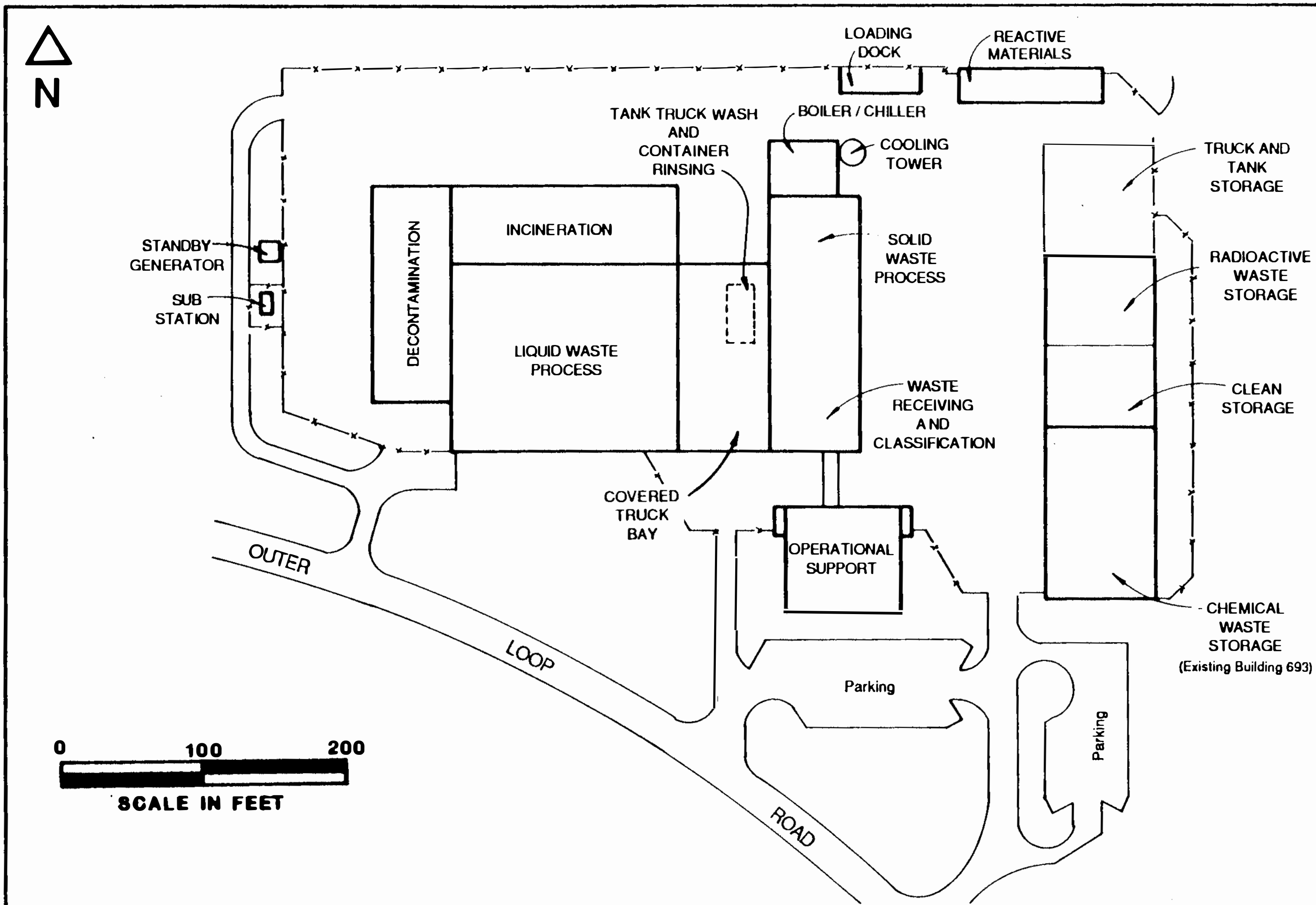


Figure 2.8-1. Layout of the Proposed DWTF at the Preferred Location, Site D

0288-023-2

building would be 67 feet by 180 feet; the overall building height would be 26 feet.

Trucks or vans delivering solid wastes for packaging, processing, or temporary storage in the DWTF would be checked in at the waste receiving/classification area of this building. Drums and other waste containers would be directed to the appropriate treatment, packaging, and storage areas. Solid waste suitable for incineration would be stored in the incinerator staging area before being sent to the incineration process area, with overflow temporarily stored in the waste receiving/classification areas. Drums of solid waste not suitable for incineration would be transferred to the solid waste processing area where the waste would be compacted in 55-gallon drums.

Drums containing liquid would be sent to the appropriate liquid waste unloading area for storage in receiving tanks in preparation for treatment. Empty drums that had previously contained hazardous waste would be crushed and packaged for off-site shipment. Two drum compactor/crushers would be provided for this operation; one would be located in the solid waste processing area for radioactive waste and the other in the waste receiving/-classification area for hazardous waste. The drum compactor/crushers would have a built-in ventilation/HEPA filtration system.

The south portion of this facility would also serve as a radioactive contamination monitoring point for personnel between DWTF process areas and the operational support building. Personnel dressing and shower areas would be located in this area.

After unloading wastes, trucks would proceed to the tank and container rinsing and cleaning area in the northeast section of the truck bay. Utility stations would be located along the wall of the waste receiving/classification and solid waste processing building and would have pressurized water, air, and steam service for cleaning and rinsing the interior of the nonradioactive tanks and containers. The floor of the cleaning area would be sloped to divert liquids to a trench and sump, which would collect aqueous cleaning wastes generated by the truck or container cleaning operations. The sump would pump collected liquids to receiving tanks in the radioactive liquid treatment process system of the liquid waste processing building.

Floors and sumps in the solid waste processing, waste receiving/-classification, and truck bay areas would have epoxy coating. Six-inch epoxy-coated curbs and door ramps would be provided around the perimeter of the building. The truck and container cleaning area would drain to a double lined, monitored wet sump. All other sumps throughout this facility would be dry sumps, 2' x 2' x 2', covered by metal grates to contain accidental releases occurring in the various containment areas. Accidental spills would be cleaned up promptly with all sumps normally maintained empty (dry). Dry sumps have cost and maintenance advantages over a drainage system connected to a monitoring tank.

2.8.1.2 Boiler/Chiller Area

The boiler/chiller area, which is a part of the solid waste processing and waste receiving/classification building, would contain steam generators and auxiliaries, centrifugal water chillers and auxiliaries, and a heat exchanger for supplying the hot water heating system. The dimensions of the boiler/chiller area of the building would be 51 feet by 39 feet; the building height would be 26 feet. The area would be the central source of supply for steam, chilled water, and hot water for the proposed DWTF. An outdoor cooling tower, adjacent to the boiler/chiller area, would supply cooling water to heat exchangers, condensers, and other DWTF equipment.

Domestic water, demineralized water, compressed air, and natural gas would be tapped from existing LLNL underground mainlines and routed to the DWTF as required. Nitrogen gas would be supplied to the incinerator area from a liquid nitrogen cylinder tank and vaporizer unit. Commercial nitrogen cylinders would be provided in other locations of the DWTF where required.

2.8.1.3 Liquid Waste Processing Area

The liquid waste processing area would contain waste treatment equipment for processing radioactive and nonradioactive wastes from various LLNL facilities. The dimensions of this area would be 161 feet by 132 feet and 37 feet high. The liquid waste processing area would provide facilities for unloading, receiving, treating, solidifying, and monitoring LLNL liquid wastes. This area would also include an analytical laboratory, a laundry for clothing contaminated with radiation, and a maintenance shop. The liquid waste processing area would include two separate systems for treatment of nonradioactive and radioactive wastewaters. The radioactive waste processing equipment would be located in the northern portion of the building, and the radioactive waste processing equipment would be located in the southern portion of the building. A wall separates these two areas.

The primary liquid wastes that would be fed to the nonradioactive liquid waste treatment system are ion exchange regeneration wastewaters, circuit board manufacture wastewater, plating rinse waters, photographic solutions, and retention tank wastewater. These nonradioactive liquid waste feeds would be primarily aqueous waste containing heavy metal ions and dissolved salts that would require treatment before discharge to the sanitary sewer. Small quantities of acids, alkali, and anion complexes would also be treated in the nonradioactive liquid waste treatment system. The nonradioactive liquid wastes would contain both hazardous and nonhazardous aqueous wastes.

Wastes that would be treated in the radioactive liquid waste treatment system include both mixed waste and radioactive wastes from spent plating rinse, Building 151 aqueous waste, CIS acidic solutions, CIS spent cleaning solutions, and acidic wastewater from the existing decontamination facility. Scrubber blowdown from the proposed DWTF incinerator would also be treated in the radioactive liquid waste treatment system. The radioactive aqueous wastes would contain radioactive species such as platonium, uranium, and tritium.

Both waste processing areas would contain liquid waste receiving tanks, evaporator/crystallizer feed tanks, evaporator/crystallizers, and monitoring tanks with associated pumps, controls, and instrumentation. The radioactive waste processing area also would contain the solidification system, laundry waste treatment system, and decontamination area drain collection tanks. The nonradioactive waste processing area would include chemical storage, silver recovery from spent photographic solutions, an analytical laboratory, and mechanical workshop areas. All process equipment and tanks would be located in spill prevention and containment areas to assure proper containment and segregation.

Figure 2.8-2 illustrates the liquid waste receiving and treatment system; Figure 2.8-3 illustrates the evaporator/crystallizer system. These conceptual diagrams are representative of both the radioactive and nonradioactive liquid waste processing units. Figure 2.8-4 illustrates the solidification system, which would solidify settled solids from treated liquid waste and incinerator and burn pan ash into a stable liquid-free form that would be acceptable for off-site shipment and disposal.

The major wastewater discharge from the liquid waste processing area would be treated aqueous streams from the evaporator/crystallizer distillate monitor tanks and the laundry waste monitor tank. These effluents would all be treated to meet the City of Livermore sanitary sewer discharge limits and the EPA Metal Finishing Category Pretreatment Standards for New Sources (40 CFR 3433). Laundry drains would be collected, filtered, and monitored before discharge to the sanitary sewer. Liquid waste from the analytical laboratory sink drains in the liquid waste processing building would also be collected and monitored before discharging into the sanitary sewer. The treated liquid in the monitor tanks of all areas (radioactive liquid waste treatment, nonradioactive liquid waste treatment, laundry waste, analytical lab liquid waste) would be sampled to determine if more processing and treatment is required before discharge to the sewer.

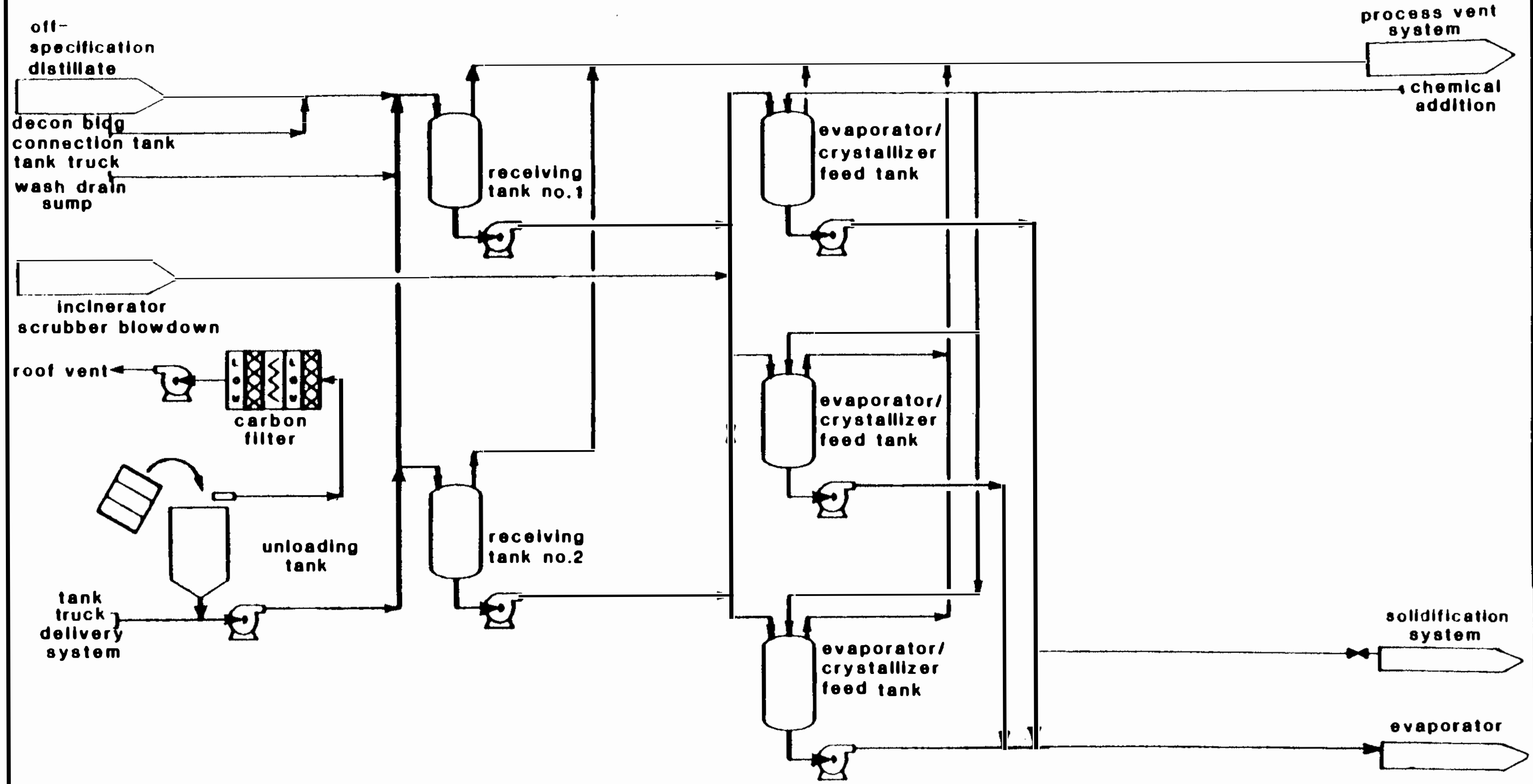


Figure 2.8-2. Liquid Waste Receiving and Treatment System

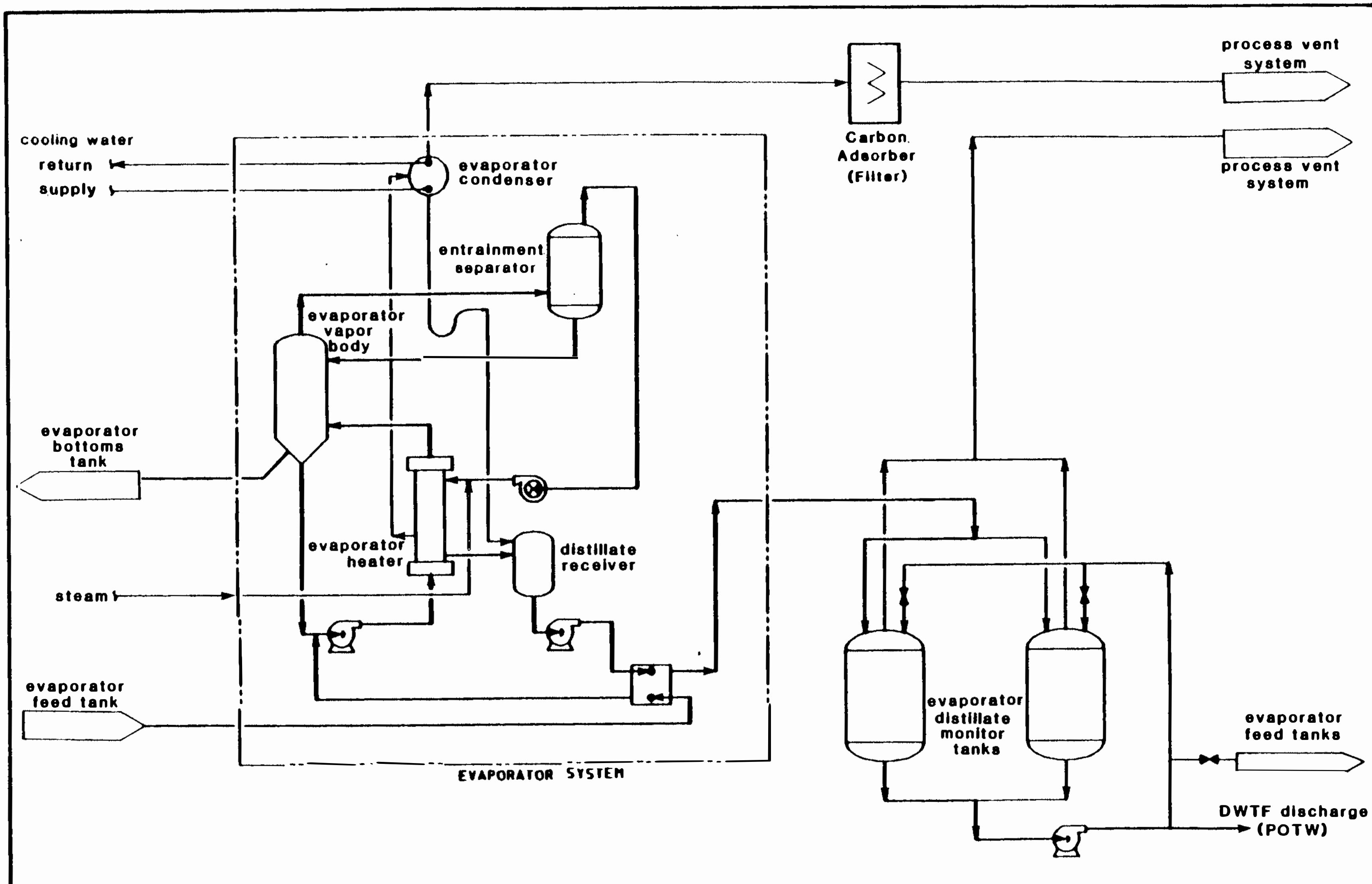


Figure 2.8-3. Liquid Waste Evaporator/Crystallizer System

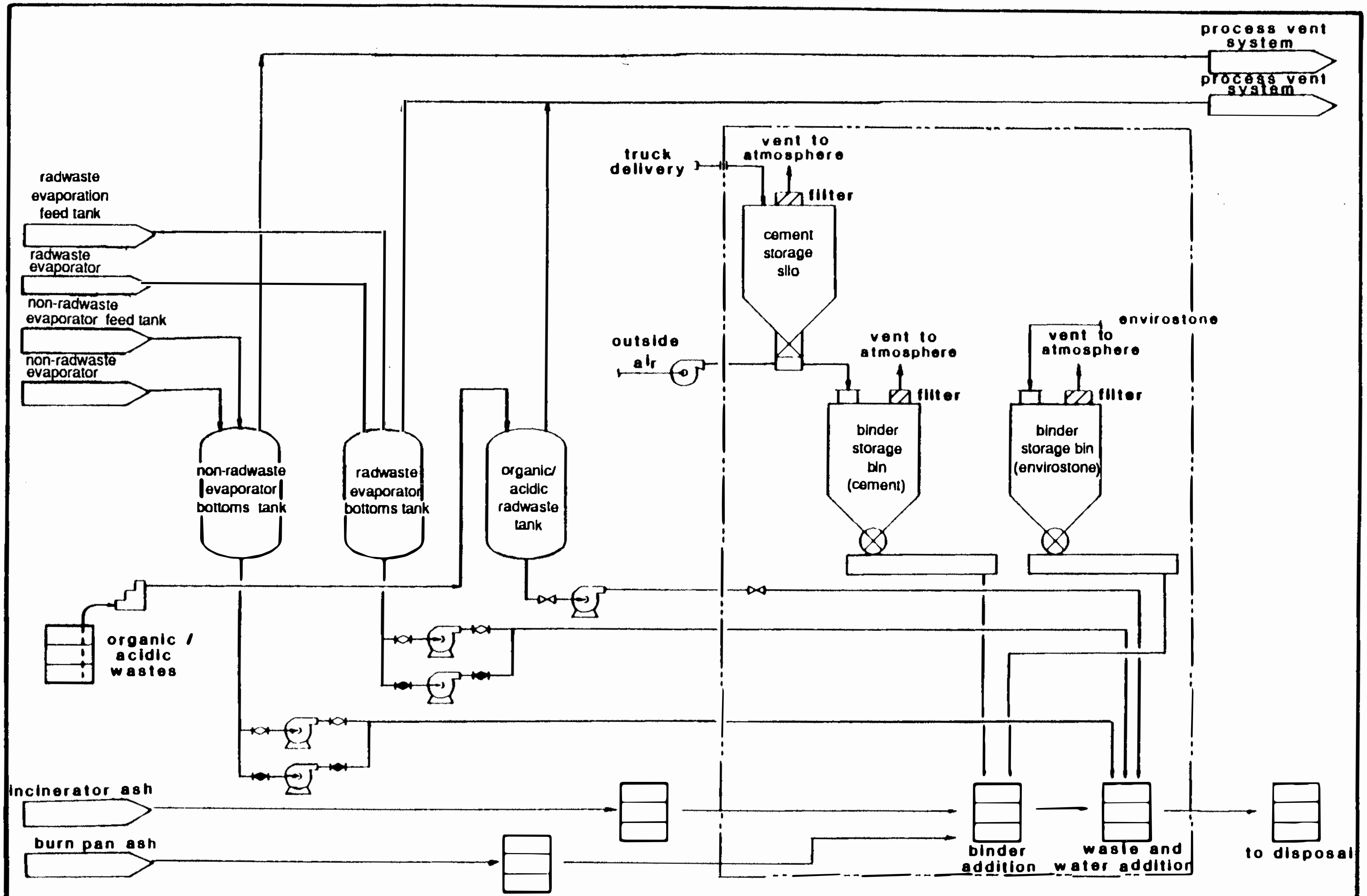


Figure 2.8-4. Solidification System

2.8.1.4 Incineration Area

The incineration area would include structures and components for receiving, storing, preparing, and burning nonradioactive (hazardous and nonhazardous), mixed, and radioactive wastes in a rotary kiln incineration system. The area also would contain a uranium oxidation system for processing depleted uranium-238 metal scrap. The dimensions of the incineration area would be 161 feet by 52 feet, and 37 feet high. The incinerator would operate 24 hours per day for approximately 10 consecutive days. LLNL would conduct approximately 12 of these campaigns per year.

The incineration area would have six-inch concrete curbs around the perimeter to contain any possible spills. Floors and sumps in the incineration area and throughout the proposed DWTF would be coated and sealed to the top of the curbs.

The liquid waste feed tank area of the incineration system would be designed as a moderate hazard structure and would be specially constructed to contain vapor and liquid releases in the event of spills occurring within this structure due to an earthquake. In addition, the waste feed area would have two seismic-damage-resistant fire suppression systems (i.e., a foam and a wet sprinkler system). The storage tanks would be curbed and have dry sumps to collect spills.

The depleted uranium oxidation system (burn pan) would burn uranium metal scrap, such as mill turnings, chips, and powder, to form an inert uranium oxide. Figure 2.8-5 presents a flow diagram of the uranium burn pan system. The uranium burn pan would be sized to receive a 110-pound batch of depleted uranium that would be processed over an eight-hour period. Approximately four 30-gallon drums, each containing 440 pounds of depleted uranium wastes, would be processed each month. The sintered metal filter and High Efficiency Particulate Air (HEPA) filters shown in Figure 2.8-5 are designed to limit the release of uranium oxide to less than two ounces per year. Emissions from this source are discussed in Sections 4.2.3 and 4.2.4.

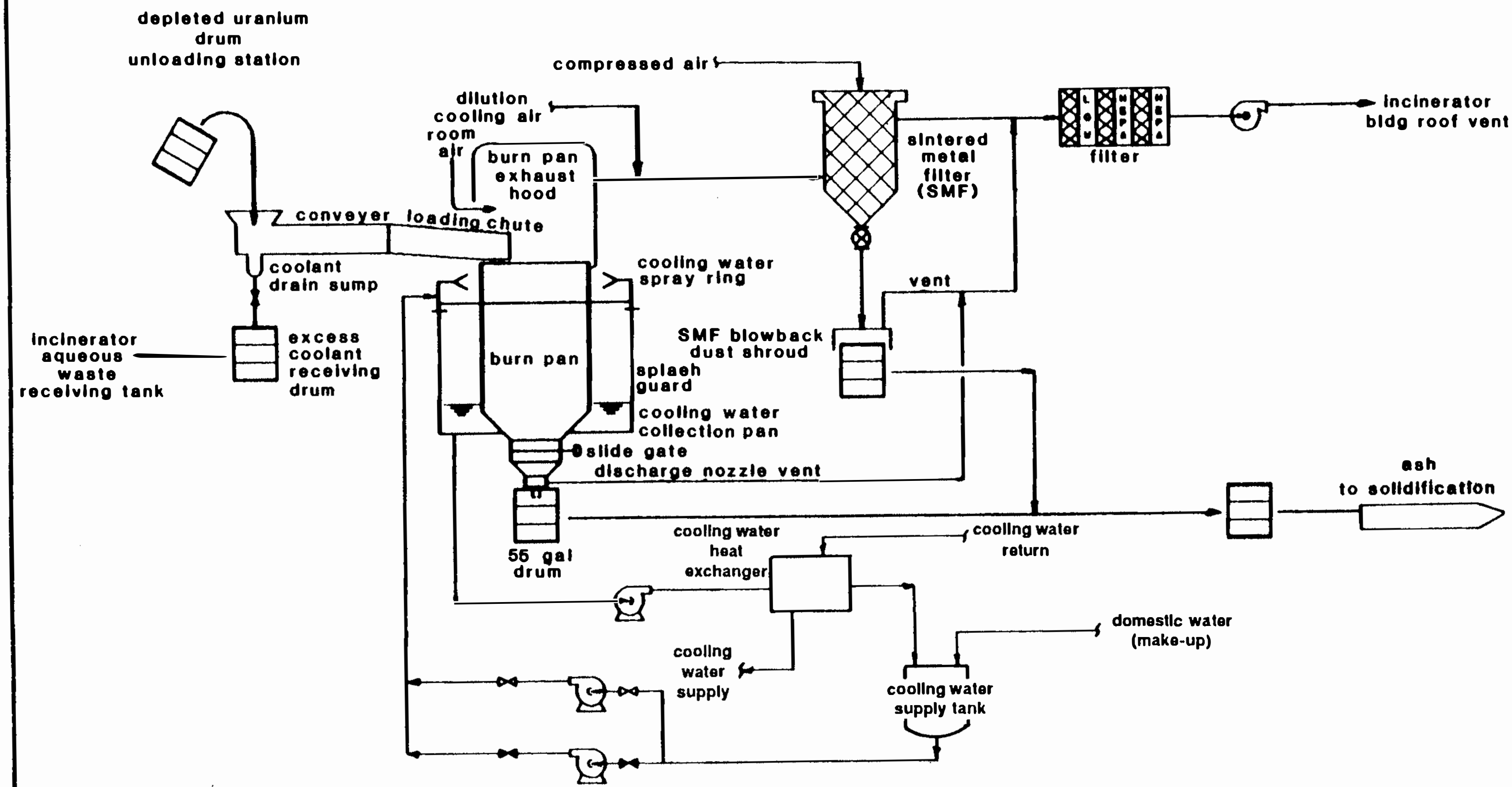


Figure 2.8-5. Uranium Burn Pan System

As shown in the figure, the oxidized uranium would be drummed and sent to the solidification process. Solidified uranium oxide would than be transported to an approved DOE disposal facility.

The incineration system would be designed to burn a wide range of nonradioactive, mixed, and radioactive wastes, including organic liquids, aqueous wastes, sludges, and solids. Solid waste materials would be fed into the incinerator in fiberboard containers in bulk form, and occasionally in metal drums. Containers would be shredded before being fed into the incinerator. An hydraulic ram would feed bulk and shredded solids into the rotary kiln. Aqueous waste and sludges would be injected into the kiln through nozzles and a lance. High heat-of-combustion liquids could be injected either into the kiln or directly in the secondary combustion chamber. The incinerator feed and combustion system and the incinerator process gas cleaning system are illustrated schematically in Figures 2.8-6 and 2.8-7, respectively.

Ash residues from the kiln would be collected in drums at a dry ash removal station. The drummed ash would be processed through the solidification facility in the liquid waste processing area. Following solidification, the ash residue would be shipped off site for disposal at a facility permitted to dispose of mixed waste.

The kiln off-gas would flow to a secondary combustion chamber where liquid wastes and/or auxiliary fuel would be injected. This mixed stream would reach a temperature of at least 2,000°F for two seconds. After secondary combustion in the incineration process, the off-gases from the secondary combustion chamber would pass through a refractory-lined duct into the process gas cleaning system. This is a wet system that reduces both acid gas and particulate emissions to the atmosphere. Cleaned flue gases would exit via an induced-draft fan out the stack. The selected process gas cleaning system would allow the incinerator to operate in compliance with federal, state, and local emissions standards, including RCRA, DOE, and Bay Area Air Quality Management District (BAAQMD) regulations for radioactive, criteria, and noncriteria pollutants.

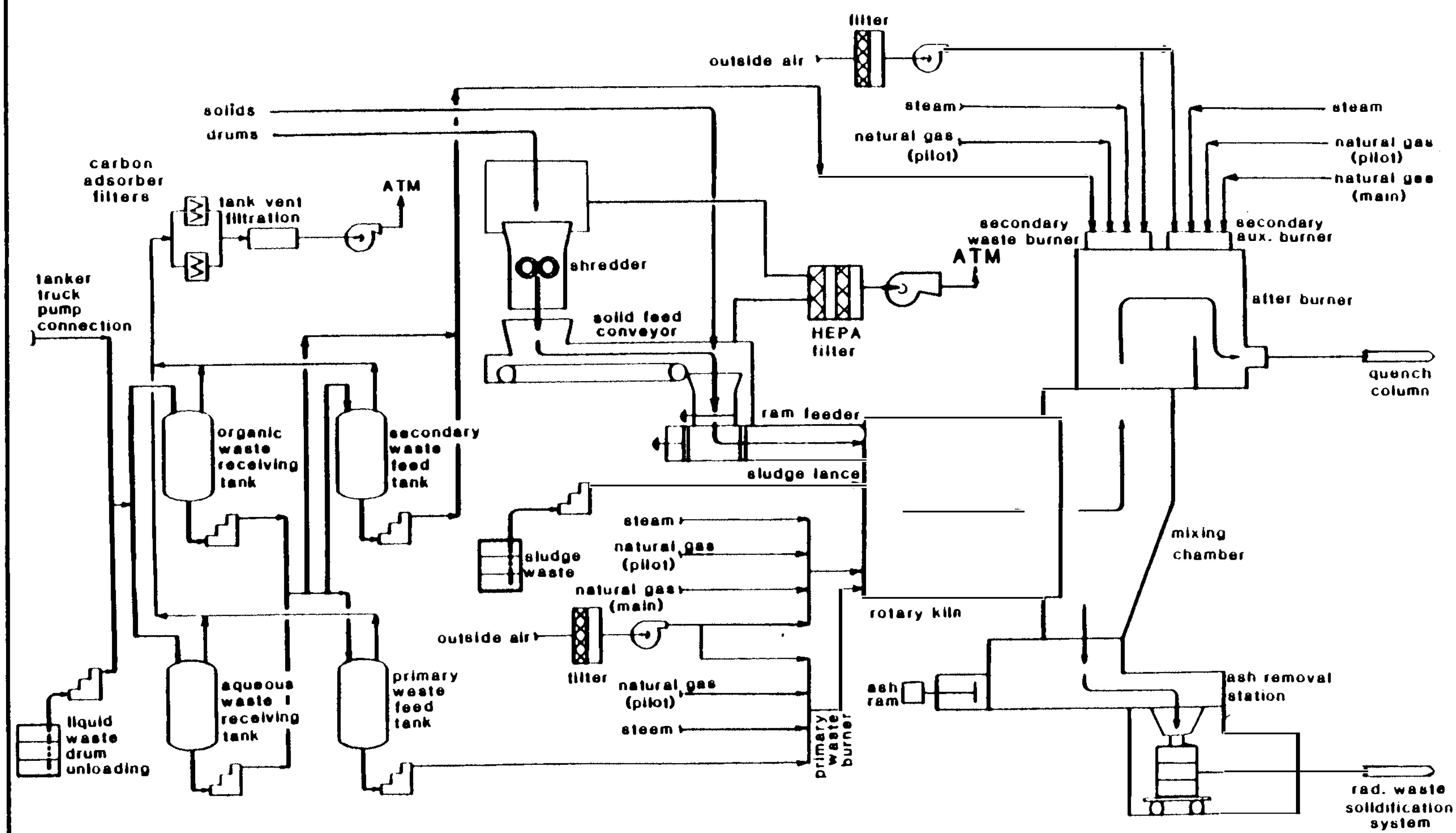


Figure 2.8-6. Incinerator Feed and Combustion System

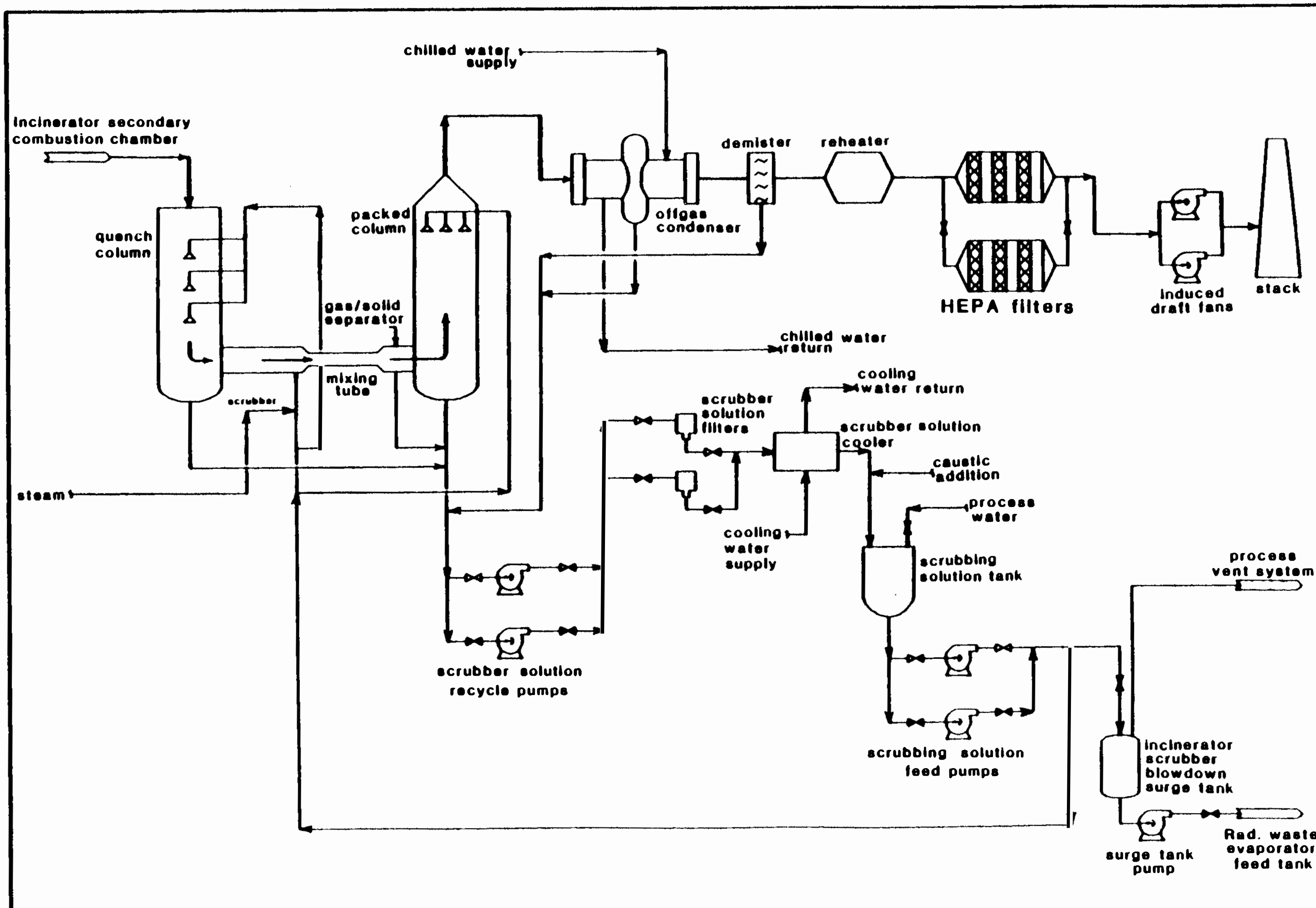


Figure 2.8-7. Incinerator Process Gas Cleaning System

The components that would be included in the process gas cleaning system are described below.

- A quench column would be installed to cool the flue gas from 2,100°F to below 185°F. The caustic solution captures a portion of the particulates and neutralizes the majority of the acid gases.

- A venturi scrubber would be installed to remove particulates of one micron and larger with a minimum efficiency of 99 percent, and to neutralize acid gases.

- A packed bed column would be installed to remove halogenated acids and gases with a minimum chlorine removal efficiency of 99 percent, in addition to sulfur dioxide removal efficiency exceeding 90 percent.

- A condenser would be provided to lower the temperature of the flue gas stream to approximately 160°F in order to remove the majority of the flue gas water vapor.

- A mist eliminator would be installed with a baffled mist pad to remove the entrained water droplets from the air stream.

- A reheater would be provided to heat the off-gas to a minimum of 20°F above saturation temperature in order to protect the downstream HEPA filters from wetting and to reduce plume visibility.

- HEPA filters would be installed to capture particulates 0.3 microns and larger with a minimum efficiency of 99.97 percent. Each parallel unit would contain a prefilter and two HEPA filters in series.

In addition to continuous process monitoring and control, the incineration system would incorporate a master interlock and shutdown system. This system would automatically shut off the waste and auxiliary fuel feed or shut down both combustion systems and the gas cleaning system in a safe, efficient manner in response to a major process upset condition or equipment malfunction. Standby electrical power would be provided for the following vital incinerator components:

- Uranium burn pan;
- Rotary kiln drive motor;
- Process handling vent fan;
- Solids handling vent fan;
- Scrubber solution feed pump;
- Scrubber solution recycle pump; and
- Induced-draft fans.

Standby electricity from backup diesel generators would also be used to provide power for controls, instrumentation, and alarms to assure a safe shutdown in case of a power failure.

After the incinerator is constructed, a trial burn plan would be conducted on the basis of EPA-, DHS-, and BAAQMD-approved conditions. During the trial burn, operational parameters would be monitored to define the operating conditions in which the incineration unit could operate in compliance with applicable emissions requirements. These operational parameters would include waste feed rates, combustion temperatures, percent oxygen, destruction and removal efficiency of hazardous organic constituents, particulate emission control, acidic (HCl) emission control, and carbon monoxide emissions.

2.8.1.5 Decontamination Area

The decontamination area would provide a centralized facility for removing radioactive and nonradioactive (hazardous) contamination from LLNL equipment and materials. The purpose of the decontamination area would be to remove both residual surface and fixed thin-layer contamination from the following typical items:

- Maintenance tools and hardware;
- Failed metal components/equipment;
- Reclaimable metal; and
- Reusable equipment.

The dimensions of this area would be 43 feet by 153 feet, and 32 feet high.

Decontamination processes would reduce the volume of contaminated radioactive wastes that presently must be disposed of off site. This decontamination area would contain equipment, systems, and tools necessary for decontaminating the items listed above and would have a flexible design that could accommodate a wide variety of decontamination methods and operations.

The decontamination techniques that would be used in the decontamination area include steam cleaning, chemical cleaning, vapor degreasing, liquid abrasive cleaning, high temperature bakeout, electropolishing, and ultrasonic cleaning. These techniques would provide a wide range of decontamination capabilities, and each of the methods is particularly suited to specific decontamination applications. A brief description of each decontamination technique is provided below.

Steam Cleaning. This technique would be used to remove residual surface contamination. Steam cleaning is performed in a walk-in booth equipped with high pressure water spray, a steam lance, and a recycle system.

Chemical Cleaning. Chemical cleaning also would be used to remove residual surface contamination. Chemical cleaning operates in the same manner as the steam cleaning system; however, decontamination chemicals would be added to the water to assist in the decontamination process.

Vapor Degreasing. The solvent degreasing operation would incorporate both solvent spray cleaning and vapor degreasing. The primary solvent employed would be Dupont Freon® or equivalent trichlorotrifluorethane. Small instruments and electric motors would be cleaned using vapor degreasing.

Liquid Abrasive Cleaning. This technique would be used to remove residual and fixed surface contamination from large items. The abrasive material (typically glass or alumina beads) is applied in a high pressure walk-in booth.

High Temperature Bakeout. Equipment contaminated with mercury or tritium would be decontaminated using this technique. Very small volumes of waste would be treated in bakeout ovens.

Electropolishing. This technique would be used to remove the thin surface layer of a contaminated metal. The removal would occur through anodic dissolution of activated surface and transfer to an electrolyte.

Ultrasonic Cleaning. This technique would be used to decontaminate components with close tolerances and with hard-to-reach crevices. Ultrasonic cleaning is typically used as a final polishing step after items have been grossly decontaminated by other systems.

Small quantities of transuranic (TRU) waste would also be solidified using cement or Envirostone and would be performed in one of the decontamination hoods installed in this building.

Dry sumps would be provided in the airlock area, and double-lined sumps would be provided in the decontamination areas. Discharge from the decontamination area sumps would be routed to the radioactive liquid waste treatment system. Six-inch curbs and door ramps would be provided around the perimeter of the decontamination area.

2.8.1.6 Radioactive Waste/Clean Storage Building

The dimensions of the radioactive waste/clean storage building would be 80 feet by 118 feet; the average building height would be 18 feet. The radioactive waste storage area of this building would be used to temporarily store solid, low-level radioactive and mixed wastes processed and packaged by the proposed DWTF until they could be shipped off site for disposal. This area would be able to store a maximum of 200 drums. For staged shipment to an off-site disposal facility, the radioactive waste storage area also would store certified TRU wastes packaged by the LLNL generator. All containers of hazardous or radioactive wastes generated at LLNL would be packaged as outlined in Guidelines for Waste Accumulation Areas (DeGrange et al., 1987) to ensure that chemical wastes are compatible with their containers, all packages are properly identified and labeled, and all packages are properly palletized and strapped for transportation. The containers used to package hazardous and radioactive wastes would meet Department of Transportation (DOT) specifications and the standards of 49 CFR Part 173. A discussion of the transportation of radioactive wastes from LLNL to off-site disposal facilities is presented in Section 3.7.2.

Additionally, this facility would store low-level radioactive dry waste. Wastes that would be stored in this building would be packaged in 55-gallon drums, boxes, metal type A boxes, and lab packs. The drums would be placed on pallets, and all containers would be stored no more than two tiers high. An estimated 450,000 pounds per year of noncombustible low-level and TRU wastes would be processed through this building each year. The ash and liquid waste processing residues would also be temporarily stored in this building until they could be shipped.

The radioactive waste storage area would be inspected daily to ensure that all containers are properly sealed and labeled, free of leaks and corrosion, and properly segregated. Daily inspections would also include checks of curbs and sumps, personnel protective equipment, and communications systems. Alarm systems for fire, radioactivity, and emergency exit openings would be checked monthly.

Mixed wastes are subject to regulations and LLNL procedures governing both radioactive and hazardous wastes. The hazardous constituents and radionuclides present in a particular container would dictate the labeling and handling requirements for that container.

All containers would be prepared for shipping (in accordance with 49 CFR 173 standards) before being brought into this facility. Radiation exposure of on-site workers would be minimized by controlling access to the facility. Dose rates outside the DWTF complex would be minimized by placing an access control fence 25 feet from the facilities and placing containers of lowest radioactivity materials around the perimeter of the building to act as shields.

To minimize the possibility of a structural member penetrating any radioactive waste containers during an earthquake, this building's steel structural system would be designed to meet the "moderate hazard" seismic criteria (defined in Section 4.3 of this DEIS). The clean area would be used for storing clean supplies and equipment for use in DWTF operations. However, the clean waste storage area would be designed the same as the radioactive waste storage area so that it could be converted to radioactive waste storage in the future without need of structural modifications.

Dry floor sumps would be incorporated in the building design to collect any accidental spillage on the floors of these facilities. A concrete curb would be provided on four sides of each storage area for spill confinement. The floors would be sloped toward collection sumps located in the center of each bay. Floors, sumps, ramps, and curbs would be sealed with a vinyl ester resin coating. Continuous radiation monitors on an automatic alarm system would be located at various locations in the radioactive waste storage area. Additionally, the building would have an automatic fire sprinkler system.

2.8.1.7 Reactive Materials Building

The reactive materials building would contain equipment to carry out reactions between highly reactive materials and appropriate treatment substances to produce more treatable and disposable waste materials. The building also would provide storage for reactive materials requiring pretreatment and/or neutralization prior to treatment or processing at the DWTF.

Typically, reactive materials to be handled in this building would be chemical reagents stored in five-gallon (or smaller) containers. Although the quantities of these materials would be small, special handling of these wastes would be carried out by facility operators specially trained in dealing with reactive materials.

The reactive materials building (which would be 66 feet by 22 feet, and 12 feet high) would consist of four storage areas: a work area, two reactive materials process cells, and an enclosed, unroofed area where the secondary off-gas scrubbers, fans, filter units, steam generator, and nitrogen cylinders would be located. Each storage area would be equipped with shelves for storing containers, a sump for low-point drain collections, and a 400 cfm exhaust fan for continuous ventilation and dilution. Fans would be connected to standby power. Each of the reaction materials process cells would be 8 feet by 8 feet in dimension and equipped with a reaction vessel and a primary scrubber. Principal products of the reactions would be:

- Hydrogen, methane, and ethane form hydrolysis reactions. These flammable gases would be vented to the atmosphere through a specially designed flame arrestor vent system.

- Corrosive gases, which would result from a variety of reactions such as the treatment of halogen oxidizers, corrosive gases, and reactive fuel gases or volatile liquids. These gases would first be neutralized and diluted in the primary scrubbers, then processed through the twin packed bed secondary scrubber. Total fumes in the off-gas must not exceed 100 ppm.

- Particulate, typically metal oxides, from combustion reactions. Off-gas from these reactions would be vented through High Efficiency Particulate Air (HEPA) filters.

The work area would be 10 feet by 15 feet in dimension and equipped with a fume hood for working with small quantities of reactive chemicals, and a nitrogen atmosphere glove box for handling small quantities of materials that may require an inert atmosphere.

The reactive materials building would be provided with heat detectors to give early warning of a fire for rapid emergency response. In addition, manual fire alarms and portable fire extinguishers would be provided throughout the facility. A dry chemical fire suppression system would be provided in the flammable cell. Emergency shower and eye wash stations would be located in the work area outside the storage areas.

Figure 2.8-8 presents a flow diagram of the venting and fume scrubbing systems for the work area and the two reactive materials process cells.

2.8.1.8 Operational Support Building

This two story building would be 41 feet by 37 feet, and 28 feet high, and would provide space and facilities for supervisory, administrative, technical, and operational personnel employed in the decontamination, waste treatment, and waste storage activities of the facility. It also would contain the waste management computer system for nonradioactive, mixed, and radioactive waste inventory and record keeping. The Data Gathering Panel, which interfaces with the Computerized Building Automation System (CBAS), would also be in this building. The Data Gathering Panel would control and monitor the heating, ventilation, and air conditioning (HVAC) system and monitor the DWTF site electrical energy consumption. Computer facilities for the operational support building would also perform central data storage tasks for the DWTF Process Monitoring System (PMS). The PMS system would also

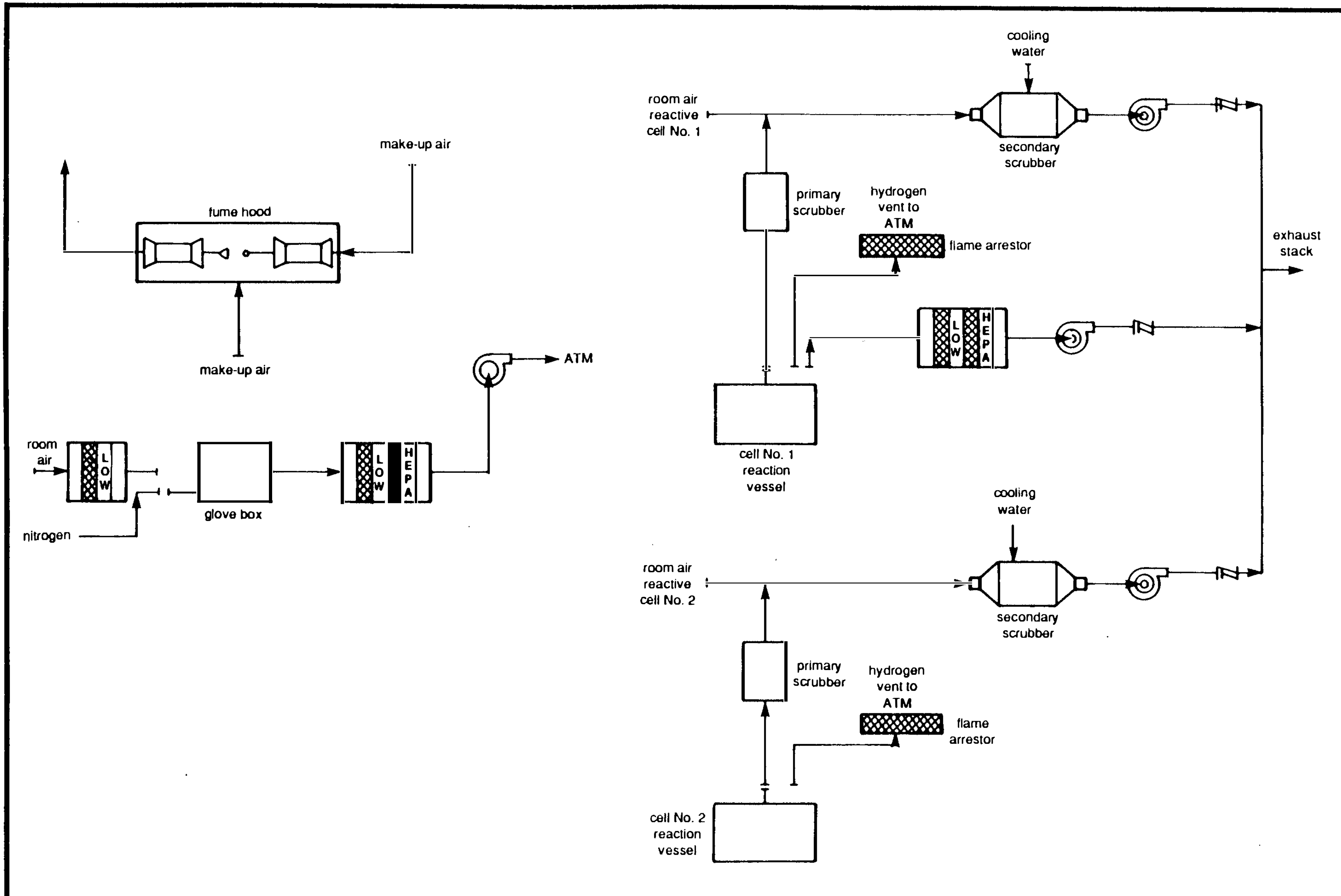


Figure 2.8-8. Reactive Materials Building Vent System

monitor and control the decontamination and waste treatment processes and the standby diesel generator. In addition, an alarm box in the lobby of the operational support building would monitor the PMS communication line for all trouble alarms and notify the central LLNL emergency operations center.

The operational support building would include a records storage room, which would be equipped with a special Halon fire protection system, a centralized library for waste management reference material, and a training room to meet the requirements of RCRA and the state for training personnel in the handling of hazardous waste. The proposed building would normally operate on a 5-day, 40-hour week schedule.

2.8.1.9 Electrical Substation/Standby Power

The electrical substation would contain the transformers and switch gear providing normal electrical power for the DWTF operations. The standby diesel generator would provide power to the critical components of the proposed DWTF in the event of loss of main power. The standby generator would be located 88 feet north of the electrical substation. Both the substation and standby generator are shown in Figure 2.8-1.

2.8.2 Level I Design

The Level I design would have identical components to the Level II design, with the exception of the type of incineration system. This design would include a controlled-air incinerator instead of the Level II design's rotary kiln incineration system. Consequently, the Level I design would not have the capability and flexibility to burn as wide a variety of wastes as the Level II design. In this case, only a small portion (percent by weight) of the combustible, solid, low-level radioactive wastes would be incinerated in the Level I facility. This small percentage of the stream would be made up of the same solid wastes that are burned in the existing incinerator (no-action alternative), such as scintillation vials, animal biological waste (primarily mice from on-site biomedical research activities), plastic, and paper. The remaining radioactive wastes and large, shreddable items would be compacted and repackaged in the Level I design solid waste processing area and shipped to NTS for disposal. Contaminated low-level radioactive waste containers would not be fed to the controlled-air incinerator and would be compacted and packaged at the DWTF for later off-site disposal. Also, organic sludges and still bottoms would not be incinerated in the Level I design. (For more detailed information, refer to Table 4.2-1.)

The controlled-air incinerator in the Level I design would be similar to LLNL's existing incinerator, with a dual chamber design, ram feed, and liquid waste injection capabilities. This incinerator would meet the 99.99 percent destruction and removal efficiency (DRE) requirement for hazardous waste incineration. However, unlike the existing incinerator, the Level I incinerator would include a pollution control system consisting of a quench column, venturi scrubber, packed tower absorber, and demister. This pollution control system would provide sufficient control to meet particulate matter and acid gas emission limits.

The pollution control system would allow many organic waste streams that cannot be burned in the existing incinerator (particularly halogenated organics) to be burned in the Level I design incineration system. Since disposal options for many of these organic wastes are becoming restricted (e.g., landfill bans), treatment methods such as incineration are necessary to meet regulatory requirements. The Level I design would also meet the current sewer discharge requirements of the Livermore sanitary sewer, as well as the treatment and disposal requirements of RCRA.

In summary, the Level I design would allow greater use of incineration than the existing HWM facilities, but it would not provide as much waste incineration capability and flexibility as the Level II design's rotary kiln incineration system. Consequently, a larger quantity of solid low-level wastes would have to be compacted in the Level I solid waste processing area and shipped off site for disposal.

2.8.3 Engineered Safety Features

The Level I and Level II designs would comply with the requirements of the DOE 5480 series orders (particularly DOE Order 5480.5, Safety of Nuclear Facilities, and DOE Order 6430.1A, General Design Criteria Manual). A list of engineered safety features is included in Section 4.5.2. A list of the applicable orders, standards, and guidelines is presented in Section 6.2.

All DWTF facilities would be designed to achieve low risk operations. In order to assure low risk operations, the Decontamination Building and the liquid waste feed tank area of the Incinerator Building would be designated as moderate hazard areas (LLNL and Radian, 1988) and designed to meet the following more stringent criteria:

- Seismic Design. Structural integrity would be maintained in the event of a design basis earthquake (DBE). Design requirements are presented in Table 2.8-1.

- Wind Design. Structures would be designed to withstand a basic wind speed of 115 mph according to American National Standards Institute A58.1. The wind speed criterion for low hazard buildings is 80 mph.

- Wind-Borne Impact Design. Structures would be designed to withstand the impact of a 2-inch by 4-inch by 12-foot timber striking on-end perpendicular to the surface in question at a velocity of 70 mph.

- Fire Protection System. The fire protection system would remain operational during and after a DBE and would be positively secured to resist the seismic forces indicated in Table 2.8-1.

TABLE 2.8-1. LLNL SEISMIC CRITERIA FOR THE PROPOSED DWTF

DWTF Building	Horizontal Ground Acceleration[a]	Vertical Ground Acceleration[b]	Additional Load Factor for Connections[c]	Design Process[d]
Decontamination Building, Liquid Waste Feed Tank Area of Incinerator Building, and Radioactive Waste and Clean Storage Building (Moderate Hazard)	0.25 g	± 0.17 g	1.5 times 0.25 g loads	Elastic range of response[e]
	0.5 g	± 0.33 g	--	Inelastic range of response[f]
All other DWTF Buildings (Low Hazard)	0.25 weight static		1.5 times 0.25 weight loads	Use current Uniform Building Code (UBC) analysis and design procedures and material strength allowables

[a] Design Basis Earthquake (DBE) horizontal ground acceleration in terms of gravity acceleration force (g). The probability of these accelerations occurring is discussed on page 128.

[b] DBE vertical ground acceleration assumed equal to 2/3 of horizontal acceleration.

[c] Structural connection and design must account for an additional load factor of 1.5, which assumes that forces are 1.5 times greater than forces due to the 0.25 g DBE (horizontal plus vertical).

[d] Structures, systems, and components, whose continued integrity and operability are essential to ensure the capability to shut down and maintain safe shut-down conditions and prevent or mitigate the consequence of accidents that could result in potential off-site exposures, must be designed to remain functional during and after the DBE. Components include piping, electrical conduit, mechanical systems, and associated support systems.

[e] Elastic range of response based on LLNL Ground Response Spectra.

[f] Inelastic range of response is evaluated based on two times the peak ground acceleration of the elastic range of response (Freeland, 1984, p. 16.).

- HEPA Filters. Double HEPA filtration would be provided in the Decontamination Building to control a potential release of radionuclides.

Table 2.8-2 presents the specific engineered design safety features that would be incorporated into the Decontamination Building and liquid waste feed tank area of the Incinerator Building to meet the moderate hazard criteria. The Radioactive Waste and Clean Storage Building, a low hazard facility, has been seismically upgraded to ensure the structural integrity of the building and prevent potential damage to waste storage drums in the event of a design basis earthquake.

2.9 Summary of Environmental Impacts of the Design Alternatives

Table 2.9-1 presents a comparison of the environmental impacts associated with the two design alternatives based on the analyses in Chapter 4.0. Construction of the Level II design on Site D is the preferred alternative.

TABLE 2.8-2. ADDITIONAL SAFETY FEATURES FOR "MODERATE HAZARD" AREAS

Decontamination Building	Incinerator Feed Tank Area	Safety Features
X	X	The building structure would have a steel framework, concrete foundations, spill containment basins, and sumps designed in accordance with the seismic requirements (DBE) listed in Table 2.8-1 and also the wind criteria for moderate hazard.
X	X	The roof and side walls of the structure would be designed for a DBE and to meet wind and missile criteria for moderate hazard.
X	X	Fire dampers designed for a DBE at all building penetrations to close in the event of fire. Dampers also designed to close in the event of a spill in the incinerator feed tank area.
X		Automatic fire sprinkler system with supports designed to meet the moderate hazard seismic criteria.
	X	An automatic independent and expanded foam-fire suppression system would be installed with a backup automatic fire sprinkler system. Both systems would have supports designed to meet moderate hazard seismic criteria.
X	X	Standby electrical power would be provided for safe shutdown and to maintain power for critical alarms and controls in the event of a power outage.
X		Double HEPA filters would be installed on the building ventilation and process exhaust systems.

(Continued)

TABLE 2.8-2. (Continued)

Decontamination Building	Incinerator Feed Tank Area	Safety Features
X	X	Ventilating equipment, the filtration system, and duct work would be supported for a DBE.
	X	Supports for liquid storage tanks would be designed for a DBE.

Note: The above measures provide a DBE-resistant envelope around each facility that has been classified "moderate hazard" to ensure the confinement of any accidental release within the facility.

TABLE 2.9-1. COMPARISON OF THE PROPOSED DWTF DESIGN ALTERNATIVES

Impact	Level I Design at Site D	Level II Design at Site D (preferred alternative)
Air Quality	No significant air quality impacts.	Impact same as Level I.
Health Effects	ALARA design would minimize radionuclide and hazardous chemical effects. Maximum cancer risk of 6.2 in one million for a hypothetical maximally exposed individual.[a]	ALARA design would minimize radionuclide and hazardous chemical effects. Maximum cancer risk of 3.1 in one million for a hypothetical maximally exposed individual.[a]
Incinerator System Flexibility	Controlled air-incinerator would lack capability to treat sludges and large size solid waste. Pollution abatement controls include quench tower, venturi scrubber, packed-bed absorber and mist eliminator.	Rotary kiln incinerator would have ability to treat all combustible wastes from LLNL operations. Pollution abatement controls include quench tower, venturi scrubber, packed-bed absorber, mist eliminator, and HEPA filters.
Seismic	A detailed seismic trenching investigation was performed to verify that compliance with state and federal seismic location standards. Absence of liquefaction was also verified.	Impact same as Level I.

(Continued)

TABLE 2.9-1. (Continued)

Impact	Level I Design at Site D	Level II Design at Site D (preferred alternative)
Ground Water/Surface Water	No adverse ground water/surface water impacts expected. Spill containment systems designed for essentially zero or ALARA releases.	Impact same as Level I.
Vegetation and Wildlife	No impacts.	No impacts.
Cultural Resources	No impacts.	No impacts.
Socioeconomics	No significant impacts. Increase in the LLNL population by approximately 0.1 percent.	Impact same as Level I.
Noise	No significant impacts.	No significant impacts.
Accidents/Occupational Risks	No significant impacts. Design features and mitigation would reduce the probability of releases to extremely low levels.	Impact same as Level I.
Waste Transportation	Transport of treated waste for disposal would require 91 truck trips per year. An accident would be expected to occur every 4.1 years. For this alternative, a traffic accident would be expected	Transport of treated waste for disposal would require 85 truck trips per year. An accident would be expected to occur every 4.4 years. For this alternative, a traffic accident would be expected to result in a

(Continued)

TABLE 2.9-1. (Continued)

Impact	Level I Design at Site D	Level II Design at Site D (preferred alternative)
	to result in a lower chance of impacts on health as compared to the no-action alternative. This is due to the increased treatment of the waste prior to shipment as compared to the no-action alternative.	lower chance of impacts on health as compared to the no-action and Level I alternatives. This is due to the increased treatment of the waste prior to shipment as compared to the Level I alternative. Majority of waste would be solidified.
Off-site Treatment and Disposal Sites	A smaller volume of low toxicity waste would result from incineration and liquid waste treatment. Radioactive solid waste not incinerated would be shipped to NTS. Nine percent of LLNL waste would be treated and disposed of off site.	Lowest volume of toxic waste compared to other alternatives. Seven percent of LLNL waste would be treated and disposed off site.
City of Livermore Sewage Treatment Plant	A negligible potential for accidental release exists since all treated waste is retained in dedicated monitoring tanks until analysis verifies compliance with discharge standards. Catchment basins would also be designed into the system. Increase discharge to the City of Livermore sanitary sewer of approximately 0.02 million gallons per day.	Impact same as Level I.

[a] Worst-case risk levels are for an individual residing and working for a 70-year lifetime at the point of maximum impact continuously, as predicted from dispersion modeling. Risk values represent the probability of developing cancer.

[THIS PAGE INTENTIONALLY LEFT BLANK]

CHAPTER 3.0

AFFECTED ENVIRONMENT

This chapter discusses the environmental characteristics of the Livermore region, and describes the environmental setting of the preferred and alternative sites for the proposed Lawrence Livermore National Laboratory (LLNL) Decontamination and Waste Treatment Facility (DWTF).

The preferred site and the alternative sites are near each other and share many of the same environmental characteristics. Site characteristics of the preferred site are generally discussed in more detail; however, site characteristics of the alternative sites are noted when they differ from those of the preferred site or when they could potentially result in significant impacts on the environment.

3.1 Site Location and Characteristics

3.1.1 Location

The LLNL is located in the southeastern section of the Livermore Valley, which lies in the California Coastal Range province between the San Francisco Bay to the west and the northern San Joaquin Valley to the east. The regional location of LLNL is illustrated in Figure 3.1-1. The Livermore Valley is generally of low relief, but contains scattered groups of hills that rise to a high of 150 feet above the valley floor. The valley is surrounded by the Tassajara Hills to the north, the Altamont Hills to the east, the Diablo Range to the south, and the Hayward Hills to the west.

The preferred site for the proposed DWTF is in the northeastern corner of LLNL property (Site D). Alternative sites are located to the west and south of the laboratory, as illustrated in Figure 3.1-2.

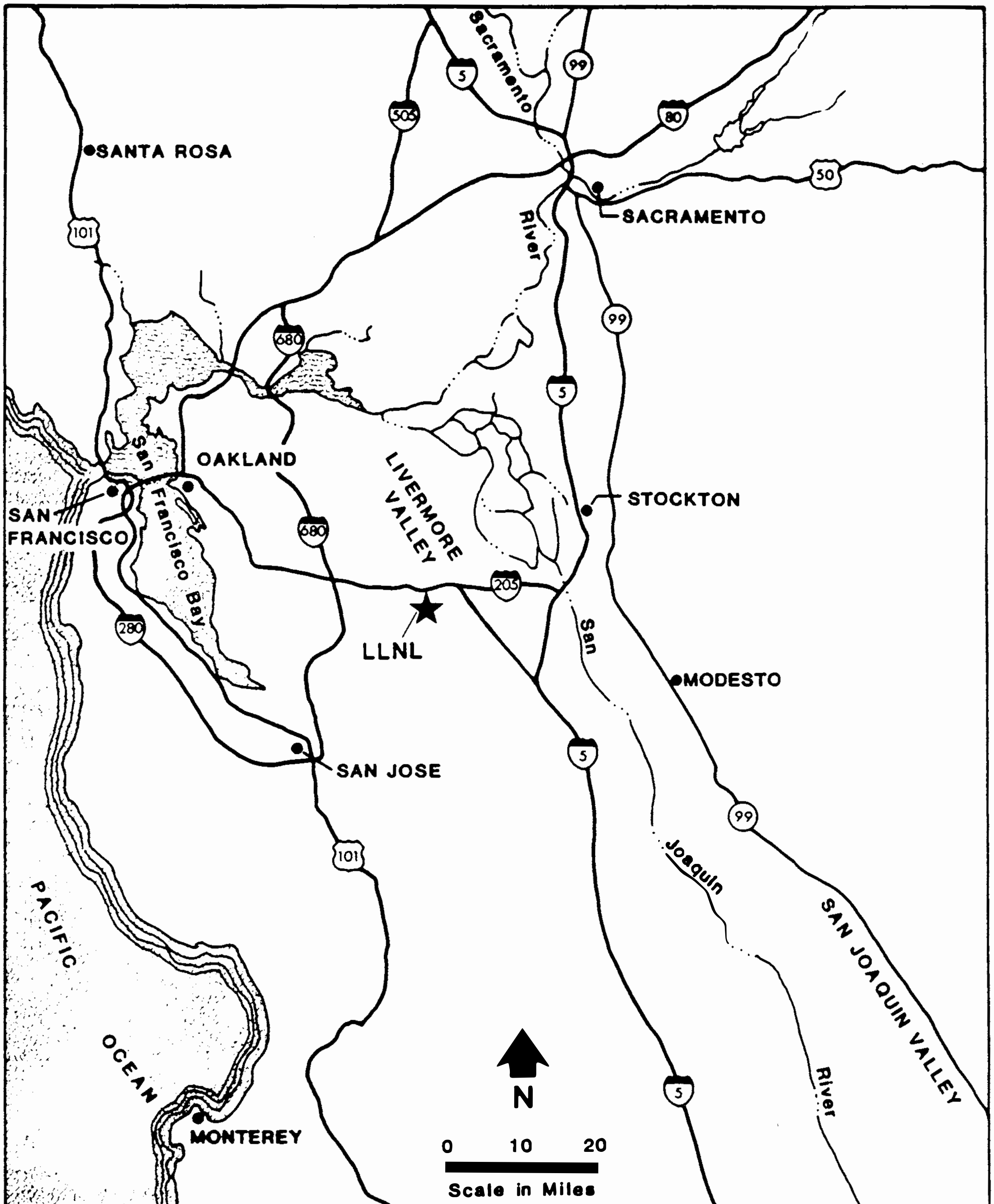


Figure 3.1-1. Regional Location of LLNL

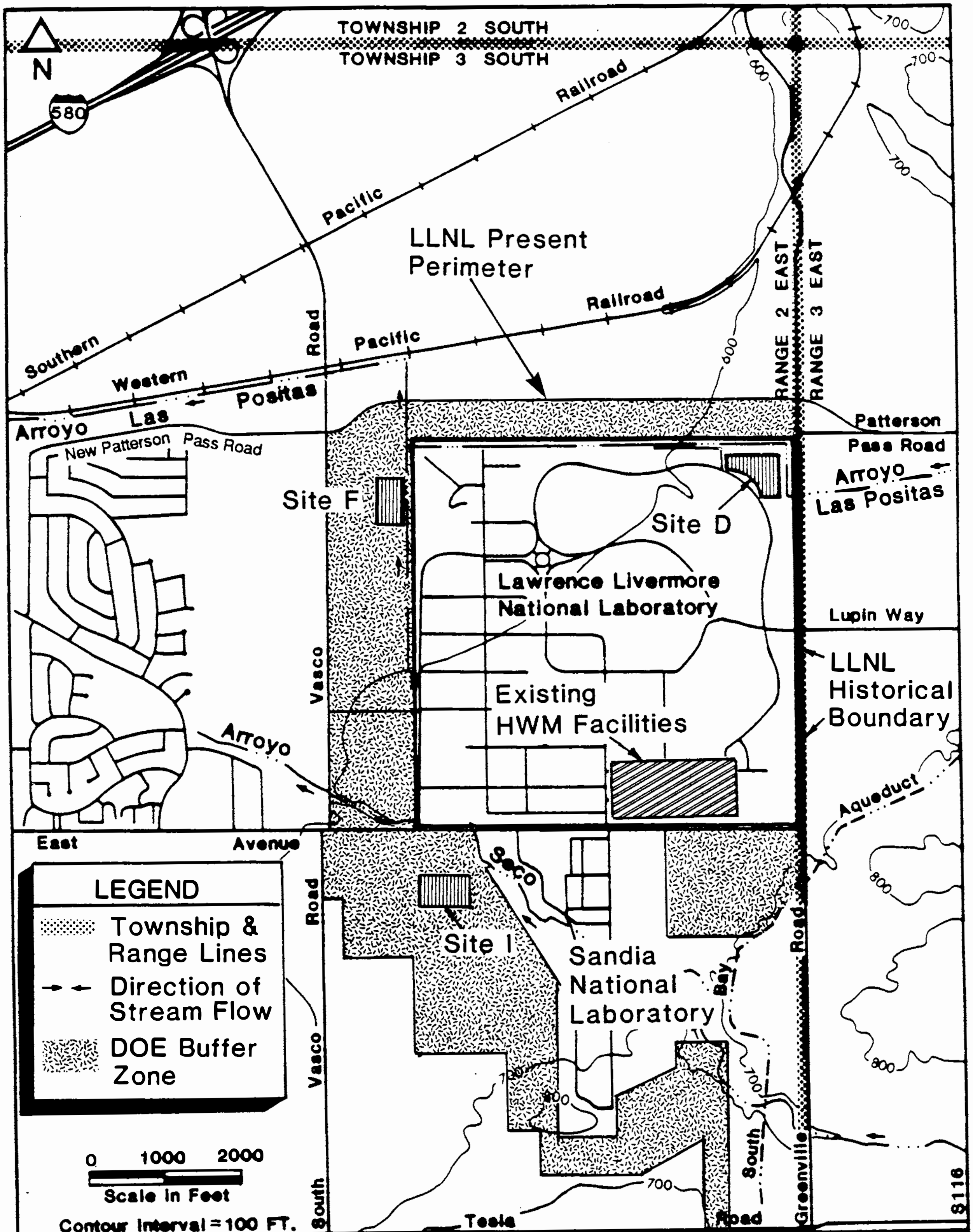


Figure 3.1-2. DWTF Alternative Sites

3.1.2 Characteristics

The topographic surface at LLNL is of low relief and slopes gently to the northwest. Elevations at LLNL range from a high of 675 feet above sea level at the southeast corner, to a low of 570 feet at the northwest corner. Slopes at the preferred site generally do not exceed three percent, except for stream banks or the sides of drainage ditches, where slopes average 50 percent. Ground surface elevations at the preferred site range from approximately 602 feet to 609 feet above mean sea level, and slope gently toward the north and west. Ground surface elevations at Site F range between 570 and 580 feet above mean sea level, sloping gently to the northwest. Site I ground surface elevations range between 620 and 630 feet above mean sea level. The center of this site is in a northwesterly trending shallow depression that collects water during the rainy season (LLNL, 1985).

3.2 Geology, Soils, and Seismology

3.2.1 Geology

This section includes information on the stratigraphy, geologic structure, and seismic characteristics of the Livermore region and specific characteristics associated with each alternative site.

3.2.1.1 Stratigraphy

3.2.1.1.1 Regional Stratigraphy

LLNL is located in the Livermore Valley, an east-west structural basin that cuts across the central part of the Coast Range province of California.

The oldest rock units exposed in the Livermore area consist of the highly deformed sedimentary, igneous, and metamorphic rocks of the Jurassic Franciscan Assemblage. This group is structurally overlain by the Cretaceous Great Valley Sequence, consisting of alternating beds of sandstone, siltstone, and shale. Both of these units are complexly folded and faulted in the mountains surrounding the Livermore Valley. The Franciscan Assemblage and the Great Valley Sequence are overlain by more gently folded Tertiary sedimentary and igneous rocks.

In the Livermore Valley, Tertiary formations are overlain by more than 3,900 feet of fluviatile and lacustrine deposits of the Late Tertiary to Holocene age. These deposits are divided into five units. The oldest unit is the Livermore Formation, which has been divided into two subunits based on the period of deposition. The lower subunit of the Livermore Formation consists of a poorly cemented pebble conglomerate, sandstone, and greenish-gray claystone of Pliocene age. The upper subunit consists of light reddish-gray, cobble-pebble gravel of Pleistocene age, with significant quantities of claystone (Dibblee, 1980). The two subunits are separated by an unconformable contact in the vicinity of Site D.

Both subunits of the Livermore Formation outcrop in the hills south and east of the Site D. Fine-grained, greenish to bluish-gray sediments that correlate with the lower subunit of the Livermore Formation have been encountered in drill holes in the southern and eastern part of LLNL property at depths from 23 to 190 feet below land surface. Sediments corresponding to the upper subunit have not been definitely identified in these borings.

Four Late Quarternary alluvial units overlie the Livermore Formation near LLNL. These units consist primarily of interbedded clays, silts, sands, and gravels. The oldest alluvial unit consists of terrace deposits of silty clay and silty-to-clayey gravel of Franciscan origin. This unit is overlain by valley fill and terrace deposits composed of reddish and yellow-brown silty gravels and sands capped by yellow and light brown sandy clays and silts.

The two youngest geologic units that occur near LLNL consist of a sequence of low terrace and alluvial deposits with local flood plain and stream channel deposits. These deposits generally consist of silty gravels and sands capped by sandy-to-clayey silts. Bore-hole data indicate that these alluvial units have a gentle, westward dip.

3.2.1.1.2 Stratigraphy of the Alternative Sites

Site D is located in the northeastern part of LLNL property. Surficial deposits consist of colluvial, organic-rich, silty clays, with silt and gravel. These deposits thicken adjacent to historical stream courses. Bore-hole and trench data indicate that the colluvial deposits are underlain by complexly interbedded silty sands, silts, clays, and gravels of generally fluviatile origin. Some of these sediments correlate with the Upper Livermore Formation (Towse and Carpenter, 1986). Deeper borings indicate that the upper Livermore formation is approximately 165 feet thick beneath the site. Deeper strata consist of very dense, greenish- to bluish-gray semilithified clays and silts, with some sands and gravels. These strata may correlate with the Lower Livermore Formation (Carpenter et al., 1984; and Towse and Carpenter, 1986).

Site D deposits consist of Late Pleistocene alluvial and terrace deposits as well as late Pleistocene-Holocene alluvial and terrace deposits. Alternative Site F has similar surface soils. Only the young alluvial and terrace deposits are mapped in the alternate Site I area. These younger deposits are thought to be more than 5 feet thick (Carpenter et al., 1984).

3.2.1.2 Structure

3.2.1.2.1 Regional Structure

The Livermore Valley is an east-west-trending synclinal structure composed primarily of gently deformed alluvial deposits overlying complexly deformed Cenozoic and Mesozoic rocks. As seen in Figure 3.2-1, the coast ranges in the Livermore region consist of north- to northwest-trending mountain ranges and valleys bounded by faults. Most of the faults in the region are right-lateral strike-slip faults associated with the San Andreas Fault system (Page, 1982). The Livermore Valley is bordered by the Calavaras Fault to the west, the Greenville Fault to the east, the foothills of Mt. Diablo to the north, and the Diablo Range Mountains to the south.

3.2.1.2.2 Structure of the Alternative Sites

Approximately 1,300 feet of excavation in four trenches was completed at the preferred DWTF site (Site D) to investigate the possibility of ground rupture related to faulting. This was done to comply with the U.S. Environmental Protection Agency (EPA) Seismic Location Standard, 40 CFR 264.18(a) and 270.14(b)(11)(B), and the California Code of Regulations (CCR), Title 22, Section 66391(a)(11)(A)(2). California seismic location standards require that new or substantially modified existing hazardous waste facilities that are located within 3,000 feet of a fault that has had displacement within the last 10,000 to 12,000 years (Holocene period) or has lineations that suggest the presence of such a fault, must undergo a comprehensive geologic investigation to demonstrate that the facility is not located within 200 feet of a fault. Although the closest known active branch of the Greenville Fault is approximately 4,000 feet northeast of the preferred site, a conservative approach was taken and trenches were dug to verify the presence or absence of recent seismic activity near the preferred DWTF site.

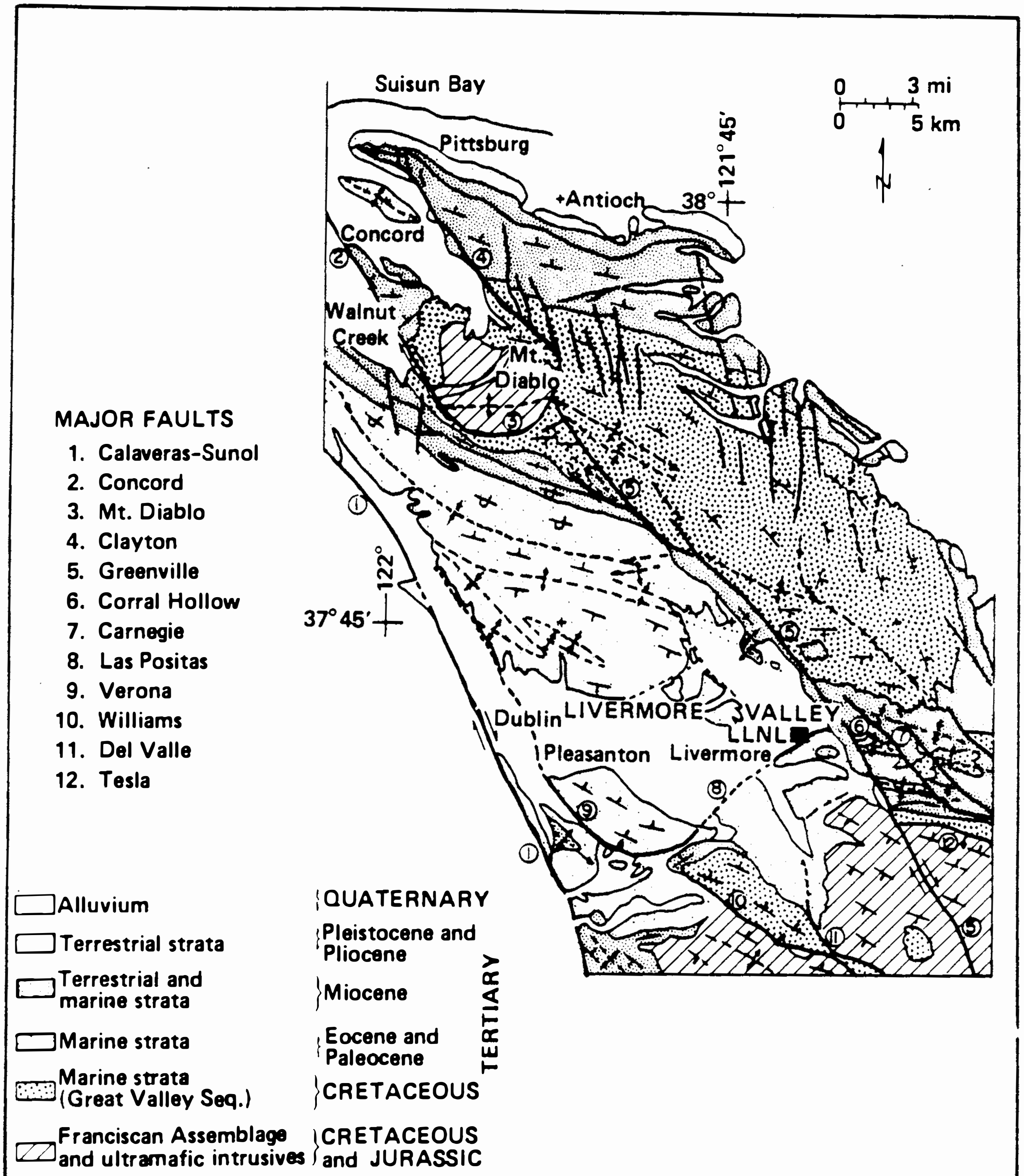


Figure 3.2-1. Geology of the Livermore Valley Area

Source: Dibblee and Darrow, 1981

A preliminary trench was dug south of the preferred site to explore the local stratigraphy and depth to pre-Holocene sediments (Weiss Associates, 1985). Three additional exploratory trenches were dug approximately perpendicular to the Greenville Fault. The alluvial deposits exposed in the trenches consisted of weakly cemented silty sand to sandy silt with clay. Well-developed surface soil and moderately- to well-developed subsurface soils were evident in all of the trenches. The surface and subsurface Holocene sediments in these trenches were found to be laterally continuous except for the occurrence of stream channels. No indications of faulting were found in the trenches (Weiss Associates, 1985).

Geologists from the California Department of Health Services (DHS) inspected the trenches and evaluated the results of the investigation with respect to the rules and regulations that govern seismic requirements for hazardous waste treatment facilities. DHS concurred that there is no direct evidence of northwest-trending Holocene fault activity in the trenches and that the existence of a northeast-trending fault through the preferred DWTF site is unlikely.

The conclusions from the trench investigation are supported with the results from previous geological investigations, including geological mapping, geophysical surveys, shallow and deep borings, and additional exploratory trenching (Carpenter et al., 1984; Towse and Carpenter, 1986). Seismic surveys for the sites are discussed in Section 3.2.3.

Surface excavations have not been conducted in the vicinity of alternative Sites I and F. This lack of data precludes accurate definition of the subsurface strata and structure beneath these sites. The same sediment types (late Pleistocene to Holocene alluvial and terrace deposits) encountered at Site D would also be found at the alternative sites (Carpenter et al., 1984).

3.2.2 Soils

Soils in the Livermore Valley have primarily developed from alluvial material eroded from local hills and mountains. Soil series found at LLNL include the San Ysidro, Zamora, and Rincon Series (Tonnessen and Tewes, 1982), as well as the Livermore and the Yolo Series (Carpenter et al., 1984). The soils range in texture from clayey to sandy loams to mixed gravels. The soils tend to be high in sodium, calcium, magnesium, iron, chlorine, and sulfur, and low in organic matter (nitrate, phosphate, and potassium).

3.2.2.1 Soils at the Alternative Sites

Soils at the preferred DWTF site belong to the San Ysidro Series. The San Ysidro Series consists of a brown loam of low permeability, which is hard when dry and plastic when wet. This soil is characterized by poor root permeability. The well-developed surface soil exposed in the trenches excavated at the preferred DWTF site is apparently continuous across the site (Weiss Associates, 1985).

Soils near Site F and Site I, adjacent to the Arroyo Seco, consist of the Livermore, Zamora, and Yolo Series (Carpenter et al., 1984). The older shallow soils are found at a depth of approximately 9 to 10 feet below land surface at Site D, 7 to 10 feet below land surface at Site F, and 10 to 11 feet below land surface at Site I (LLNL, 1985).

3.2.3 Seismology

The LLNL site is in a region that has experienced earthquakes within historical times. Historically active faults in the Livermore area are illustrated in Figure 3.2-2. Active faults in the region considered capable of causing strong ground motion at the alternative DWTF sites are the San Andreas, Hayward, Calaveras, Concord-Green Valley, Greenville, Las Positas, and Verona Faults (Scheimer, 1985). These faults are described in Table 3.2-1. Table 3.2-1 presents the earthquake magnitudes that would be generated

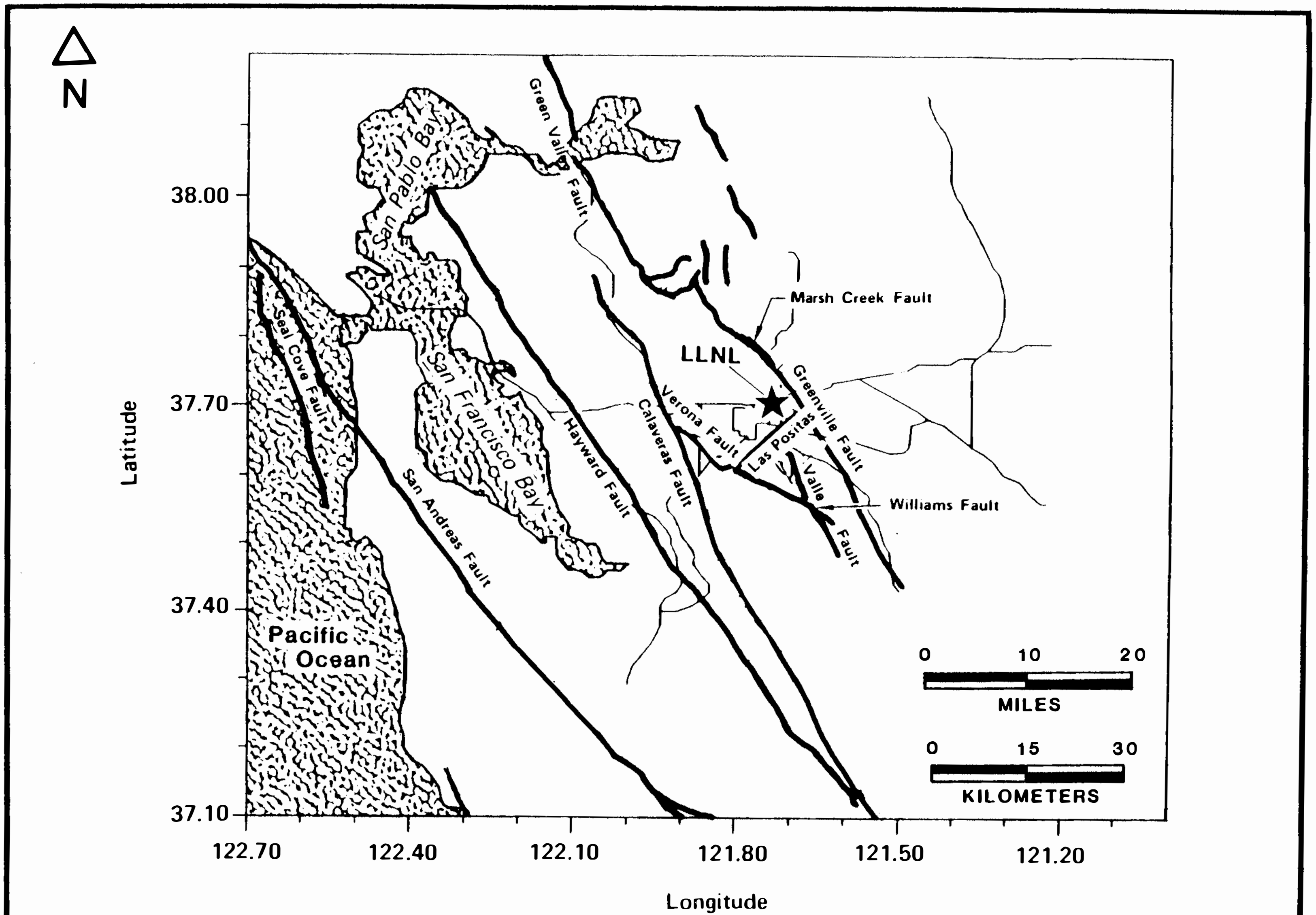


Figure 3.2-2. Faults in the Livermore Area

Source: Scheimer, 1985.

TABLE 3.2-1. FAULTS EXHIBITING RECENT ACTIVITY IN THE LIVERMORE AREA

Fault	Approximate Distance from Preferred LLNL-DWTF Site	Summary Description
San Andreas	36 miles	Generated several significant earthquakes, including the 1906 San Francisco earthquake, which caused structural damage in the Livermore Valley. Considered capable of generating an earthquake of Richter magnitude 7.5 to 8.5.
Hayward	16 miles	On the eastern margin of the San Francisco Bay area. Historical accounts of strong earthquakes along the fault zone in 1983 and 1868, as well as tectonic creep and microseismic activity. Considered capable of generating earthquakes of Richter magnitude 6.7 to 7.7. Strain is apparently being relieved by tectonic creep and periodic small-to-moderate earthquakes.
Calaveras	11 miles	Forms the western margin of the Livermore Valley. Historically active; has produced surface faulting and possible ground failures. Considered capable of generating earthquakes of Richter magnitude 7.1 to 7.7. Prescott et al., (1981) suggest that strain along the fault is being relieved by tectonic creep and small-to-moderate earthquakes in a zone of deformation wider than the fault itself; zone includes the Coyote Reservoir earthquake of August 6, 1979 (magnitude 5.7); the Morgan Hill earthqake of April 29, 1984; and the March 31, 1986, Mt. Lewis earthquake (magnitude 5.3) (Page et al., 1986).
Concord-Green Valley	17 miles	Suspected to have been the source of a 1955 earthquake, although no evidence of surface faulting was discovered. Evidence unclear as to whether the Concord and Green Valley Faults form a single fault trend, or are two separate features (Carpenter et al., 1984). Trend is considered capable of generating earthquakes of Richter magnitude 5.0 to 6.6.

(Continued)

TABLE 3.2-1. (Continued)

Fault	Approximate Distance from Preferred LLNL-CWTF Site	Summary Description
Verona	3.5 miles	Fault has been mapped using ground-water data Geologic evidence for recent fault movement is inconclusive, but minor microseismicity is reported in the vicinity (Carpenter et al., 1984). Considered capable of generating earthquakes of Richter magnitude 6.0.
Greenville 1980 Strand	4,000 ft	A major structural feature that extends southeast from Mount Diablo, along the eastern side of Livermore Valley and into the Diablo Range south of LLNL. A January 24, 1980 earthquake caused considerable ground shaking and some minor damage at the Livermore site (Carpenter et al., 1984). Considered capable of generating earthquakes of Richter magnitude 6.8. The January 24, 1980 earthquake was Richter magnitude 5.9 (Cockerham et al., 1980).
Las Positas North Branch	1.0 mile	Geologic evidence and microseismicity demonstrate recent activity. Considered capable of generating earthquakes of Richter magnitude 5.0 to 6.7.
South Branch	1.3 miles	

Sources: Carpenter et al., 1984; Prescott et al., 1981; Page et al., 1986; Cockerham et al., 1980.

Note: The listed Richter magnitudes are those at the fault location.

at the fault, not at the alternative sites. Earthquakes caused by other, more distant faults are considered to have a very low probability of causing strong ground motion at Site D (Woodward-Clyde, 1985; Geomatrix, 1985b).

3.2.3.1 Seismology at the Alternative Sites

Earthquakes present three major hazards to the project sites: strong ground motion from nearby or large regional earthquakes, ground surface rupture due to fault movement, and soil failure due to liquefaction or landsliding. Each of these hazards is discussed below.

The Greenville and Las Positas Fault Zones are the major contributors to the potential seismic hazard at the preferred site (Woodward-Clyde, 1985). The Greenville Fault zone trends northwest, east of LLNL, and is illustrated in Figure 3.2-3. The fault zone is composed of numerous fault segments. Evidence from road cuts and trenches indicate that some of the more easterly segments have disrupted recent alluvial deposits and soil. The Ancestral Greenville Fault, an inactive segment of the Greenville Fault, is exposed between the north and south branches of the Las Positas Fault in the hills southeast of the preferred DWTF site. This segment of the Greenville Fault is thought to have been active during Pliocene to Pleistocene epochs, but became isolated as faulting moved eastward. Bore-hole and geophysical data indicate that the northward projection of the Ancestral Greenville Fault is covered by sediments believed to be at least 300,000 years old, implying that no major movement has occurred on the Ancestral Greenville Fault since that time.

The Las Positas Fault zone, located south of the Livermore site, consists of at least two northeasterly trending branches. The northern branch passes approximately 300 feet from the southeastern corner of LLNL property. Springer (1984) speculates that the northern branch of the Las Positas Fault, as it bends northward, is related to the Greenville Fault zone. Exposures of the fault zone in road cuts and trenches clearly indicate recent movement along the north and south branches of the Las Positas Fault.

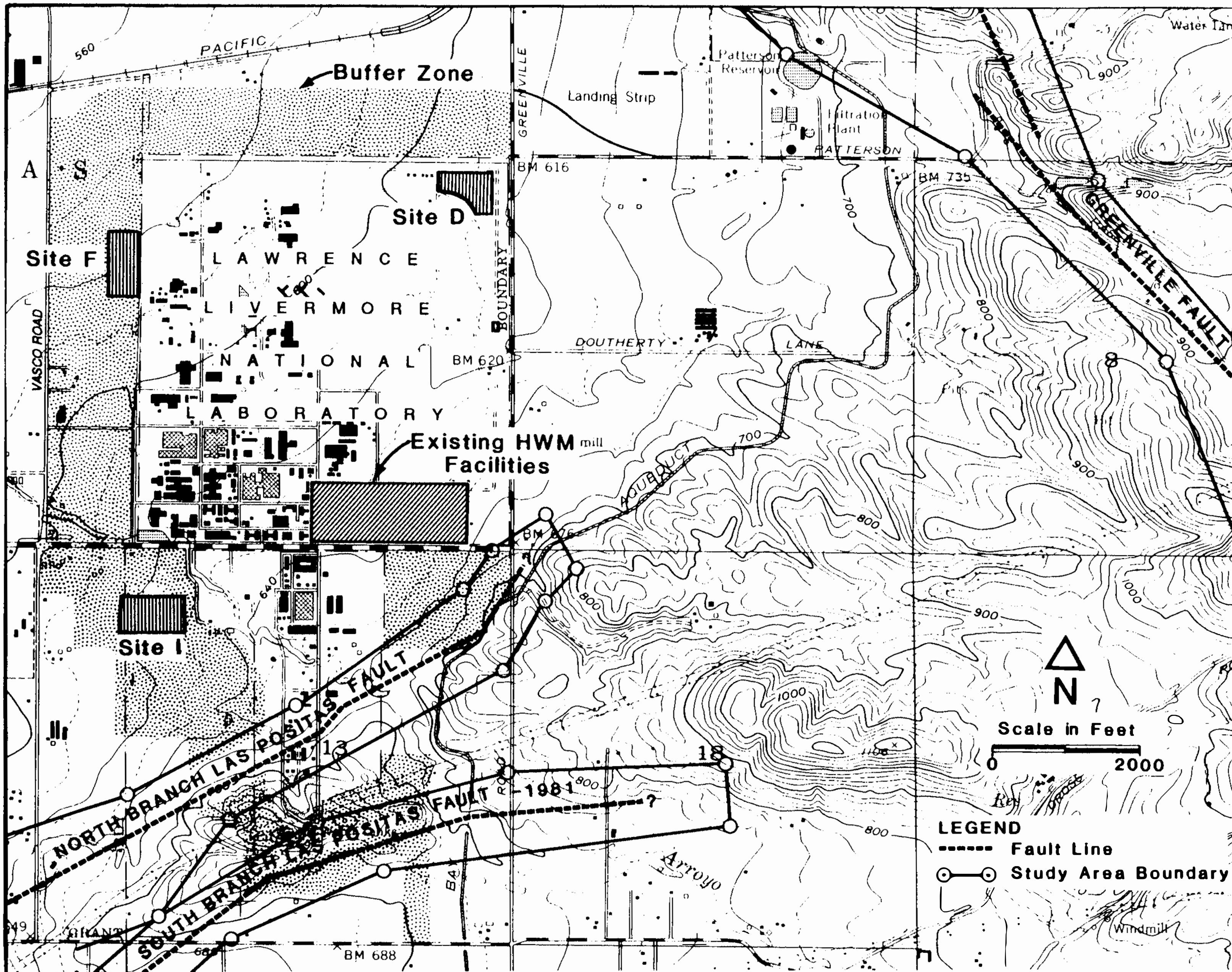


Figure 3.2-3. Las Positas and Greenville Fault Special Study Areas

Source: California Division of Mines and Geology, 1982.

The potentially active fault segment closest to the preferred DWTF site is located approximately 4,000 feet to the northeast, in the Greenville Fault zone. Although minor surface rupture was observed on fault segments within the Greenville and Las Positas Fault zones following earthquakes in January 1980, the segment closest to the preferred site did not rupture. The distances of the alternate and existing Hazardous Waste Management Facility (HWMF) sites from the Greenville and Las Positas faults are presented in Table 3.2-2.

The probability of ground surface rupturing due to earthquakes is considered extremely low at the preferred DWTF site (Site D) because no active faults are known to underlie the site. Extensive geologic investigations of all fault projections and lineaments identified on aerial photographs found that recent sediments (those deposited approximately 10,000 years ago) have not been displaced by fault movement. Detailed geologic studies of the preferred DWTF site also show that no active fault traces are apparent in the Holocene sediments studied in excavations near the preferred site.

As described in Section 2.4.2, upgrading the existing HWMF was considered as an alternative to the proposed DWTF. The proximity of the HWMF site to the Las Positas fault required a seismic investigation before design or construction of the facility upgrading could begin. A preliminary investigation of a crack found in the pavement near the HWMF site concluded that it would be costly and time consuming to prove that the crack was not fault-induced. Therefore, upgrading the existing HWMF would be very difficult to permit due to federal and state seismic location standards. Consequently, upgrading the existing HWM facilities was not considered to be a viable alternative.

Alternative Site F has the lowest earthquake potential of all the alternative sites. It is located approximately 7,500 feet from both the Greenville and Las Positas fault systems. One fault projection was observed by Carpenter et al. (1984) in an aerial photograph near alternative Site F.

TABLE 3.2-2. DISTANCE OF PREFERRED, ALTERNATIVE, AND EXISTING SITES FROM THE NEAREST STRAND OF THE GREENVILLE AND THE LAS POSITAS FAULT ZONES

Site	Distance from Greenville Fault	Distance from Las Positas Fault	Remarks
D	4,000 ft	4,500 ft	Two purported air photo lineaments nearby; however, trench studies indicate no evidence of faulting on the site.
F	7,500 ft	7,500 ft	1 air photo lineament nearby
I	12,000 ft	2,700 ft	3 air photo lineaments nearby
Existing HWM Facilities	10,000 ft	1,400 ft	Crack in the pavement was found adjacent to the site.

Sources: LLNL, 1985; Towse and Carpenter, 1986; Geomatrix, 1985a.

Alternative Site I lies within 2,700 feet of the Las Positas fault. Detailed studies or trenching performed by LLNL and independent contractors showed no evidence of active faults near Site I or within the LLNL property (Carpenter et al., 1984, p. 86). Site I has the highest earthquake potential of all the alternative sites due to its proximity to the Las Positas fault.

Although secondary seismic effects include phenomena associated with liquefaction, landslides, and water bodies, only the potential for liquefaction needs to be considered with regard to the proposed DWTF sites. The landslides are not considered a potential hazard due to the lack of local topographic relief. Major water bodies are also not considered a potential seismic hazard because there are no major water bodies directly above the proposed sites.

Towse and Carpenter (1986) conclude that the alluvial sediments beneath the preferred DWTF site do not generally possess the physical properties of materials subject to liquefaction. The soils located at the preferred DWTF site are generally dense to very dense, and unsaturated to a depth of 38 feet below land surface. Consequently, the liquefaction potential of the soils at the site is very low (Bechtel, 1986). Since the soil types across LLNL property do not differ significantly, the liquefaction potential at all the sites should be low.

3.3 Hydrology

3.3.1 Surface Water

Figure 3.3-1 illustrates the surface-water features surrounding LLNL. Major drainages in the LLNL vicinity include Arroyo Las Positas and Arroyo Seco. The South Bay Aqueduct is located east of LLNL, conveying water from the Hetch Hetchy Reservoir to the San Francisco area.

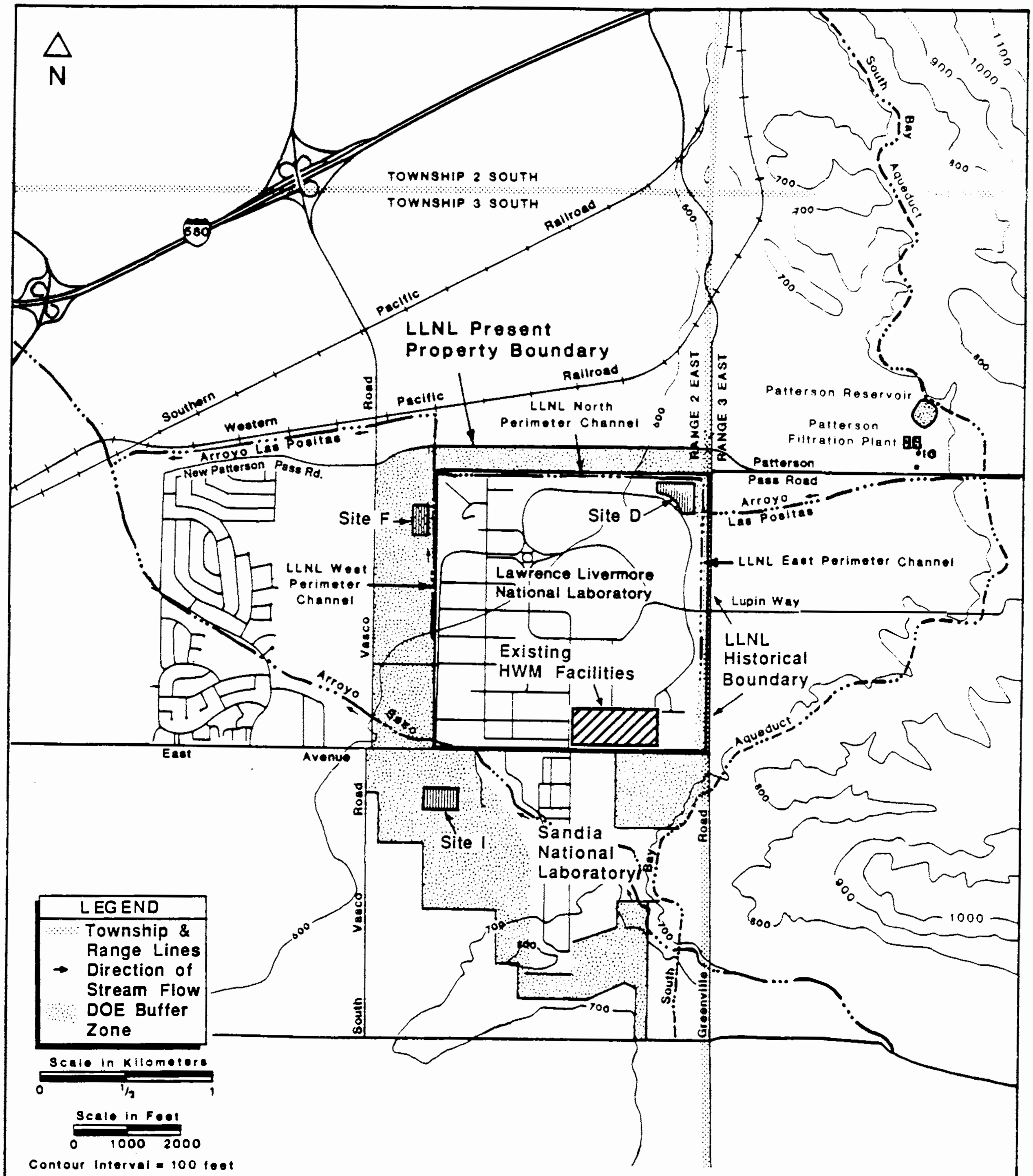


Figure 3.3-1. Regional Surface-Water Features

0288-023-4

Three major drainages empty into the northwest corner of the LLNL property. A retention/siltation basin is located near the center of the LLNL facility to aid in the prevention of flooding on site, and to decrease the sediment load of the surface water leaving the property.

Surface water enters the LLNL property during the rainy season through Arroyo Las Positas and its tributaries from the east. This creek has been rechannelized across the northern boundary of LLNL and has been renamed the North Perimeter Channel in this area. A series of underground pipes and open channels carry surface water from the eastern section of LLNL to the North Perimeter Channel.

Runoff water from the west section of LLNL drains into the West Perimeter Channel, which joins Arroyo Las Positas at the northwestern corner of LLNL property. Surface water can be retained and sampled, if necessary, at this location in the surface drainage system.

Surface-water runoff from the preferred site (Site D) would drain into the North Perimeter Channel. Runoff from Site F would empty into the West Perimeter Channel. Site I drainage would likely empty into Arroyo Seco, or be channelized into the underground pipe system in the southwest corner of LLNL property. The surface runoff from the existing HWMF is channelized and carried through the retention basin to the North Perimeter Channel.

3.3.1.1 Flood Potential

According to 100-year flood and zone plans defined by the Federal Emergency Management Agency (1981 and 1986) for the LLNL area, the boundary of the Arroyo Las Positas 100-year flood zone is approximately 125 feet from the north perimeter of Site D. The elevation of Site D is approximately five feet above the boundary of this defined 100-year flood zone. Flow in Arroyo Las Positas is intermittent and the Arroyo is generally dry during the summer. Therefore, flood potential at Site D is low. To further mitigate flood potential, the site would be raised an average of two feet and graded to allow for safe forklift operation. The site would also be graded to prevent rainwater from running onto the DWTF site.

The flood potential for alternate Site F is also low. The west side of the LLNL property does not receive direct runoff from the mountains to the east. The accumulation of water in the West Perimeter Channel originates from on-site runoff only. Site grading and construction would mitigate flood potential.

Alternate Site I has the greatest flood potential of the three proposed sites, since a portion of the site lies in a northwest trending swale that collects water during the rainy season (LLNL, 1985).

None of the alternative sites are intersected by the defined 100-year flood plain zones (Federal Emergency Management Agency, 1981 and 1986).

3.3.1.2 Water Quality

The specific conductance of water samples taken from Arroyo Las Positas by the U.S. Geological Survey (1985) tends to be higher than the specific conductance of water taken from other creeks in the Livermore Valley. Specific conductance can be used as an indirect measurement of the amount of dissolved solid material in the water. Water samples taken from the gauging stations on Arroyo Las Positas appeared to be more saline than samples taken from other valley drainages. The samples also contained greater concentrations of dissolved ions than any of the other stations in the area. The higher specific conductance in this stream near Livermore is most likely a result of the proximity and composition of the Arroyo Las Positas headwaters. This water is derived from a natural watershed composed primarily of marine sediments, yielding large amounts of dissolved materials. Further downstream, near Pleasanton, the specific conductance of Arroyo Las Positas is lower, indicating dilution of the stream from other sources.

Filter backwash from the Patterson water treatment facility (see Figure 3.3-1) is sent to an on-site concrete-lined lagoon. All solids are disposed of in an appropriate landfill (Horen, personal communication, 1987). Therefore, the Patterson water treatment facility has no known impact on the water quality of Arroyo Las Positas. Table 3.3-1 shows that there is little difference in the quality of storm water entering LLNL and exiting LLNL at Arroyo Las Positas.

3.3.2 Ground Water

Ground water in the Livermore Valley occurs in multilayered systems comprised of an upper, unconfined aquifer overlying a series of semiconfined aquifers (State of California, 1974). The two most important units containing the aquifers are the surface valley fill deposits and the Livermore Formation.

The valley fill deposits consist largely of unconsolidated sands and gravels along with some silts and clays. Ground water occurs in these deposits in both confined and unconfined conditions. Additionally, the Livermore Formation contains significant water-bearing units. All of the deep wells in the eastern half of the valley draw water from the Livermore Formation.

Ground water flows toward the east-west longitudinal axis of the Livermore Valley and then in a generally westward direction. Vertical movement of water between the Livermore Formation and the valley-fill alluvium is restricted by permeability differences and by internal stratification within these sedimentary units.

The Livermore Valley has been divided into several ground-water subbasins (State of California, 1974; U.S. Geological Survey, 1985). The proposed DWTF site is located within the Spring subbasin. Within the Spring subbasin, ground water is unconfined in the valley-fill materials, and partially confined in the underlying Livermore Formation (State of California, 1974; U.S. Geological Survey, 1985). At the proposed site, it is generally not possible to distinguish between beds of the upper part of the Livermore

TABLE 3.3-1. SURFACE WATER QUALITY

Analyses (mg/l)	Storm Water Runoff Entering LLNL[a]	Arroyo Las Positas Exiting LLNL[b]
Arsenic	<0.001	<0.001
Barium	<0.1	<0.1
Beryllium	<0.01	<0.01
Cadmium	<0.01	<0.01
Chromium	<0.02	<0.02
Lead	<0.001	<0.001
Mercury	<0.0001	<0.0001
Selenium	<0.001	<0.001
Silver	<0.01	<0.01
Nitrate (as N)	0.10	1.4
Fluoride	0.19	0.26
Chemical Oxygen Demand	85.0	88.0
Total Organic Carbon	31.0	21.0
Oil and Grease	8.0	9.0
2,4-D (ug/l)	11.0	3.2
Chloroform (ug/l)	<1.0	<1.0
Trichlorofluoromethane (ug/l)	3.0	3.0

Source: Holland et al., 1987.

[a] Measured at Arroyo Las Positas east of LLNL, and Arroyo Seco, south of LLNL.

[b] Measured at Arroyo Las Positas near the northwest corner of LLNL.

Formation and the overlying alluvial valley fill. The aquifers are locally recharged by percolation through the valley alluvium and by infiltration via Arroyo Seco and Arroyo Las Positas.

Depth to the water table beneath LLNL ranges from approximately 25 to 145 feet below ground, with ground and surface water flowing in a westward direction (Griggs and Buddemeier, 1986; Hoffman et al., 1987). In measurements taken in July 1986 (dry season), the depth to the water table was 113 feet at Site D, 35 feet at Site F, and 79 feet at Site I. In measurements taken in April 1987 (rainy season), the depth to the water table was 111 feet at Site D, 33 feet at Site F, and 80 feet at Site I (Hoffman et al., 1987). The depth to the water table at the existing HWMF ranges from approximately 100 to 145 feet.

3.3.2.1 Ground Water at the Alternative Sites

Figure 3.3-2 shows the monitor wells located adjacent to the alternative sites. Ground-water samples collected from wells in the vicinity of Site D contained inorganic compounds at concentrations above drinking water standards (see Table 3.3-2). Nitrate concentrations in samples collected from wells MW-7 and 7D2 are likely the result of wastes from nearby agricultural activities. Concentrations of other inorganic compounds are the result of natural ground-water quality evolution (Stone et al., 1982). None of the samples collected from wells in the area of Site D contained volatile organic compounds (VOCs) above drinking water standards. In contrast, samples from wells located near the other two alternative sites and the existing HWMF contained concentrations of VOCs above recommended maximum contaminant levels, as seen in Table 3.3-2. The VOCs observed in ground-water wells in the vicinity of the HWM facilities exist in portions of aquifers that are not used for potable water supplies (Holland et al., 1987). These wells are presently being sampled on a quarterly basis by LLNL.

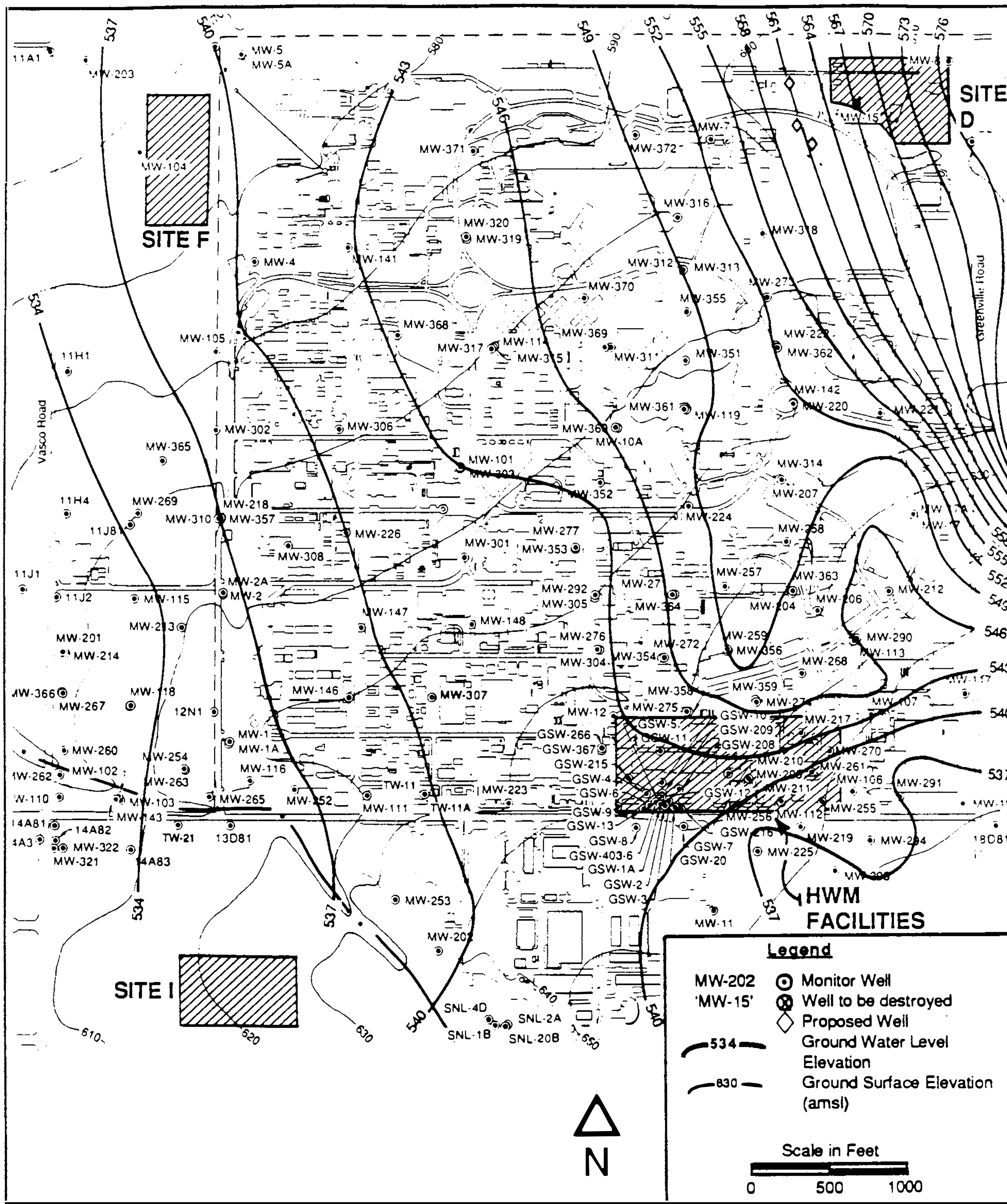


Figure 3.3-2. Monitoring Wells in the Vicinity of the Alternative Sites

TABLE 3.3-2. MAXIMUM CONCENTRATIONS OF CONSTITUENTS REPORTED IN GROUND-WATER WELLS ADJACENT TO ALTERNATIVE SITES AT CONCENTRATIONS ABOVE DRINKING WATER STANDARDS (MAXIMUM CONTAMINANT LEVELS)

	Site	Well Number	Inorganic Chemicals (mg/l)			Organic Chemicals (ppb)[a]				
			Chloride	Solids	Nitrate	TCE[b]	DCE[c]	PCE[d]	CTC[e]	DCA[f]
Action Level			500[g]	1,000[g]	10[h]	5[h]	7[h]	4[i]	5[h]	5[h]
	D	7D2	--	1,560[j]	10[k]	11[m]	--	--	--	--
		MW7	--	--	--	--	--	--	--	--
		MW8	610[l]	1,770[l]	--	--	--	--	--	--
	F	MW-4	--	--	--	58	12	--	--	--
	I	TB-21	--	--	--	--	--	6	--	--
		13D81	--	--	--	--	--	6	--	--
		MW-265	--	--	--	12	--	53	--	--
	HWM	MW-205	--	--	--	540	--	--	5.5	--
		MW-217	--	--	--	110	22	12	83	3.3

[a] Source: Hoffman et al., 1986 (Appendix B).
[b] Trichloroethylene
[c] Dichloroethylene
[d] Perchloroethylene
[e] Carbon tetrachloride
[f] Dichloroethane
[g] Source: Title 22, Division 4, Chapter 15, California Code of Regulations (CCR)
[h] Source: 40 CFR 141 (EPA regulations)
[i] Source: DHS Action Level (Speth, personal communication, 1988)
[j] Source: Stone et al., 1982
[k] Source: U.S. Geological Survey, 1985
[l] Source: Stone and Ruggieri, 1983
[m] Results from only one sample. Six other samples showed nondetectable levels.

No exceedance of action level indicated by (--).

As indicated in Table 3.3-2, analyses of soil and ground water at LLNL and the nearby vicinity indicate that past LLNL site operations have resulted in the presence of low levels of organic solvents at several locations. Since 1984, LLNL has been conducting a program to investigate both the source and the extent of VOCs and other compounds in ground water (University of California, 1987, p. 7-25). In addition, LLNL is implementing necessary clean-up actions pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, Superfund Amendments Reauthorization Act of 1986, and the State of California.

3.4 Climate, Meteorology, and Air Quality

3.4.1 Climate

The Livermore Valley is flat and roughly bowl-shaped, about 13.0 miles long and 4.3 to 6.8 miles wide, and surrounded by hills that are 984 to 1,968 feet high. The general area has a Mediterranean scrub woodland climate that is characterized by mild, rainy winter weather (about 15 inches of rain) from October to April. Summers are characteristically warm and dry, with little or no rain from May through September.

Winter storms result from migratory low-pressure systems that become detached from the semipermanent Aleutian Low and move over the area. Following the passage of the migratory low-pressure systems, skies typically clear as the Eastern Pacific High builds inland. Occasionally under these conditions, strong northerly surface winds with gusts up to 67 miles per hour (mph) are observed for a day or two.

The summer in the Livermore Valley is consistently warm and dry. A sea breeze typically develops during the afternoon when modified ocean air moves inland (eastward). The strength of this sea breeze rarely exceeds 13 meters per second (m/s) (29 mph) in the Livermore area. The spring and autumn seasons are typically transitional periods with no significant precipitation or temperature extremes occurring. The mean annual temperature is 59°F, with a minimum winter temperature of 32°F and a summer high temperature of 100°F.

3.4.2 Meteorology

The predominant wind direction at LLNL throughout the year, and especially during the dry season, is from the southwest through west. During the wet season, post-frontal anti-cyclonic flow occurs often enough to cause north-northeast and northeast winds of comparable frequency to the southwest through west directions. The most common windspeeds during all seasons are 11 to 16 mph from the southwest through west. This relatively high speed is caused by winds channeling through passes in hills to the west. The wet season winds from the north-northeast and northeast are most common in the 4 to 7 mph range. In general, the strongest winds blow during the wet season from the north-northeast and northeast. Figure 3.4-1 shows the typical annual average wind pattern for the Livermore region.

Atmospheric inversions frequently occur, limiting the vertical dispersion of pollutants, especially during the nighttime and early morning. Oakland upper air sounding data have been analyzed to describe mean mixing heights under inversion conditions (Holzworth, 1972) and adjusted to better reflect the mixing heights in Livermore. This adjustment was based on an evaluation conducted by the Bay Area Air Quality Management District (BAAQMD) that related differences in surface temperature between Oakland and Livermore to differences in mixing height (Bay Area Air Quality Management District, 1987; Basso, personal communication, 1987). The mean annual morning mixing height of 1,847 feet is the height available for mixing pollutants in the atmosphere under inversion conditions. The mean afternoon annual mixing height is 2,661 feet. Seasonally, mixing heights are lowest in the winter and highest in spring.

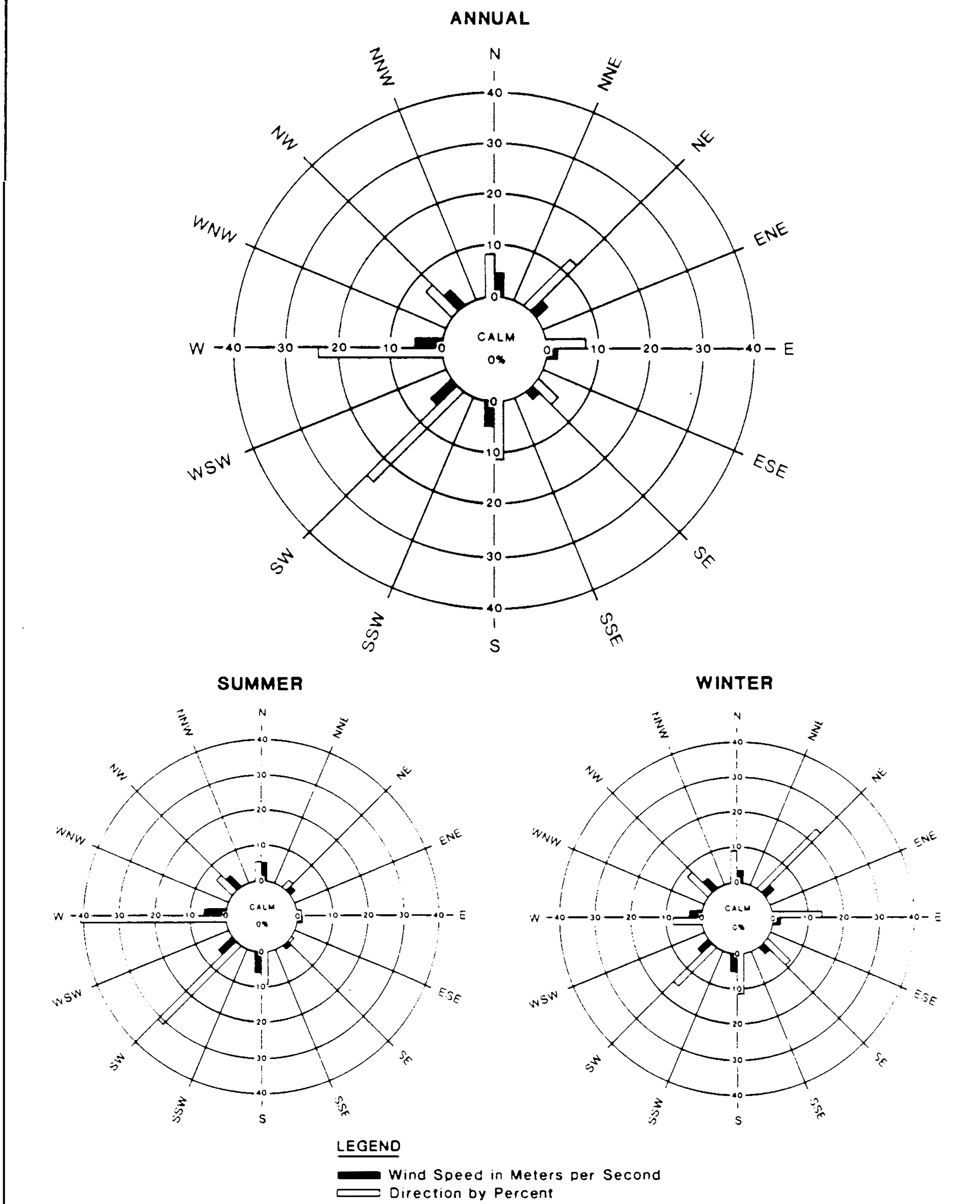


Figure 3.4-1. Average Annual Wind Pattern for the Livermore Region

Source: Hayes et al., 1984

3.4.3 Air Quality

3.4.3.1 Criteria Pollutants

Existing ambient concentrations of criteria air pollutants have been monitored by the BAAQMD at a station on Old First Street in Livermore, located 4.0 miles west (upwind) from LLNL. Sulfur dioxide (SO_2) concentrations are not measured in Livermore, or at any site in Alameda County. For this reason, SO_2 data from a monitoring station in Pittsburg (which is approximately 28 miles north of the City of Livermore) in adjacent Contra Costa County were used as the background level described in Section 4.2.3.2. On the basis of measurements taken at the Livermore station or at other stations in Bay Area counties, the EPA has determined that the Livermore area meets ambient standards for all air pollutants, with the exception of ozone. Table 3.4-1 presents a summary of the Livermore station air quality modeling.

3.4.3.2 Other Monitored Pollutants

LLNL conducts an ongoing air sampling program in which concentrations of radioactive species and beryllium (noncriteria pollutants) are measured weekly at several locations on the perimeter of the laboratory and in the surrounding valley. The locations of monitoring stations at which concentrations of radionuclides (Pu-239, U-235, U-238) and beryllium are measured are shown in Figures 3.4-2 and 3.4-3. In addition, environmental radiation is measured quarterly at 22 LLNL perimeter locations for gamma and neutron dose rates (Figure 3.4-4) and at 55 off-site locations for gamma dose rates (Figure 3.4-5). In 1986, the measured concentrations of beryllium averaged less than 1 percent of the BAAQMD ambient standards, and the measured concentration of radionuclides (Pu-238, U-235, U-238) averaged less than 1 percent of those standards stipulated in U.S. Department of Energy (DOE) guidelines (Holland et al., 1987).

TABLE 3.4-1. SUMMARY OF LIVERMORE AIR QUALITY DATA

Pollutant	Averaging Time	Maximum Monitored Concentration[a] (ppm)	California Standard[b] (ppm)	Federal Standard[c] (ppm)
Ozone	1 hour	0.14	0.10	0.12
NO_2	1 hour	0.15	0.25	--
	Annual	0.021	--	0.05
CO	1 hour	12.0	20.0	35.0
	8 hour	4.80	9.0	9.0
SO_2	1 hour	0.18	0.25	--
	3 hour		--	0.5
	24 hour		0.05[e]	0.14[d]
	Annual	0.002	--	0.03[d]
PM	24 hour	132 mg/m^3	--	--
	Annual	55 mg/m^3	--	--
PM_{10}	24 hour	NA	50 ug/m^3	150.0 ug/m^3
	Annual	NA	30 ug/m^3	50.0 ug/m^3

a With the exception of ozone, these are the maximum values reported from the City of Livermore during 1982-1985 (California Air Resources Board, 1982 through 1985). The ozone value is the maximum for 1986. SO_2 data are from Pittsburg, CA (California Air Resources Board, 1982 through 1985).

b California Ambient Air Quality Standard (CAAQS). California Health and Safety Code, Title 17, Chapter 1, Subchapter 1, Article 2.

c Federal Secondary Standard (NAAQS secondary). Code of Federal Regulations, Volume 40, Part 50.

d Federal Primary Standard (NAAQS primary), no secondary standard exists.

e Applies when California oxidant and/or particulate matter standards are violated.

NA - not available

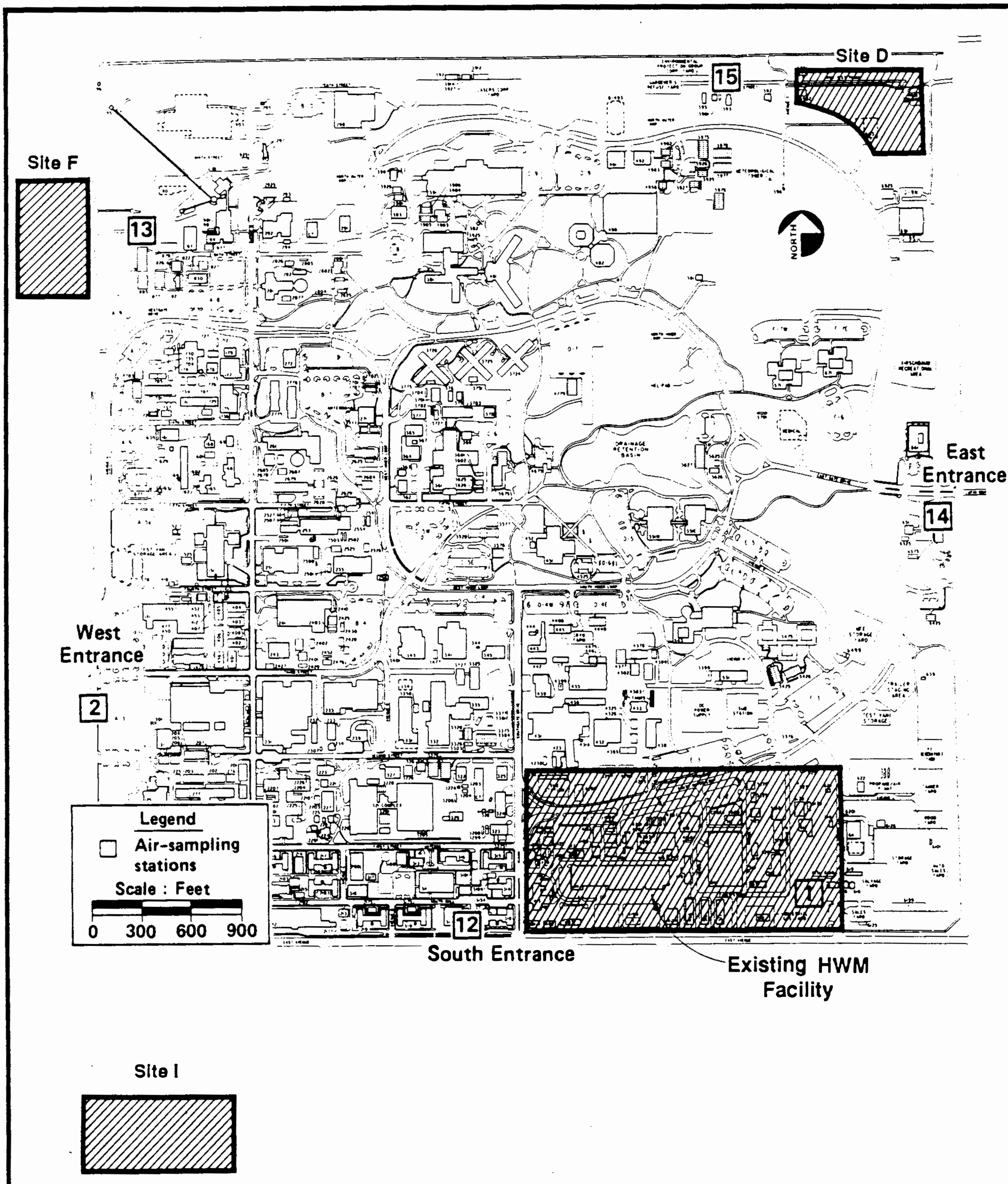


Figure 3.4-2. LLNL Perimeter Air-Sampling Locations
for Beryllium and Radionuclides

Source: Holland et al., 1987.

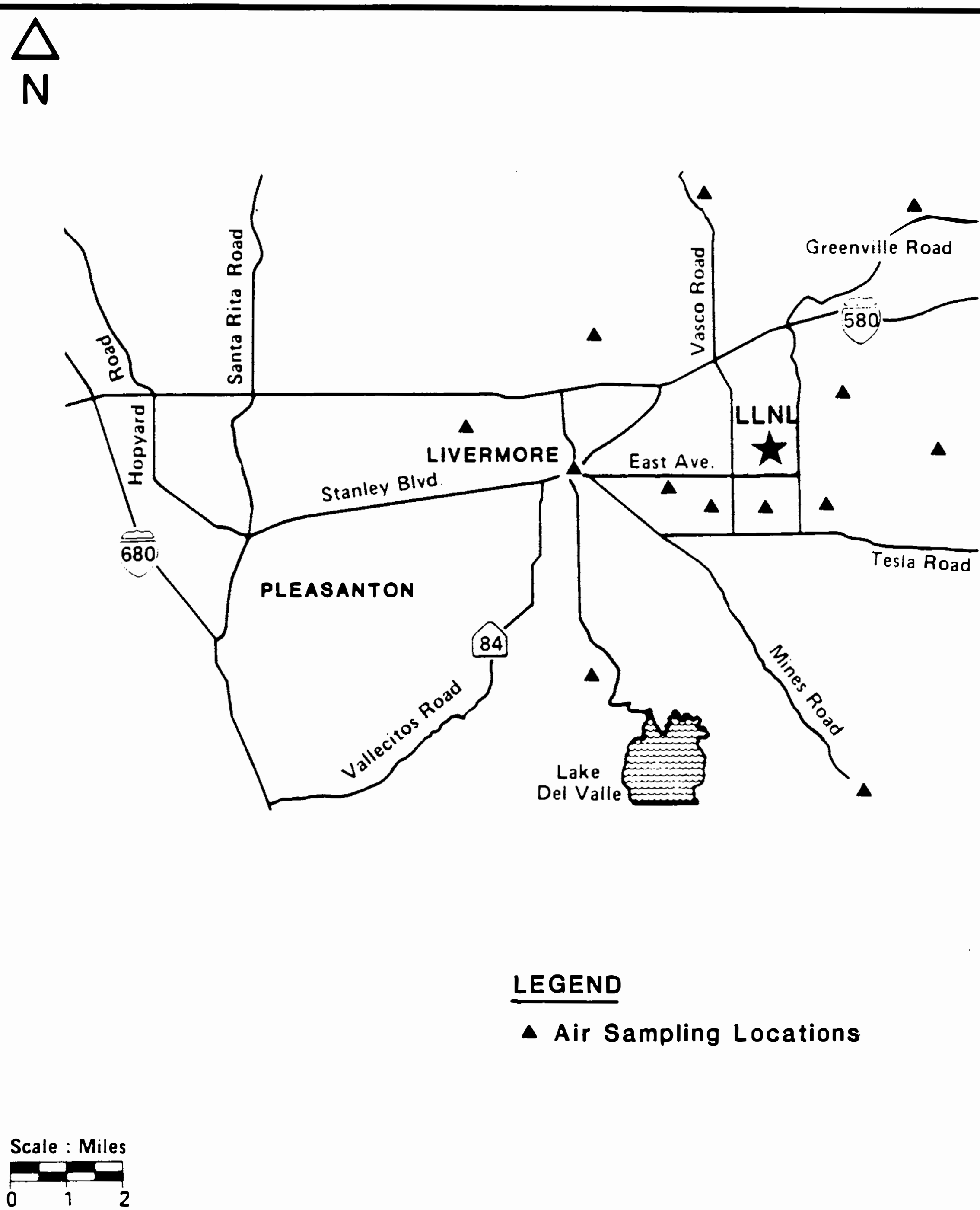


Figure 3.4-3. Livermore Valley Air-Sampling Locations for Beryllium and Radionuclides

Source: Holland et al., 1987.

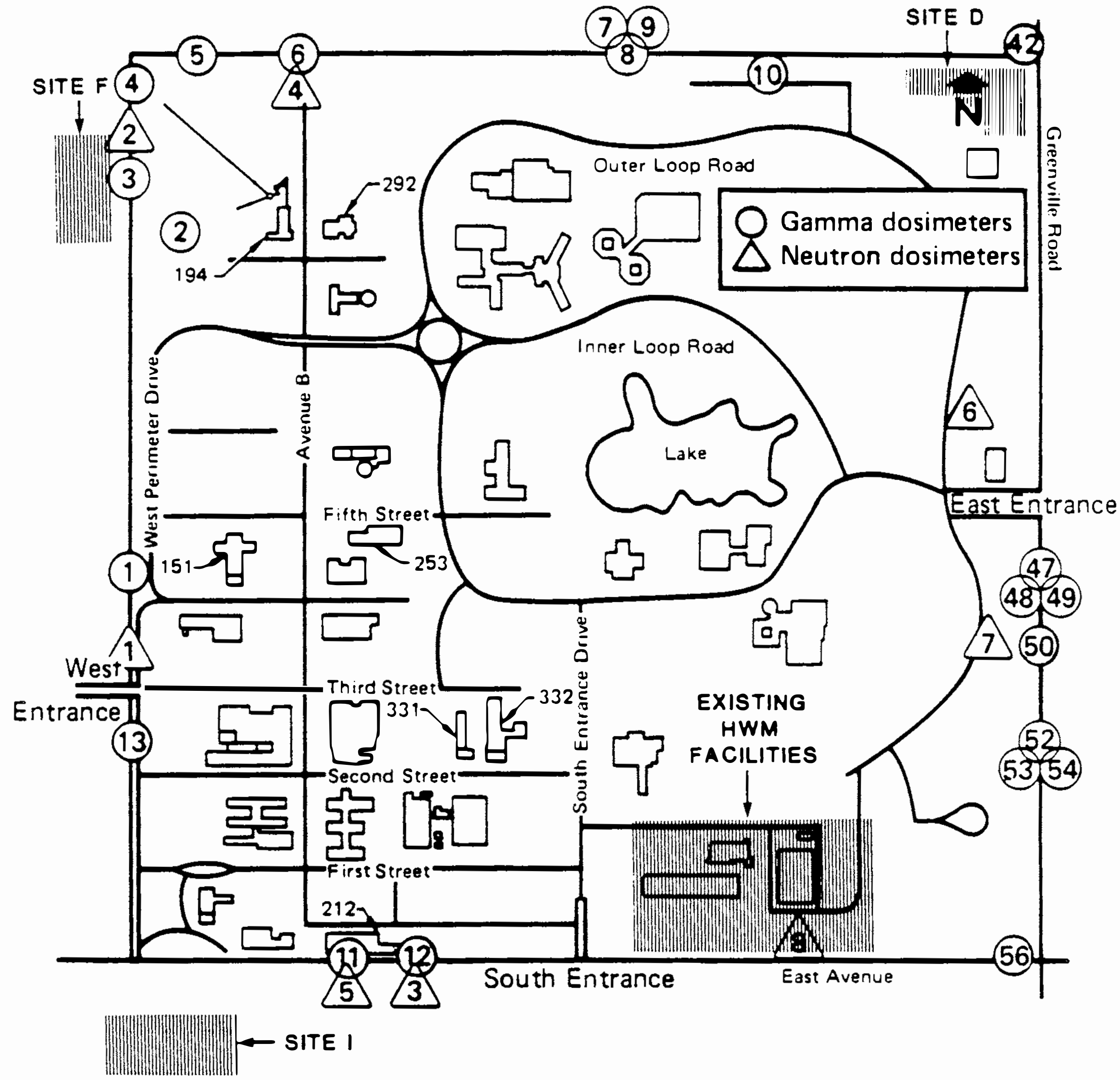


Figure 3.4-4. LLNL Perimeter Locations for Gamma and Neutron Dosimeters that Measure Radionuclides

Source: Holland et al., 1987.

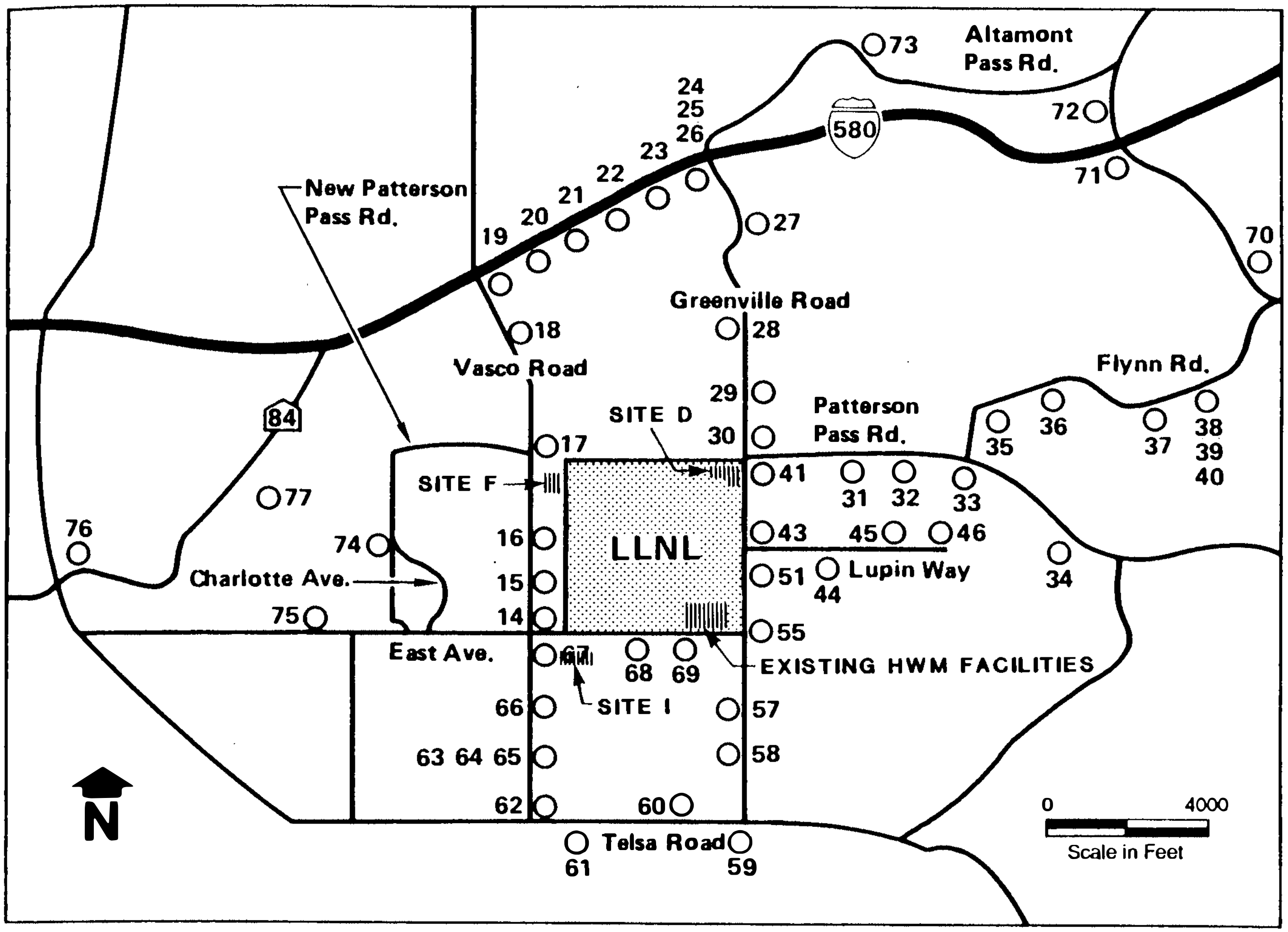


Figure 3.4-5. LLNL Off-Site Locations for Gamma Dosimeters

Source: Holland et al., 1987.

The air quality modeling results (Radian, 1988b) indicate that concentrations of other noncriteria pollutants such as hydrogen chloride (HCl), halogeneous compounds, and metals from the no-action and DWTF alternatives would not significantly increase the concentrations of these pollutants. Monitoring is not currently required for these compounds.

3.5 Vegetation and Wildlife

The plant and animal species observed on the LLNL site include 114 plants, 11 mammals, 69 birds, 5 amphibians, 45 insects, 5 arachnids, 3 crustaceans, and 2 reptiles (University of California, 1986).

3.5.1 Vegetation

The biotic communities found in the Livermore Valley area include primarily grassland and savanna and a limited number of agricultural fields. The grasslands are often used for grazing sheep or cattle. These grasslands are made up of annual grasses and wild flowers species. Many of these species of grasses are non-native and are on lands disturbed by livestock grazing. Agricultural land in the valley is cultivated for oats, hay, grape vineyards, and orchards.

Vegetation on the LLNL property is made up of both ornamental and native species of landscape plants, as well as weedy species that have invaded disturbed areas. The three alternative DWTF sites vary only slightly in vegetative composition. Site F, on the northwest side of LLNL, is grazed by cattle and is covered with weedy species of grasses and forbs. Site I, on the south side of East Avenue, is cultivated for oat hay.

The preferred site (Site D) is located in the northeast corner of LLNL property. Currently, the land is partially undeveloped and is used to store general and heavy equipment and is used for office trailer siting.

Building 592 is located on the western end of the site. The site is covered with weedy species of grasses and forbs with a group of ornamental conifers along the western edge of the site. Landscape vegetation exists along the north and east section of the site adjacent to the LLNL security fence.

Existing decontamination facilities are located in the southeast portion of LLNL. Other existing waste disposal and storage facilities are also in the developed industrial areas of the southeast portion of LLNL. No native vegetation exists in these industrialized areas. The only existing vegetation are a few ornamental trees scattered in the southeast portion of LLNL.

3.5.2 Wildlife

In the hills surrounding the Livermore Valley, within a savanna grassland, oak trees provide habitat for diverse species. Oaks provide nesting sites for numerous birds, as well as shade and food for other wildlife. Large mammals, such as deer and coyotes, are more frequently found here than in the grassland communities. All the natural streams in the area are intermittent and support no natural fish populations.

Sites F and I support populations of birds and small mammals. These species are less numerous at Site D due to ongoing use of this property for LLNL activities.

During 1985, as part of LLNL's environmental monitoring program goatmilk samples were obtained from three farms within about 5 km of LLNL. Cow's milk was also sampled when available from one of the farms. The results of these milk samples showed that the levels of nuclides in the milk were extremely low and that there was no impact attributable to existing LLNL activities (Holland et al., 1987). Using this as an indicator of impacts from radionuclides to wildlife, it can be concluded that there are no impacts to wildlife in the surrounding area attributable to effluents from LLNL and existing HWM operations.

3.5.3 Endangered Species

The California Department of Fish and Game's Natural Diversity Data Base (NDDB) lists all documented sitings of threatened and endangered species in California. A NDDB search was conducted for the area, including the City of Livermore, LLNL, Sandia National Laboratory at Livermore, and the surrounding Livermore Valley. None of the species listed as threatened or endangered in this search are present on the LLNL site, or found on any of the DWTF alternative sites (California Department of Fish and Game, 1987). This finding is consistent with a determination by the U.S. Fish and Wildlife Service that there is no evidence of any endangered or threatened species within the LLNL area (Kobetich, 1987).

3.5.4 Biological Impacts from Existing LLNL Radionuclide Releases

As part of LLNL's environmental monitoring program which has been conducted since 1974 to verify the effectiveness of control measures and to assess environmental impacts from LLNL operations, LLNL collects vegetation samples on a quarterly basis at several locations in the Livermore Valley. Since lab facilities at LLNL emit a relatively large level of tritium and because tritium is easily absorbable and incorporated into plant and animal tissue, LLNL focuses their environmental monitoring and analysis program on determining levels of tritium found in vegetation and other medium in the area. LLNL has found that tritium levels in vegetation of Livermore Valley have generally remained the same since the monitoring program began in 1974 (Griggs and Buddemeier, 1986).

As a means of evaluating the possible impact of LLNL effluents on locally grown found stuff, LLNL compared the tritium content of Livermore Valley wines with values from other California and European wines. The tritium levels in valley wines are within the range found to be present in European wines and surface waters throughout the world, but are somewhat higher than those produced from grapes grown in other parts of California. Samples of honey produced from a variety of flower sources both in and outside the Livermore Valley were analyzed for tritium content. Honey produced in the Livermore Valley contained tritium levels comparable to those found in honey from neighbouring areas (Griggs and Buddemeier, 1986). Based on this information from the LLNL environmental monitoring program, there is no evidence indicating existing impacts to vegetation in the Livermore area from the existing HWM facility and other current LLNL operations.

3.6 Socioeconomics

The Livermore-Amador Valley area includes the cities of Dublin, Pleasanton, Livermore, and the unincorporated area around Pleasanton and Livermore. LLNL has significant socioeconomic influence in the surrounding communities. The population, development, and economy of the Livermore-Amador Valley area is greatly influenced by the number of persons employed by LLNL, the large annual payroll generated by LLNL, and the industry and commerce supported by LLNL. The existing socioeconomic conditions are addressed in the following sections.

3.6.1 Demography

Residential growth in the Livermore-Amador Valley has been rapid since the 1960s, and has consisted predominantly of single-family residential developments, though this growth rate declined slightly during the late 1970s. Between 1970 and 1980, the area population increased by roughly 60 percent. In 1984, the population of the City of Livermore was 51,946 and the population of the greater Livermore-Amador Valley area was estimated to be 180,280 (see Table 3.6-1) (Alameda County Planning Department, 1986a).

3.6.1.1 Employment

In 1985, there were an estimated 19,850 persons employed in the City of Livermore. This number is projected to increase by 25,020 to 44,870 in 2005. Of the 25,020 increase, 8,840 persons will be employed in manufacturing and wholesale, 10,190 will be employed in the service sector, 3,020 will be employed in retail, and 3,160 will be employed in "other" occupations.

TABLE 3.6-1. POPULATION, 1980 - 1984, LIVERMORE-AMADOR VALLEY AND SURROUNDING AREA

Area	1980	1985	Percent Change 1980-84
Dublin	15,299	17,600	15.3%
Pleasanton	35,319	41,600	9.0%
Pleasanton Uninc.	2,542	2,615	2.9%
Livermore	49,612	53,900	7.4%
Livermore Uninc.	3,237	3,331	2.9%
Alameda-Contra Costa Counties	1,761,759	1,866,015	5.9%

Source: Alameda County Planning Department (1986a).

Employment rates for agriculture, forestry, and mining are projected to decrease in the same period from 330 jobs to only 140 jobs in 2005 (Association of Bay Area Governments, 1985).

Ongoing operation of LLNL has a beneficial impact on local employment, since LLNL contributes significantly to the local labor force. The presence of LLNL in the Livermore-Amador Valley also supports commerce, industry, and service-related employment. As of May 1986, the total employee population at LLNL was approximately 8,500 comprised of 3,010 scientists and engineers, and 5,490 administrative and support personnel. In addition, there are approximately 2,000 contracted employees at LLNL.

Approximately 60 percent of the workers employed by LLNL reside in the Livermore Valley, and 52 percent live in the City of Livermore. The remaining 40 percent of these employees commute to work from varying directions and distances (mostly from cities to the west, such as Pleasanton, Walnut Creek, Oakland, and Berkeley). The median commuting distance of LLNL employees is 15 miles round-trip. Eighty-four percent commute by private vehicle, including carpools (LLNL, 1984).

The existing HWM facilities at LLNL currently employ 35 persons. The number of scientists, engineers, and support staff is not expected to change significantly from these current levels if the DWTF is built. The operation of LLNL at current projected staffing levels will not have a major impact on the demographic character of the Livermore-Amador Valley area.

3.6.2 Public Services

Police protection in Livermore is provided by the City of Livermore Police Department. LLNL has its own security department, which monitors the site by security patrols and by remote electronic devices (LLNL, 1984).

Fire protection for the Livermore-Amador Valley is provided by the State Department of Forestry, Alameda County, individual cities, and other public protection services (University of California, 1986). LLNL provides its own fire protection on LLNL property. On-site services are currently adequate to serve demands generated by continuing operation of LLNL.

Police, fire, hospital, and other emergency services in Alameda County and adjacent San Joaquin County are prepared to supplement existing LLNL services in the event of an emergency. Continuing LLNL operations and the development of the proposed DWTF would have no significant impact on the available public services.

LLNL has an Emergency Preparedness Plan that sets forth the management standards, response procedures, and the personnel roles for all major emergencies and disasters occurring either on LLNL properties or occurring off site that might potentially impact LLNL (LLNL, 1985).

3.6.2.1 Utilities

The Livermore-Amador Valley is served by five water retailers, one water wholesaler, and numerous private wells (City of Livermore, 1981). These sources include the Alameda County Flood Control and Water Conservation District (ACFCWCD), which is responsible for supplying water to the City of Livermore. LLNL and the Sandia National Laboratory are served by the San Francisco Water Company. The primary supply of potable water for LLNL is from San Francisco's Hetch-Hetchy water system. Water is pumped out of the Hetch-Hetchy Coast Range tunnel at Mocho Shaft into two standpipe tanks. From there it is delivered by gravity flow via a 6.2 mile pipeline to three storage tanks at the south end of the Sandia site (LLNL, 1984). This is the primary water source for LLNL. In addition to the Hetch-Hetchy water supply, an emergency supply is available from the ACFCWCD.

LLNL's domestic wastewater flows through sanitary sewers for off-site treatment by the City of Livermore. The peak wastewater flow discharged from LLNL is estimated to be 1,000 gallons per minute (gpm), which is approximately 86 percent of the maximum flow of 1,158 gpm allowed LLNL by the City of Livermore.

Electrical services for the Livermore-Amador Valley area are provided by the Pacific Gas and Electric Company (PG and E). The LLNL power system is served by two 115-kv transmission lines: the Newark line (normal feed) and the Kasson/Tesla line (standby service). Part of LLNL's power is brought over PG and E lines from Western Area Power Administration's system in the Sacramento and San Joaquin Valleys (LLNL, 1984).

Natural gas is purchased by LLNL from PG and E. A propane-air gas plant on site provides standby gas when PG and E service is interrupted. Natural gas is used as a source of heat for most of LLNL's buildings, as a laboratory gas, and as a fuel for shop equipment and special research apparatus (LLNL, 1984).

3.7 Hazardous and Radioactive Waste Transportation

3.7.1 On-Site Transport

Hazardous waste transportation within the LLNL facilities is handled by the Hazardous Waste Management (HWM) transportation group. HWM personnel are highly skilled in waste handling, spill response, containment, cleanup, and transportation. The transportation vehicles carry safety, spill control, and containment equipment.

Radioactive, mixed, and hazardous waste materials are stored temporarily in tagged drums or other containers in designated waste accumulation areas. Prior to pickup by HWM personnel, the containers must be labeled with an HWM tag that identifies the contents and analytical results, and the accumulation start date (DeGrange et al., 1987).

Wastes are transported in DOT-approved containers. Analytical chemical wastes are segregated by type (acids, caustics, oxidizers, etc.), properly labeled, and transported for processing by HWM. All industrial wastes are transported from the point of generation by either HWM or licensed waste haulers or recyclers.

Waste at the Livermore site is subject to four phases of handling at its source of generation. These phases are:

- Identification. A hazardous waste label must be secured to every container of waste. The label must identify the contents as hazardous or radioactive and provide an accumulation start date.

- Separation. Radioactive wastes are separated from chemically hazardous or reactive waste materials at the originating source. Incompatible wastes must also be separated. Any waste containing significant amounts of both chemically hazardous and radioactive materials is designated as "mixed" waste at the point of generation.

- Packaging. Radioactive, hazardous, and mixed wastes are solidified and packaged in DOT-approved containers, consistent with DOE Order 1540.2. All waste containers are inspected daily for any accidental leakage. Overpack containers are provided where necessary. All waste packages are placed on pallets and strapped down prior to transportation.

- Transportation. Pallets and containers of radioactive waste are transported to the HWM area on flatbed trucks. The LLNL Transportation Division transports radioactive wastes on site, and HWM personnel conduct waste pickup. Off-site transport is done by haulers licensed by the State of California.

Detailed guidelines for the packaging and transporting nonradioactive, mixed, and radioactive wastes are presented in Guidelines for Waste Accumulation Areas (DeGrange et al., 1987), and also in Hazardous Waste Operation Plan: Livermore Site, March 1985 (Steenhoven, 1985). Transuranic (TRU) wastes are subject to additional packaging and certification requirements so that they may be accepted for disposal at an approved DOE site. The certification process for TRU wastes is described in the LLNL TRU Waste Certification Program (LLNL, 1987). Off-site transportation of non-radioactive, mixed, and radioactive wastes is discussed in Section 3.7.2.

Within LLNL, containers of solid wastes are transported primarily on flatbed trucks. Bulk liquids are transported in 5,000-gallon stainless steel or lined steel tank trucks. Trucks with self-contained pumps are used to pump out liquid wastes that were temporarily stored in sumps and permanent tanks. Smaller liquid containers and tanks are transported on flatbed trucks.

The proposed DWTF would also receive bulk liquids in tuff-tanks and large portable tanks. Both plastic and stainless steel tuff- tanks would be used. Plastic tuff-tanks are 330-gallon polyethylene containers that are supported by an exterior frame. These would be used for aqueous solutions such as acids and bases and corrosive compounds. Stainless steel tuff-tanks are self-supporting 440-gallon tanks, which would be used for coolants and organic mixtures. Both types of tuff-tanks have skids attached to the bottom to facilitate movement by a forklift. The portable tanks are long, cylindrical containers. Each container is mounted horizontally on a skid, and is constructed of thick stainless steel. The DWTF design would include provisions for overnight storage of empty containers and tanks.

3.7.2 Off-Site Transport

U.S. Department of Transportation (DOT) regulations (49 CFR 171), U.S. Nuclear Regulatory Commission (NRC) regulations (10 CFR 71), and DOE regulations (DOE orders 5480.1B, 5480.2, 5480.3, and 1540.2) govern hazardous, mixed, and radioactive waste packaging and transport from LLNL to disposal sites or to LLNL from its satellite facilities. The containers used to transport hazardous, mixed, and radioactive wastes off site must meet the DOT, DOE, and NRC specifications outlined in the regulations mentioned above.

Hazardous wastes transported from LLNL are typically carried in 55-gallon drums on covered trucks. Bulk liquids are hauled in tank trucks that may be lined with glass, rubber, or steel, depending on the material to be transported. Empty drums are transported in covered, truck-sized drop boxes.

Contractors who transport hazardous wastes from LLNL must be licensed to do so by the state. Trucks carrying hazardous wastes in California are subject to inspections by the California Highway Patrol both on-highway and on-terminal.

Low-level radioactive and mixed wastes from LLNL are categorized as one of three waste types for purposes of packing and off-site transport. The Code of Federal Regulations (CFR), Title 49, Section 173 specifies formulas for classifying wastes and procedures for testing containers. The three waste types and their containers are:

- Low Specific Activity (LSA) wastes, as defined in 40 CFR 173.403. These wastes are shipped in 55-gallon drums and leakproof metal boxes (four by four by seven feet).

- Type A wastes, which are wastes that cannot be classified as LSA, but whose activity levels fall within the guidelines presented in 49 CFR 173.433 through 173.435. These wastes are shipped in containers that must withstand more rigorous testing. These containers are typically drums or metal boxes (four by four by seven feet).

- Wastes with greater than Type A activity levels. These materials are first placed in Type A containers. The Type A containers are protected by an overpack and enclosed in a Type B container. Type B containers must be able to withstand five tests based on accident scenarios. The Type B containers used by LLNL weigh approximately 25,000 pounds and are reusable. Only one container is carried per truck. These containers are transported to Mercury, Nevada on flat bed trucks driven by specially trained and licensed LLNL personnel.

Each container of waste is classified into one of these three categories based on the types, amounts, and activity levels of the radionuclides present in that container. These classification and packaging requirements for radioactive wastes ensure that each package transported is designed and prepared for shipment so that the radiation level does not exceed 200 millirem per hour at any point on the external surface of the package.

Until recently, hazardous waste materials from LLNL have been shipped primarily to treatment, storage, and disposal (TSD) facilities in California. However, regulatory and physical limitations have greatly reduced the number of facilities able to accept nonradioactive hazardous wastes in California. Additionally, DOE limits the sites where hazardous waste from DOE facilities may be disposed. Currently, most hazardous waste generated by LLNL is being transported to U.S. Pollution Control in Clive, Utah. Radioactive wastes are disposed of at the Nevada Test Site in Mercury, Nevada. All drivers transporting radioactive wastes must be specially licensed. The estimated number of truck trips and vehicle miles traveled en route to these facilities are listed in Table 4.2-12.

3.8 Land Use

The Livermore Valley area was once economically dependent on agriculture and, to a lesser extent, on sand and gravel production. In the 1950s, LLNL began to dominate the economy of the Livermore Valley area. In the 1960s and 1970s, the Livermore Valley experienced a very strong increase in demand for housing, with rapid residential development increasing suburban density. Urban areas in the valley comprised approximately 5,400 acres in 1970, an approximate five-fold increase over 1960. In 1980, urban areas increased to comprise nearly 10,100 acres (Alameda County Planning Department, 1986b). Current land uses in the Livermore Valley area include agricultural, residential, commercial, and light and heavy industrial. Agricultural land in the valley is used for grazing, vineyards, orchards, and growing oat hay. Area industries include electronics, optics, steel, trucking, and various small businesses (LLNL, 1984).

Land use in the area surrounding the Livermore site is illustrated in Figure 3.8-1. LLNL occupies 812 acres adjacent to the east boundary of the City of Livermore. DOE has acquired additional land around the Livermore site as a buffer zone to preserve site security from encroaching residential areas. This buffer zone, as well as the LLNL site, is zoned for light industrial use. The Sandia National Laboratory at Livermore (SNLL), which is also surrounded by a buffer zone, is located immediately south of LLNL.

Property to the east of LLNL is agricultural land with rural residential development. A 288-acre parcel immediately northeast of LLNL has been zoned as a planned development (heavy industrial). The area north of LLNL is presently experiencing large-scale industrial growth, and the property immediately north of LLNL is being developed for the Lincoln Amador Business Center. Property adjacent to the western boundary of the LLNL buffer zone has been prezoned by the city as planned residential development; however, annexation to the city is currently pending approval by the Local Agency Formation Commission (Horst, personal communication, 1987).

The Livermore-Amador Valley is expected to experience substantial increases in residential, commercial, and industrial growth. Through 2005, acreage for residential land use is expected to more than double over that of 1980; most of this acreage increase (54 percent) would occur in the Pleasanton area. Acreage for commercial and industrial land use is projected to increase by about 57 percent over that of 1980, with the majority of this increase in

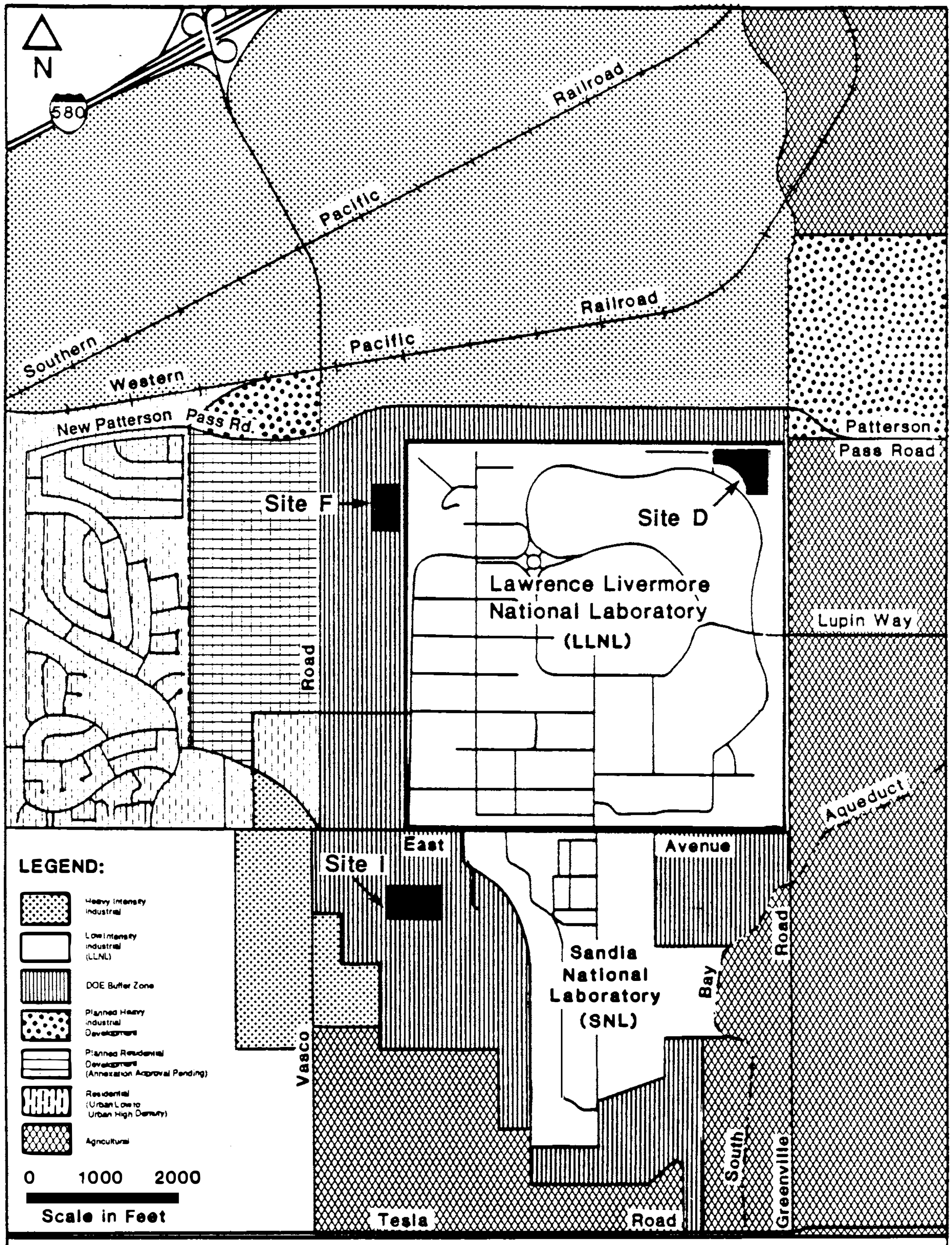


Figure 3.8-1. Regional Land Use in the Vicinity of LLNL

0288-023-5

the Livermore area (Alameda County Planning Department, 1986b). Current land use east of LLNL is primarily agricultural, with cattle grazing and some small dairy operations. A horse ranch is immediately east of LLNL across Greenville Road.

3.8.1 Aesthetics

The general visual character of the Livermore Valley is semi-rural (pasture lands). Overall visual quality can be expected to change as the area experiences rapid residential and industrial growth. The industrial character of LLNL is partially buffered by densely planted trees and shrubs along the LLNL perimeter. As additional industries locate in the valley, the LLNL facility will become more integrated with the surrounding areas.

3.8.2 Noise

The primary sources of noise in the LLNL area include freeway and road traffic, railroad operations, and aviation activity. With the exception of noise from construction projects, there is no significant noise generated by LLNL operations (University of California, 1986).

3.9 Cultural Resources

A qualified archaeologist surveyed properties adjacent to the northeast corner of LLNL in 1982, including all intermittent water courses and rock outcroppings. The study did not reveal evidence of archaeological material in this area (U.S. Department of Energy, 1984). No sensitive archaeological or cultural resources have been identified on the LLNL property. No archaeological studies have been conducted in the LLNL buffer zone or to the south of East Avenue.

CHAPTER 4.0

ENVIRONMENTAL CONSEQUENCES

This chapter presents the environmental impacts of the reasonable alternatives, including the proposed action for treating, processing, and storing nonradioactive (hazardous and nonhazardous), mixed, and radioactive wastes at LLNL. The analysis of potential alternatives in Chapter 2.0 considered the no-action alternative, the upgrade of the existing Hazardous Waste Management (HWM) facilities, increased off-site shipment of wastes, increased off-site treatment of wastes, three candidate sites for a new on-site decontamination and waste treatment facility (DWTF), and two alternative facility designs. This chapter evaluates the environmental consequences of the no-action alternative and the reasonable alternatives consisting of two design alternatives and three site alternatives.

The alternative sites are Site D in the northeast corner of LLNL, Site F in the LLNL west buffer zone, and Site I in the LLNL southern buffer zone. The Level I alternative facility design includes constructing a new controlled-air incinerator and new decontamination, treatment, processing, and storage facilities. The Level II design incorporates similar decontamination, treatment, process, and storage components with a new rotary kiln incinerator instead of a controlled-air incinerator. The use of a rotary kiln incinerator would also permit the incineration of organic sludges, low-level radioactive solid wastes, and contaminated containers. A significant reduction in waste quantities requiring off-site transportation for treatment or disposal would result from either the Level I or Level II design alternatives (see Section 4.2.8). The Level II design (the preferred design) located at Site D (the preferred site) is the preferred alternative.

4.1 Construction Activity Impacts

Construction activity associated with a new on-site DWTF would involve grading and preparing of the site, followed by actual construction of the proposed project buildings and utilities, and installation of treatment and processing equipment. No construction activity would be associated with the no-action alternative. Grading and preparation at any of the alternative sites would not be extensive because the proposed DWTF project area is small (six acres) and each alternative site is predominantly free of vegetation and is fairly level. The entire site would be graded, and fill material would be placed to provide a suitable grade for the safe operation of forklifts and other vehicles within the six-acre site.

The number of workers that would be employed to construct the proposed waste management facility would not exceed 80 at any one time, based on estimates for a similar DOE facility (U.S. Department of Energy, 1982). The equipment used to construct the proposed facility would include dump trucks, backhoes, cranes, compactors, air compressors, welding machines, and several other miscellaneous pieces of equipment. The existing roads and parking facilities would be sufficient to accommodate the increased traffic due to construction. No significant impacts are anticipated during the construction of the proposed facility.

After the final site preparation work, concrete building foundations, flooring, and collection sumps would be installed. Assembly of the buildings, incinerator, and other equipment components would follow, including the installation of piping, storage tanks, and safety design features. The new facilities for the Level I or Level II design would include 87,800 square feet of new building space. A fenced-in yard and employee parking area would be paved and lighted for safety and security.

4.1.1 Impacts to Water Quality from Construction Activities

The paving and grading activities associated with construction would require approximately seven feet of fill to be placed in the western section of the preferred site. Topsoil and vegetation would be stripped from all areas that would be filled or paved. Natural soils would be compacted before placing the fill. Exposed soil on the site could be subject to erosion if it rained during the construction period. Increased erosion during construction activities could increase the sediment load to Arroyo Las Positas adjacent to

Site D. In addition to soil sediment, minor amounts of other materials found on construction sites could enter the waterway via surface runoff.

Mitigation measures would minimize the potential impacts of soil erosion and materials runoff. Hay bales or other barriers would be installed between the exposed soil area and the intermittent waterway to help limit sediment loading and material runoff. Construction materials would be stored away from the waterway to further limit potential runoff. Major construction activity would be planned to occur during the summer months (dry season) to further reduce the potential for surface-water quality impacts.

4.1.2 Impacts to Air Quality from Construction Activities

Heavy equipment would be required to prepare the selected site and to construct the proposed DWTF. This equipment would be used for an estimated 60-day period. Construction of the Level I or Level II design would require the temporary use of heavy equipment in a maximum area of 10 acres. This would result in the generation of about 400 pounds (worst-case) of dust per day, assuming an emission rate of 1.2 tons/month/acre (U.S. Environmental Protection Agency, 1985), 50 percent dust control through water spraying, disturbance of all 10 acres, and high wind conditions throughout each day. These dust emissions could cause elevated particulate concentrations over an area several hundred yards downwind of the construction site, depending on wind conditions. The primary impact of construction-related fugitive dust emissions would be confined to the immediate vicinity of the proposed project site. During high winds, fugitive dust emissions could result in exceedences of the 24-hour average state and federal standards for suspended particulate matter less than 10 microns in diameter (PM_{10}). Such exceedences would be temporary and would be confined to an area less than 400 yards downwind of the proposed project site. Futhermore, maximum dust emissions would occur for only about 10 days during grading activities.

The construction of the Level I or Level II design would also result in an increase in SO_2, NO_x, and particulate matter (PM) emissions from construction equipment. The emissions from mobile sources of SO_2, NO_x, and PM would be an estimated 33, 8, and 12 percent of annual emissions from the proposed DWTF, respectively. Because of the short-term and localized nature of these emissions, fugitive dust and vehicle emissions associated with construction activities are not anticipated to have a significant environmental impact.

4.1.3 Site Preparation and Utility Impacts

The impacts of site preparation and construction on utilities, roads, security, and relocation of existing facilities for each site alternative are addressed in this section. The construction of the proposed DWTF at Site D would require the extension of utilities along LLNL's Outer Loop Road. The work would include the installation of potable, demineralized, and low conductivity water lines; gas lines; electrical power; and a communication duct to serve not only the DWTF, but other planned LLNL facilities. Service lines would be extended from the utility mains to the individual DWTF buildings. The construction would also require the relocation of ground-water monitoring well MW-15, a seismic monitoring station, trailers, Building 592 (a small laboratory), and the oil shale samples. Some trees would need to be removed or relocated, but measures would be taken to retain as many existing trees along the DWTF perimeter as possible. An abandoned concrete roadway and existing utility lines within the construction site would also be removed. Because Site D is within the historical LLNL boundaries, it would not require additional perimeter fencing.

Construction on Site F would not require the relocation of any buildings or equipment. A few trees along the eastern border of this site would need to be removed to provide truck access. An additional security fence would have to be constructed around the facility. Additional construction, including a culvert over Arroyo Las Positas and utility run extensions, would be required for Site F preparation and construction.

Alternative Site I development would require construction of a new truck access road. In addition, this site would require additional security provisions and additional electricity and water connections.

4.2 Operation Impacts and Mitigation Measures

4.2.1 Soils and Seismicity

4.2.1.1 Soils

All Level I and Level II waste storage and treatment would be accomplished within enclosed buildings with containment areas and sumps to control potential spills. The entire outdoor area within the DWTF site would be paved, and storm drainage systems would be provided to collect rainwater. A concrete bermed area with rainwater retention and spill containment would be provided for the overnight or short-term parking of filled and empty tanker trucks and portable tanks. This parking area would be designed to meet mandates of the California Code of Regulations (CCR), which requires that the containment capacity be 10 percent of the storage capacity, or 100 percent of the largest container's volume plus water from sprinkler discharge. Outdoor storage of mixed and radioactive wastes in 55-gallon drums would continue under the no-action alternative. Because of these mitigation measures, the impacts on soils would be insignificant.

4.2.1.2 Seismicity

As discussed in Section 3.2.3, LLNL and the three alternative sites are in a region that has experienced earthquakes within recorded historical times. The Greenville and Las Positas Fault Zones are the major contributors to the potential seismic hazard to the LLNL facilities, with lesser contributions from the Calaveras Fault (Woodward-Clyde, 1985). Other, more distant, active faults would not present a major hazard to the LLNL region, including the alternative DWTF sites (Scheimer, 1985). Exploratory trenching and geotechnical investigation concluded that there was no evidence of faulting at Site D or within 200 feet of this site; therefore, Site D meets the seismic location standards in 40 CFR 264.18(a) and CCR Title 22, Section 66391(a)(11)(A) (Weiss Associates, 1985; Towse and Carpenter, 1986).

Under the federal regulations, new hazardous waste treatment, storage, and disposal facilities must not be within 200 feet of a fault that has had displacement in recent geologic time (Holocene period). California seismic location standards require that when a new hazardous waste facility is to be sited within 3,000 feet of a fault that has had displacement within Holocene time (the last 10,000 to 12,000 years), or has lineations that suggest the presence of such a fault, a comprehensive geologic investigation must be performed to demonstrate that the facility is not located within 200 feet of the fault.

To date, there have been no exploratory trenching studies at Site F or Site I. Data previously discussed in Section 3.2.3 indicates evidence of possible faulting adjacent to Site I. Site F, located the furthest from the Greenville and Las Positas faults, displays no evidence of faulting.

A surface crack in the salvage yard pavement within 200 feet of the existing HWM facility was discovered in 1985. A seismic investigation of this area was conducted by LLNL and consulting geologists for the State of California. The investigation concluded that it would be difficult, if not impossible, and costly to conclusively prove compliance with the state and federal seismic location standards and to verify that the crack was not fault-induced (Geomatrix, 1985b).

In addition to compliance to the seismic location standards, DWTF facilities must meet specific seismic design criteria based on the safety classification of the facility or structure. This is further discussed in Section 4.3.

The horizontal ground motion that would occur at LLNL (including Sites D, F, and I) due to seismic events has been estimated based on a probabilistic seismic hazard assessment (Scheimer, 1985). These data indicate that there is a 90 percent probability of ground motion exceeding 0.25g once every 20 to 200 years. The 90 percent probability of exceeding 0.5g is estimated to occur once every 200 to 2,500 years. The impacts of these ground motions on facility design is shown in Table 2.8-1 on page 65.

components of the proposed DWTF are designed to withstand this acceleration (see Table 2.8-1, p. 65).

4.2.2 Hydrology

4.2.2.1 Surface Water

Site D is located directly south of the rechannelized Arroyo Las Positas. Site F is located directly west of a drainage canal, and Site I is located south of Arroyo Seco. Mitigation measures would be implemented as indicated below to prevent the proposed DWTF from impacting or being impacted by surface water.

The surface of the DWTF site would be graded to prevent rain water from entering any of the buildings or collecting on the paved area on site. The entire site would be paved to prevent storm water from entering native soils and elevated to minimize storm-water run-on to the site. Potential storm-water run-on would be intercepted and directed into the existing drainage system. Storm-water drainage from the paved areas inside the facility boundaries would be collected in the storm-water drainage system and discharged into the existing surface-water drainage system located at the northern portion of the site.

In case of a spill in the paved areas, drainage would be retained, analyzed, and treated as necessary. Curbing and spill containment collection sumps would be constructed in all buildings of the facility that treat, process, or store waste to collect any fluids resulting from upset conditions or accidents. Individual sumps, retaining walls, or berms within all buildings would be constructed to ensure that incompatible substances would not come in contact with each other.

There is no evidence of surface-water contamination due to operation of the existing HWM facilities. Water quality data presented in Section 3.3.1.2 indicate that surface-water quality entering the southeast area of LLNL near the HWM facilities is similar to surface-water outflow in the northwest area of LLNL (Holland et al., 1987).

4.2.2.2 Ground Water

The entire six-acre DWTF facility would be paved for both the Level II and Level I designs. All areas receiving, treating, processing, or storing waste would be inside buildings constructed with spill containment systems (sumps, curbs, retaining walls, etc.) that would decrease the potential for accidental ground-water contamination to almost zero. The combination of DWTF site paving and installation of curbing and sump collection systems for spill retention would comply with requirements of California Code of Regulations (CCR) Title 22, Division 4, Chapter 30, Section 67245, as discussed previously in Section 4.2.1.1.

Monitor wells located upgradient (generally east) and downgradient (generally west) of the facility site would be sampled quarterly to check ground-water quality in the vicinity of the proposed DWTF. At Site D, samples would be collected and analyzed from monitor wells 7D2, MW-7, and MW-8, and proposed new wells (see Figure 3.3-2). Samples would also be collected from a well replacing MW-15, which would be relocated immediately west of Site D. Monitor wells MW-104, MW-203, and 11A1 would be sampled and analyzed to check ground-water quality if the proposed DWTF was constructed at Site F. Monitor well TW-21 and any downgradient domestic wells would be sampled and analyzed if the proposed facility was constructed at Site I. Ground-water samples collected from these wells would be analyzed for the following parameters, including a subset of the parameters found in the CCR Title 22, Chapter 15 regulations for public drinking water supplies: arsenic, chromium, lead, mercury, nitrate, selenium, silver, copper, iron, manganese, zinc, specific conductivity, total dissolved solids, chloride, sulfate, gross alpha, gross beta, and tritium radioactivity. Wells will be sampled routinely for volatile organic compounds by EPA Method 624 initially and routine analysis by EPA Method 601 as prescribed by 40 CFR Part 136.

Monitor wells that directly surround buildings used for HWM activities (wells 107, 205, 210, 217, 268, and 274) are sampled quarterly, with sample analysis similar to that described above. The presence of solvents in ground water in the southwest portion of LLNL near Site I and the existing HWM facilities, and fuel hydrocarbons near Building 403 are not considered to have major adverse impacts since contamination exists in portions of aquifers that are not used for potable water supplies (Holland et al., 1987). There is no evidence that there is any contamination in this area due to current HWM operations. Actions to remediate organics in the ground water in this area are presently being evaluated by LLNL under the guidance of EPA and state regulatory agencies.

4.2.3 Air Quality

In this section, emissions, air quality impacts, and mitigation measures are discussed for the Level II, Level I, and no-action project alternatives. Variations among the three alternative sites for the proposed DWTF are also noted. However, impacts and mitigation measures would be similar for each of the three sites.

4.2.3.1 Emissions of Air Pollutants

A summary of the waste feed quantities for the alternative incinerator designs and the no-action alternative is presented in Table 4.2-1. Summaries of the estimated controlled emission rates of criteria pollutants, noncriteria pollutants, and radionuclides for the no-action, Level I, and Level II design alternatives are presented in Tables 4.2-2, 4.2-3, and 4.2-4.

As shown in these tables, even with substantial increases in annual incinerator waste feed quantities from no action to Level II design, the increases of air emissions from the DWTF would be small. This is due primarily to the efficiency of the Level I and Level II incinerator off-gas cleaning systems.

4.2.3.2 Air Quality Impacts

Analysis of potential air quality impacts of the Level I, Level II, and no-action alternatives was necessary to determine whether operation of any of these alternatives would violate any ambient air quality standard or cause a significant public health risk.

TABLE 4.2-1. COMPARISION OF ANNUAL INCINERATOR WASTE FEEDS FOR ALTERNATIVE DESIGN OPTIONS

	Annual Incinerator Waste Feed[a]		
	Nonradioactive[b]	Radioactive	Mixed
Level II Design			
- Solid	83,000 lb	220,000 lb	0
- Liquid	83,000 gal	0	31,400 gal
Level I Design			
- Solid	83,000 lb	7,000 lb	0
- Liquid	79,700 gal	0	31,400 gal
No Action			
- Solid	83,000 lb	7,000 lb	0
- Liquid	10,100 gal	0	1,800 gal

[a] Based on DWTF design waste throughput (Radian, 1988b).

[b] Includes chemical constituents that are defined as hazardous in 40 CFR Part 261.

TABLE 4.2-2. CRITERIA AND NONCRITERIA POLLUTANT EMISSIONS FROM THE ALTERNATIVE DESIGN OPTIONS

Pollutant	No Action			Level I Design			Level II Design		
	Incinerator Emissions (lb/yr)	Other Emissions (lb/yr)[a]	Total Emissions (lb/yr)	Incinerator Emissions (lb/yr)	Other Emissions (lb/yr)[b]	Total Emissions (lb/yr)	Incinerator Emissions (lb/yr)	Other Emissions (lb/yr)[b]	Total Emissions (lb/yr)
Criteria Pollutants									
NO_x	550	0	550	1,780	14,820	16,580	12,280	14,820	27,080
CO	50	0	50	115	2,980	3,095	1,000	2,980	3,980
SO_2	1,000	0	1,000	410	100	510	500	100	600
PM	150	0	150	10	900	910	600	900	1,500
Noncriteria Pollutants									
ROG Precursor organics[c]	30	230	280	125	2,025	2,150	125	2,025	2,150
Nonprecursor organics	15	2,385	2,380	70	2,800	2,870	70	2,800	2,870
Hazardous organics[d]	40	2,390	2,430	180	1,250	1,430	180	1,250	1,430
Metals	12	0	12	12	0	12	2	0	2
Acid Gases	0	0	0	1,900	0	1,900	2,000	0	2,000
Radionuclides (ci/yr)	3.80	0.10	3.90	0.88	0.10	0.78	0.95	0.10	1.05

[a] Includes fugitive emissions, bakeout oven emissions, and vapor degreaser emissions.

[b] Includes fugitive emissions, storage tanks, two boilers, uranium burn pan, bakeout oven, standby generator, laundry, and cooling tower. Values are based on maximum operating rates and capacities.

[c] Reactive organics that act as precursors to the formation of ozone.

[d] Includes organic constituents defined as hazardous in Appendix VIII of 40 CFR Part 281. Hazardous organics include selected precursor and nonprecursor organic compounds.

Source: Radian, 1988b.

TABLE 4.2-3. HAZARDOUS ORGANICS EMISSIONS FROM THE ALTERNATIVE DESIGN OPTIONS

Hazardous Organics[a]	Emissions (lbs/yr) No Action	Level I Design	Level II Design
Acetonitrile	1.22	1.05	1.05
Benz(a)anthracene	0.00	0.07	0.07
Benzo(a)pyrene	0.00	0.02	0.02
Benzene	21.97	40.13	40.13
Chloroform	0.00	23.58	23.58
Dioxane	0.26	0.50	0.50
Ethylene Dibromide	0.00	0.00	0.00
Ethylene Dichloride	0.00	0.61	0.61
Formaldehyde	2.21	7.72	7.72
Glycol Ether	0.19	0.22	0.22
Hexane Isomers	32.74	907.37	907.37
Methylene Chloride	0.00	52.66	52.66
Napthalene	0.00	8.44	8.44
Perchloroethylene	0.00	67.53	67.53
Tetrachloroethane	0.00	36.88	36.88
Toluene	1.97	7.27	7.27
1,1,1-Trichloroethane	2,366.00	168.78	168.78
1,1,2-Trichloroethane	0.00	0.04	0.04
Trichloroethylene	0.00	91.10	91.10
Vinyl Chloride	0.00	0.90	0.90
Xylene	0.12	5.81	5.81
Aromatic PICs[b]	0.20	0.76	0.76
Nonaromatic PICs[b]	0.13	7.20	7.20
Dioxins	0.00	(c)	(c)
Furans	0.00	(c)	(c)

[a] Hazardous organics are defined as those organic compounds listed as Hazardous Constituents in the Code of Federal Regulations, 40 CFR 261, Appendix VIII. However, several compounds that are not listed in 40 CFR have been added to the table: aromatic and nonaromatic PICs, hexane isomers, glycol ether, and xylene.

[b] Products of incomplete combustion.

[c] Dioxins and furans are not present in the LLNL waste stream, nor are significant amounts of compounds suspected of being precursors to the formation of dioxins and furans. Estimates of possible emissions of toxic equivalent TCDD range from 9.0×10^{-7} to 6.4×10^{-6} lb/yr.

Note: A zero (0.00) in the emissions column indicates that emissions are estimates to be less than 0.005 lb/yr. The organic emissions for the Level I alternative match those for the Level II alternative because the organic waste streams and processing would be equivalent.

Source: Radian, 1988b.

TABLE 4.2-4. RADIONUCLIDE EMISSIONS FROM THE ALTERNATIVE DESIGN OPTIONS

Nuclide	Total Radionuclide Emissions No Action (ci/yr)	Level I Design (ci/yr)	Level II Design (ci/yr)
Am-241	--	--	6.4×10^{-7}
Am-243	--	--	4.8×10^{-6}
Bk-249	--	--	3.2×10^{-11}
Cf-249	--	--	3.2×10^{-11}
Cf-250	--	--	3.2×10^{-10}
Cf-252	--	--	9.5×10^{-11}
Cm-244	--	--	1.1×10^{-9}
Cm-248	--	--	4.8×10^{-12}
CO-57	--	--	3.2×10^{-8}
CO-60	--	--	9.5×10^{-7}
Cr-51	--	--	9.5×10^{-9}
Cs-137	--	--	9.5×10^{-6}
Cu-64	--	--	3.2×10^{-4}
C-14	1.3×10^{-2}	1.3×10^{-2}	1.2×10^{-2}
Es-254	--	--	8.0×10^{-11}
Fe-59	--	--	3.2×10^{-4}
H-3	8.0×10^{-1}	6.1×10^{-1}	8.8×10^{-1}
I-125	1.2×10^{-3}	1.2×10^{-3}	1.3×10^{-3}
I-131	2.0×10^{-4}	2.0×10^{-4}	3.2×10^{-4}
MFP	--	2.8×10^{-5}	3.1×10^{-6}
Mn-54	--	--	9.5×10^{-7}
Na-22	--	--	9.5×10^{-7}
Np-237	--	--	9.5×10^{-7}
Pb-210	--	--	9.5×10^{-12}
Pb-212	--	--	9.5×10^{-11}
Pu-238	--	--	8.0×10^{-7}
Pu-239	--	3.0×10^{-9}	9.5×10^{-5}
Pu-242	--	--	3.2×10^{-6}
P-32	1.1	5.3×10^{-2}	5.5×10^{-2}
Ra-226	--	--	6.4×10^{-8}
S-35	2.0	1.0×10^{-1}	1.0×10^{-1}
Sr-90	--	--	9.5×10^{-6}
Th-232	--	--	8.0×10^{-8}
U-235	--	--	8.0×10^{-7}
U-238	--	4.6×10^{-5}	1.6×10^{-4}
Zn-65	--	--	6.4×10^{-6}
TOTALS	3.9	0.78	1.05

Note MFP = mixed fission products (assumed to be Pu-239)

Source: Radian, 1988b.

Impacts on ambient concentrations of criteria air pollutants were estimated using several air quality models recommended by the EPA and the California Air Resources Board (ARB). The air quality models used in the evaluation included COMPLEX I, ISCST, (Wackter and Foster, 1986), and PTFUM (Wagner, 1984). Using these models, the impacts of emissions from the alternatives were evaluated for the following three scenarios:

- Plume fumigation, which occurs during early morning breakup of a temperature inversion;
- Dispersion in elevated terrain, in which the plume impacts nearby hilly terrain; and
- Dispersion in flat terrain.

The maximum concentration estimated for each pollutant was compared to existing state and federal standards. Impacts of noncriteria and radioactive pollutant emissions on human health were evaluated through a health risk assessment.

The analyses assumed that the Level II design or Level I design DWTF would be located at Site D. Because Sites F and I are relatively close to Site D, locating the proposed DWTF at these sites would result in similar air quality impacts. These analyses assumed that all emission sources would operate continuously.

Table 4.2-5 shows the estimated impacts of the alternatives on criteria air pollutant concentrations. The concentrations shown in Table 4.2-5 are compared to the existing background concentrations (which include LLNL's existing impact) and ambient air quality standards. The project impact data are the maximum values for all of the scenarios evaluated. The impacts for the Level I and Level II alternatives are similar for most pollutants and averaging periods. Operation of any of the alternatives would have a negligible impact on any ambient air quality based on the standards.

TABLE 4.2-5. COMPARISON OF NET AIR QUALITY IMPACTS OF THE ALTERNATIVE DESIGNS AND NO-ACTION ALTERNATIVES WITH AMBIENT STANDARDS

Criteria Pollutant	Averaging Time	Maximum Project Impact (ppm)			Maximum Background[a] (ppm)	Maximum Total Impact[b] (ppm)			California Standard[c] (ppm)	Federal Standard[d] (ppm)
		Level I	Level II	No-Action		Level I	Level II	No-Action		
NO_2	1 hour	0.046	0.049	0.003	0.15	0.196	0.199	0.153	0.25	--
	Annual	0.005	0.005	<0.001	0.021	0.026	0.028	0.026	--	0.05
CO	1 hour	0.015	0.015	<0.001	12.0	12.015	12.015	12.000	20.0	35.0
	8 hour	0.010	0.010	<0.001	4.80	4.810	4.810	4.800	9.0	9.0
SO_2	1 hour	0.007	0.007	0.005	0.18	0.187	0.187	0.183	0.25	--
	3 hour	0.006	0.006	0.004	NA	0.006	0.006	0.004	--	0.5[f]
	24 hour	0.002	0.002	0.002	NA	0.002	0.002	0.002	0.05[e]	0.14[f]
	Annual	<0.001	<0.001	<0.001	0.002	0.002	0.002	0.002	--	0.03[f]
PM_{10}	24 hour	3.1 ug/m^3	3.5 ug/m^3	0.85 ug/m^3	NA	NA	NA	NA	50 ug/m^3	150.0 ug/m^3
	Annual	0.8 ug/m^3	1.2 ug/m^3	0.2 ug/m^3	NA	NA	NA	NA	30 ug/m^3	50.0 ug/m^3

[a] Maximum value reported from the City of Livermore during 1982-1985. SO_2 data are from Pittsburg, CA.

[b] Maximum total impact equals maximum project impact plus maximum background level.

[c] California Ambient Air Quality Standard (CAAQS); California Health and Safety Code, Title 17, Chapter 1, Subchapter 1, Article 2.

[d] Federal Secondary Standard (NAAQS secondary); 40 CFR Part 50.

[e] Applies when California oxidant and/or particulate matter standards are violated.

[f] Federal Primary Standard (NAAQS primary), no Secondary Standard exists.

PM_{10} = Particulate matter less than 10 microns in size

NA = Not available

In addition to the standards presented in Table 4.2-5, the proposed DWTF must meet U.S. Department of Energy (DOE) orders for ambient radiation levels (DOE Order 5480.xx [draft], March 31, 1987, "Radiation Protection of the Public and the Environment") and EPA National Emission Standards for Hazardous Air Pollutants (NESHAP), which specify limitations on dose levels (40 CFR 61). Ambient air radiation levels associated with the DWTF Level II and Level I designs and the no-action alternative were evaluated using the respective emission rates and the EPA-recommended AIRDOS atmospheric dispersion model.

Ambient radiation levels estimated by AIRDOS on an annual basis were compared with their respective derived concentration guides (DCGs) specified by DOE Draft Order 5480.xx. The DCGs are intended to meet dose limitations specified in DOE orders. Modeled ambient radiation levels were compared with DCGs from inhalation exposures for members of the public (exposure standards for workers on site are discussed in Section 4.2.4.1). In cases where different inhalation DCGs were presented, based on different lung retention classes, the most restrictive DCG was used. The DCG values are presented for individual radionuclides. For known mixtures of radionuclides, the sum of the ratios of the observed concentrations of each radionuclide and its corresponding DCG must not exceed 1.0. The results of this analysis are presented in Table 4.2-6. These results show that all of the alternatives would result in radiation levels that are significantly below the applicable DOE DCGs.

DOE Order 5480.xx (draft, March 31, 1987) states that exposing of members of the public to radiation sources as a consequence of routine DOE activities and remedial actions must not cause any individual to receive an effective dose equivalent greater than 100 mrem in one year. In addition, the exposure must not cause a dose equivalent for any tissue (including the skin and the lens of the eye) greater than 5 rem in a year for members of the public. These dose limits must apply to individuals who are not "occupational workers," as defined in DOE Order 5480.11 (draft, November 15, 1987). These dose limits must take into consideration all man-made sources, except for

TABLE 4.2-6 COMPARISON OF MAXIMUM RADIONUCLIDE GLCs[a] TO DEPARTMENT OF ENERGY STANDARDS

Radio-nuclide	No Action (uCi/ml)[b]	Level I Design (uCi/ml)	Level II Design (uCi/ml)	DOE DCG[c] (uCi/ml)
Am-241	--	--	3.32×10^{-20}	2.00×10^{-14}
Am-243	--	--	2.49×10^{-19}	2.00×10^{-14}
Bk-249	--	--	1.65×10^{-24}	9.00×10^{-12}
Cf-249	--	--	1.67×10^{-24}	2.00×10^{-14}
Cf-250	--	--	1.67×10^{-23}	5.00×10^{-14}
Cf-252	--	--	4.95×10^{-24}	9.00×10^{-14}
Cm-244	--	--	5.71×10^{-23}	4.00×10^{-14}
Cm-248	--	--	2.49×10^{-25}	6.00×10^{-15}
Co-57	--	--	1.66×10^{-21}	2.00×10^{-09}
Co-60	--	--	4.93×10^{-20}	8.00×10^{-11}
Cr-51	--	--	4.93×10^{-22}	5.00×10^{-08}
Cs-137	--	--	4.93×10^{-19}	4.00×10^{-10}
Cu-64	--	--	1.66×10^{-17}	5.00×10^{-08}
C-14	1.80×10^{-15}	9.97×10^{-16}	6.22×10^{-16}	6.00×10^{-09}
Es-254	--	--	4.14×10^{-24}	3.00×10^{-13}
Fe-59	--	--	1.66×10^{-17}	8.00×10^{-10}
H-3	1.48×10^{-13}	1.06×10^{-13}	1.05×10^{-13}	1.00×10^{-07}
I-125	1.66×10^{-16}	9.20×10^{-17}	6.74×10^{-17}	5.00×10^{-10}
I-131	2.76×10^{-17}	1.53×10^{-17}	1.66×10^{-17}	4.00×10^{-10}
MFP[d]	--	2.15×10^{-18}	1.61×10^{-19}	2.00×10^{-14}
Mn-54	--	--	4.93×10^{-20}	2.00×10^{-09}
Na-22	--	--	4.93×10^{-20}	1.00×10^{-09}
Np-237	--	--	4.93×10^{-20}	2.00×10^{-14}
Pb-210	--	--	4.93×10^{-25}	9.00×10^{-13}
Pb-212	--	--	4.92×10^{-24}	8.00×10^{-11}
Pu-238	--	--	4.15×10^{-20}	3.00×10^{-14}
Pu-239	--	2.30×10^{-22}	4.92×10^{-18}	2.00×10^{-14}
Pu-242	--	--	1.66×10^{-19}	2.00×10^{-14}
P-32	1.52×10^{-13}	4.06×10^{-15}	2.75×10^{-15}	9.00×10^{-10}
Ra-226	--	--	3.32×10^{-21}	1.00×10^{-12}
Sr-90	--	--	4.93×10^{-19}	9.00×10^{-12}
S-35	2.76×10^{-13}	7.67×10^{-15}	5.19×10^{-15}	5.00×10^{-09}
Th-232	--	--	4.15×10^{-21}	7.00×10^{-15}
U-235	--	--	4.15×10^{-20}	1.00×10^{-13}
U-238	--	8.23×10^{-18}	1.24×10^{-17}	1.00×10^{-13}
Zn-65	--	--	3.32×10^{-19}	6.00×10^{-10}
Sum of ratio[e]	2.26×10^{-04}	1.97×10^{-04}	4.10×10^{-04}	

(Continued)

TABLE 4.2-6 (Continued)

Footnotes:

-- = Radionuclide not emitted.

[a] Ground-level concentration (GLC), based on annual average GLCs for the point of maximum impact, as estimated by AIRDOS - EPA model.

[b] Microcuries per milliliter.

[c] Derived concentration guide from DOE Draft Order 5480.xx, Attachment 1, "Derived Concentration Guides (DCGs) for Air and Water," March 31, 1987. Where the DCG of a radionuclide depends on associated elements, the most stringent DCG is listed in this table.

[d] Mixed Fission Products; assumed to be Pu-239.

[e] The sum of the ratios of each concentration over its representative standard must sum to less than or equal to 1.0 (DOE 5480.1 chg 2, Attachment XI-1, pg. 14). In other words, if radionuclides A, B, and C are present in concentrations C_A, C_B, and C_C, and if the applicable CGs are CG_A, CG_B, and CG_C, respectively, then the concentrations should be limited so that the following relationship exists:

$$\frac{C_A}{CG_A} + \frac{C_B}{CG_B} + \frac{C_C}{CG_C} \leq 1$$

those used for medicinal purposes, and all routes of exposure. (See Chapter 7.0 for definitions of the terms "dose equivalent" and "effective dose equivalent.")

DOE facilities must also comply with EPA's NESHAP for radionuclides, specified in 40 CFR 61. The NESHAP, which considers exposures only from the air pathway, states that exposing members of the public to radioactive materials released to the atmosphere as a consequence of DOE activities must not cause any member of the public to receive, in a year, a committed effective dose equivalent greater than 2.5×10^{-2} rem to the whole body or a committed dose equivalent greater than 7.5×10^{-2} rem to any organ. Dose equivalents under NESHAP are the same as DOE whole body effective dose equivalents. Because whole-body effective dose equivalents are obtained by multiplying organ-specific dose equivalents by organ-specific weighting factors, allowable organ doses may exceed allowable whole-body doses. For example, an organ-specific dose equivalent of 8.0×10^{-5} rem/yr to the bone is equivalent to a whole-body effective dose equivalent of 3.0×10^{-6} rem/yr.

Compliance with these dose limits for each alternative was evaluated using the AIRDOS/DARTAB radiation risk assessment model, as required under the NESHAP. The AIRDOS computer code estimates radionuclide concentrations in air; rates of deposition on ground surfaces; C ground surface concentrations; intake rates via inhalation of air and ingestion of meat, milk, and fresh vegetables; and radiation doses to humans from airborne releases of radionuclides (U.S. Environmental Protection Agency, 1979). The DARTAB computer code combines radionuclide environmental exposure data with dosimetric and health effects data to tabulate the predicted impact of radioactive airborne effluents (Begovich et al., 1981). Both codes were developed at Oak Ridge National Laboratory (ORNL) to be used by the U.S. Environmental Protection Agency (EPA) as a methodology to evaluate health risks to humans from atmospheric radionuclide releases.

The results of this analysis are presented in Table 4.2-7. The committed effective dose equivalents to the whole body and the committed dose equivalent to the maximum exposed organ are presented in this table. These values are conservative estimates based on a committed dose assuming a 70-year facility operation. This analysis shows that all estimated committed dose levels are substantially below DOE or EPA mandated dose limits. Cancer risks associated with these radioactive exposures have been estimated to calculate risks from combined radioactive and hazardous emissions from the alternatives (Radian, 1988a).

The proposed DWTF design includes a 1,800 gpm cooling tower. The estimated evaporation and drift from this tower would be approximately 22 gpm. This water loss would result in a visible plume on days with low temperatures and high relative humidity. The proposed cooling tower would increase existing LLNL cooling tower capacity by only 2 percent. Therefore, this water loss would have a negligible additional impact to the environment.

Cooling tower water must contain a corrosion inhibitor, a microbicide, and chlorine to protect the machinery and prevent fouling. LLNL uses Drewgard 4301 Corrosion Inhibitor at 100 to 150 ppm, Drew Biosperse 201 Microbicide at approximately 15 ppm, and 12.5 percent sodium hypochlorite liquid at 3 ppm chlorine. None of these additives contain chromium compounds. There are no significant impacts anticipated from operation of the proposed cooling tower.

4.2.3.3 Air Quality Impact Mitigation Measures

In this section, design measures intended to minimize air quality impacts from the alternative designs are discussed. With the exception of the incinerator systems, the Level I and Level II designs would be very similar. Equipment that would effectively control air pollutant emissions is incorporated as mitigation measures into the design of the proposed facility.

TABLE 4.2-7. MAXIMUM OFF-SITE RADIOLOGICAL DOSE LEVELS TO THE GENERAL PUBLIC (NORMAL OPERATIONS)[a]

	Committed Effective Dose Equivalent (rem)	Committed Dose Equivalent to Maximum Exposed Organ (rem)
Alternative		
No Action	4.0×10^{-5}	1.8×10^{-4}
Level I	2.0×10^{-5}	8.0×10^{-5}
Level II	4.0×10^{-5}	2.4×10^{-4}
Dose Limit to Public	**Effective Dose Equivalent (rem/yr)**	**Dose Equivalent to Maximum Exposed Organ (rem/yr)**
DOE Order 5480.xx	1.0×10^{-1}	5.0
EPA (40 CFR 61)	2.5×10^{-2}	7.5×10^{-2}

[a] Dose is based on 70 years of facility operation.

The proposed equipment that would be incorporated into both alternative designs to prevent potential air quality impacts are described below.

- Solid Waste Processing and Waste Receiving/Classification:

  -- an integral ventilation/HEPA filtration system on two drum compactor/crushers in the solid waste processing and waste receiving and classification areas. The particulate matter control efficiency of this ventilation/filtration system would be 99.97 percent. The design capacity for this system would be 1,600 cfm.

- Liquid Waste Processing:

  -- carbon filters on process evaporators and vents for liquid waste unloading tanks in the liquid waste processing system. The organic compound control efficiency of the carbon filters would be 95 percent. The design capacity of the filters would be 50 cfm.

  -- bin vent filters on Envirostone and cement silos and bins in the solidification unit of the liquid waste processing area. The bin vent filters would be designed to achieve a particulate matter control efficiency of 99 percent. The capacity of these filters depends on the solidification system selected.

  -- HEPA filters on contaminated laundry exhaust. The HEPA filters would be designed to achieve a particulate matter control efficiency of 99.97 percent. The capacity of these filters would be 2,200 cfm.

- Decontamination:

  -- double HEPA filtration of individual decontamination operations and the decontamination building HVAC exhaust, and single HEPA filtration on other operations associated with radionuclides. The double HEPA filtration systems would be designed to achieve a particulate matter control efficiency of 99.97 percent. The design capacity for each filtration unit would vary with each decontamination operation. The range of capacities would be 300 to 18,000 cfm.

- Reactive Materials Processing:

  -- primary and secondary scrubbers or HEPA filtration of exhaust from reactive materials processing cells. The primary and secondary scrubber systems would have control efficiencies of 99 percent. The capacity of these systems would be 4,100 cfm.

  -- HEPA filtration of a reactive materials glove box operation. The HEPA filter would have a particulate matter control efficiency of 99.97 percent and a design capacity of 100 cfm.

- Incineration:

  -- a nitrogen blanket, pressure/vacuum relief system, and rupture disc on the incinerator waste feed tanks.

  -- dampers and construction of incinerator waste feed tanks with room to provide confinement of any accidental release within the facility.

-- a carbon filter and HEPA filter on the process vents of the incinerator waste feed tanks. The design capacity of these filters would be 50 cfm. The organic compound and particulate matter control efficiencies of the carbon filter and the HEPA filter would be 95 and 99.97 percent, respectively.

-- a monthly inspection and maintenance program that would be applied to piping components of the liquid waste receiving and feed system (e.g., valves, connections). This leak detection and repair program is expected to achieve 59 percent control of fugitive organic emissions.

-- sealless pumps, used in the liquid waste receiving and feed system to eliminate fugitive emissions from the pumps.

-- an oxygen-deficient air sweep (fire control) system for the bulk solids hopper and conveyor enclosures with exhaust through a HEPA filter. The oxygen-deficient air sweep system is part of a larger system and the design has not been finalized. The HEPA filters, however, would achieve a particulate matter control efficiency of 99.97 percent and would have a design capacity of 1,000 cfm.

-- a sintered metal filter and HEPA filter that would reduce emissions of particulates from the uranium burn pan. These filters would be designed to remove at least 99.97 percent of the particulates greater than 0.3 micron in diameter, and would have a design capacity of 2,400 cfm.

- Standby power to all critical components needed to assure a safe system shutdown and maintenance of alarm and monitoring system.

In addition to the preceding control measures, the Level I design would have the following:

- Dual-chamber controlled-air incinerator capable of 99.99 percent destruction and removal efficiency (DRE) for hazardous organic compounds; and

- Incinerator off-gas treatment system consisting of a quench column, a venturi scrubber with 99 percent removal of particulate matter greater than one micron in size, a packed bed absorber with 99 percent removal of acid gases and 90 percent removal of sulfur dioxide, and a demister.

The Level II design would have the following additional control measures:

- Rotary kiln incinerator with a secondary combustion chamber to achieve 99.99 percent DRE of hazardous organic compounds;

- Incinerator off-gas treatment system with 12,500 cfm capacity consisting of a quench column, a venturi scrubber with 99 percent removal of particulate matter greater than one micron in size, a packed bed absorber with 99 percent removal of acid gases and 90 percent removal of sulfur dioxide, a condenser with 40 percent removal of tritium, a mist eliminator, and a HEPA filtration system with 99.97 percent removal of particulate matter greater than 0.3 micron in size; and

- Waste shredder purged with nitrogen gas and vented through a 1,000 cfm HEPA filtration system with 99.97 percent removal efficiency of particulate matter.

The incinerator off-gas treatment system must be designed to comply with DOE and RCRA regulations and state and local emissions standards. Design specifications to assure this compliance include the following:

- Particulate stack emissions of less than 180 milligrams/dry standard cubic meter of off-gas;

- Hydrochloric acid stack emissions with 99 percent control efficiency;

- Continuous emission monitoring system; and

- High efficiency drift eliminators for the cooling tower.

4.2.4 Occupational and Public Health Impacts

Potential impacts to workers and the off-site public from routine operation of the DWTF are discussed below.

4.2.4.1 Occupational Health Impacts

Potentially hazardous chemicals would be handled at the proposed DWTF. These materials may be flammable, toxic, carcinogenic, irritating, reactive, or corrosive. Specific adverse effects would depend on the route and magnitude of exposure, physical and chemical properties of the chemicals, and, in some cases, a person's sensitivity.

Significant routes of exposure for workers at the proposed DWTF are dermal absorption, accidental ingestion, and inhalation. The types of chemicals that may be handled at the proposed DWTF include common industrial solvents (chlorinated hydrocarbons, aliphatic and aromatic hydrocarbons, acetone, methyl ethyl ketone, alcohols); a variety of other chemical products, including paints, adhesives, resins, laboratory reagents, inorganic acids, and inorganic bases; and materials contaminated with heavy metals, such as mercury or beryllium. Certain laboratory research activities at LLNL could also generate biohazards or infectious wastes.

Several materials presenting radioactive hazards (radionuclides) may be handled at the proposed DWTF. Common radionuclides include uranium (U^{235}, U^{238}), cesium (Cs^{137}), strontium (Sr^{90}), and plutonium (Pu^{238}, Pu^{239}, Pu^{242}). These nuclides decay naturally, releasing radioactive energies in the form of alpha and beta particles and gamma rays. Routes of exposure may include external irradiation of the body, and inhalation and accidental ingestion, which result in internal irradiation.

Several regulatory standards and recommendations are applicable for controlling worker exposures. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends Threshold Limit Values (TLVs) for chemical substances in the workroom air. TLVs represent the time-weighted average concentration for a normal eight-hour workday or 40-hour workweek to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

The U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) used ACGIH recommendations in establishing federal regulations. Permissible exposure limits to chemical agents are defined in 29 CFR 1910. The OSHA regulations differ from ACGIH recommendations in that the ACGIH recommendations are updated more frequently as warranted by relevant toxicological and epidemiological studies. The Department of Energy (DOE) prescribes mandatory safety programs that are comparable to OSHA requirements.

DOE Order 5480.11 (draft, November 15, 1985) specifies radiation protection standards for workers on site. This order specifies that the annual effective dose equivalent received in any year must not exceed 5 rem. The annual dose equivalent for any individual organ or tissue must not exceed 50 rem, or 15 rem to the lens of the eye. The effective dose equivalent must not exceed 100 rem over an employee's working lifetime, nominally 50 years. Additionally, the annual effective dose equivalent received by the unborn from the period of conception to birth as a result of occupational exposure of a female worker, who has declared that she is pregnant, must be maintained as low as reasonably achievable, and must not exceed 0.5 rem during the entire gestation period.

To meet these standards, DOE facilities must be operated so that an individual would not likely inhale, ingest, or absorb a quantity of a radionuclide or mixture of radionuclides that would assimilate in a critical organ to exceed the DOE limits specified above. DOE specifies derived concentration guides, representing radionuclide concentrations in water or air, which are intended to meet the above dose equivalent standards. These concentration guides are used to evaluate the adequacy of control measures for ambient radioactivity.

The potential for worker exposure to chemical and physical agents during facility operations would depend on the particular process or facility operation and the control technology employed to mitigate environmental releases. Mitigation measures included in the proposed DWTF design would assure a low risk operation. The highest potential risk activities to on-site personnel involve decontamination operations in the existing HWM (Building 419) and the proposed DWTF decontamination area. Section 4.3 presents a more detailed discussion of the hazards associated with these operations and mitigation measures to ensure protection and safety in the decontamination areas.

DOE facilities are required to prescribe safety standards compatible with standards from of OSHA and other federal agencies. A written plan (referred to as a Safety Procedure) would be required under LLNL's Health and Safety Program prior to operating the proposed DWTF to provide a standard against which the operation may be audited. LLNL's Health and Safety Program provides for monitoring a new activity to determine if there are hazards that should be mitigated by additional safety measures.

The following design features, control methods, and administrative controls would be incorporated into the proposed DWTF to reduce the potential for occupational exposure to hazards:

- Automatic fire sprinklers, and chemical and foam protection systems;
- Manual and automatic fire alarms;
- Standby power systems to allow a safe shutdown of equipment and to provide sufficient electrical power for DWTF safety systems in the event of a loss of primary power;
- Education and training of personnel working in potentially hazardous areas;
- Protective clothing and equipment for personnel;
- Engineered process ventilation systems, including hoods, enclosures, carbon filters, HEPA filters, and scrubbers, depending on the process;
- Secondary containment systems for leaks and spills, such as curbed or diked process areas and waste spill collection sumps;
- Continuous air monitors (CAMs) for radiation detection;
- Monitoring of decontamination building air, incinerator exhaust, and process vent exhausts;
- Administrative access controls, such as change rooms, access control points and barriers, and hand-and-foot radioactive contamination counters;

- Records maintained on personnel exposure data, including accidental exposures, to keep exposures below applicable standards;

- Emergency shower and eye washes;

- Work performed inside buildings;

- Segregation of highly reactive waste from primary waste streams;

- Seismic tie-down equipment and tables; and

- Equipment and facility design to limit noise levels within the DWTF to 85 dBA maximum.

4.2.4.2 Public Health Impacts

The proposed DWTF would release radioactive and nonradioactive pollutants into the air, which may result in exposure of nearby residents. Exposures of the public to selected air pollutants are regulated under federal standards promulgated by EPA and state standards promulgated by the California Air Resources Board (ARB) (i.e., the National and California Ambient Air Quality Standards, respectively). Public and environmental exposure to radionuclides is regulated by DOE Order 5480.xx (draft, March 31, 1987) and the EPA radionuclide NESHAP (40 CFR 61). Several of the nonradioactive pollutants that may be emitted from the facility are not regulated by ambient air standards. Acceptable levels of exposure to all expected pollutants for each alternative were evaluated by performing a health risk assessment.

Ambient air standards have been promulgated by EPA and ARB for the following pollutants:

- Nitrogen dioxide (NO_2);
- Particulate matter less than 10 microns in diameter (PM_{10});
- Carbon monoxide;
- Ozone;
- Sulfur dioxide;
- Sulfates;
- Lead;
- Hydrogen sulfide; and
- Vinyl chloride.

Air emissions from the no-action, Level I, and Level II alternatives would be below the ambient air standards. Section 4.2.3 of this document presents a more detailed discussion of compliance with ambient air standards.

Off-site radiation protection standards for the public are specified in a letter to all DOE field operations offices from William A. Vaughan, DOE Assistant Secretary, Environmental Safety and Health, dated August 5, 1985. These standards will be formally addressed in DOE Order 5480.xx, "Radiation Protection of the Public and the Environment." Exposures to members of the public must be as low as reasonably achievable within the standards specified in Section 4.2.4.2.

Off-site public exposure to radioactive emissions was evaluated using the AIRDOS/DARTAB models, which estimate dose to human receptors from radionuclide exposure via airborne emissions. These models are discussed in Section 4.2.3.2. The results of this analysis show that radioactive emissions from the proposed DWTF do not exceed DOE or EPA dose limits.

To determine the health risks associated with exposure to emissions from the proposed DWTF, an assessment based on an individual's risk of developing cancer from lifetime exposure to these pollutants was conducted (Radian, 1988a). Estimated emissions from normal operations and upset conditions (mechanical failure of pollution control equipment) were considered in calculating the cancer risk values. Potential cancer risks associated with radioactive and nonradioactive emission exposures were estimated using linear extrapolation techniques recommended by EPA and the International Commission on Radiological Protection (ICRP). These techniques extrapolate cancer risks observed in animal studies or human populations from high levels of exposure to extremely low levels of exposure (as those associated with the proposed DWTF emissions). The health risk assessment considered inhalation, ingestion, and dermal pathways (see Figure 4.2-1) of exposure associated with a 70-year operation of the proposed DWTF. The health risk assessment is currently under technical review by state regulatory agencies.

Table 4.2-8 presents the worst-case risk estimates of developing cancer and the population cancer burden associated with both radioactive and nonradioactive emissions for a hypothetical individual located at the point of maximum impact for a 70-year lifetime. The maximum off-site impact location would be located approximately 600 feet east of the DWTF fenceline. The risks to an individual at any other location would be lower. The cancer risk associated with any of the alternatives would be significantly less than cancer risks associated with many commonplace activities, as shown in Table 4.2-9.

Tables 4.2-8 and 4.2-9 show that the proposed action would not result in significant public health impacts. The modeling and human exposure assumptions used in the assessment were conservative and overestimated cancer risks. Measures mitigating the public health impacts from the proposed action are the same as those presented in Section 4.2.3 (air quality) and Section 4.2.4.1 (occupational health).

4.2.5 Vegetation and Wildlife

This section provides a discussion of impacts to vegetation and wildlife from operation of the proposed DWTF. The emphasis of the section is impacts to vegetation and wildlife from air pollutants that would be emitted from the facility including criteria and noncriteria pollutants. The criteria pollutants are nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide

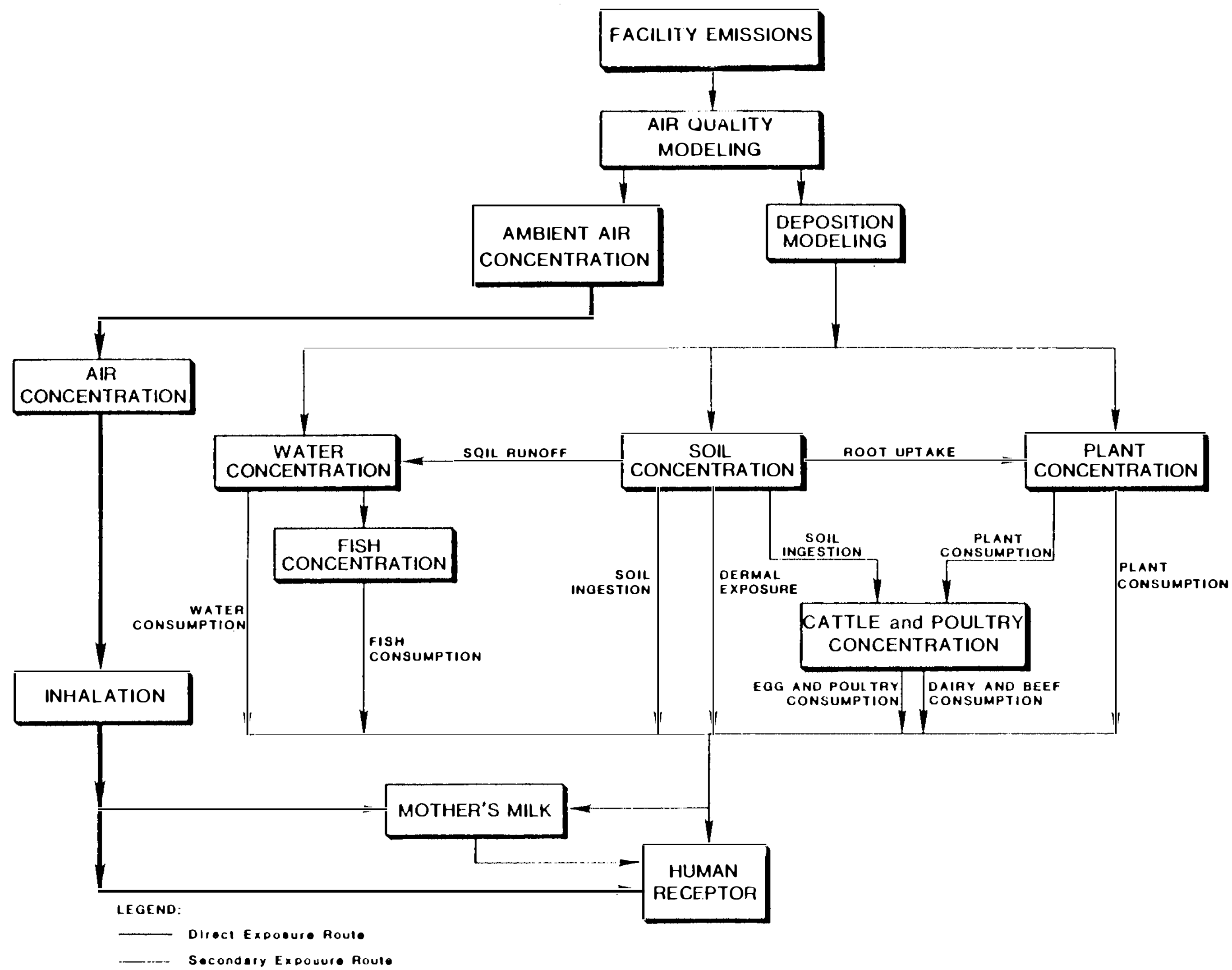


Figure 4.2-1. Environmental Fate and Exposure Pathways for Radioactive and Hazardous Emissions

TABLE 4.2-8. COMBINED RADIOACTIVE AND HAZARDOUS (NONRADIOACTIVE) CANCER RISKS AND POPULATION BURDEN FOR THE DWTF ALTERNATIVES

Alternative	Hazardous (Nonradioactive) Emissions Cancer Risk[a]	Radioactive Emissions Cancer Risk[a]	Total Combined[b] Cancer Risk	Population[c] Cancer Burden
Level II Design (preferred alternative)	1.8×10^{-6}	1.3×10^{-6}	3.1×10^{-6}	0.01
Level I Design	5.9×10^{-6}	2.8×10^{-7}	6.2×10^{-6}	0.04
No Action	9.7×10^{-6}	1.2×10^{-6}	1.1×10^{-5}	0.02

a Includes risk of developing cancer associated with emissions from normal operations and emissions during upset conditions (mechanical failure of air pollution control equipment). Risk is based on committed effective dose equivalent as calculated by the AIRDOS/DARTAB model for a 70-year exposure period.

b Worst-case risk levels are for an individual residing and working for a 70-year lifetime at the point of maximum impact continuously, as predicted from dispersion modeling. Risk values represent the probability of developing cancer. Regulatory agencies are currently reviewing the health risk assessment.

c Population cancer burden represents the number of excess cancer cases for the population exposed to the specific substances emitted by each alternative. The cancer burden estimate was based on the distribution of risk values as determined by dispersion modeling within the study area population. An exposed population of 101,000 was used in the analysis. This value was derived from the census tracts surrounding LLNL and projected population increases to the year 2025, using growth rates obtained from the Alameda County Planning Department.

Source: Radian, 1988b and 1988c.

TABLE 4.2-9. CANCER RISKS ASSOCIATED WITH COMMONPLACE ACTIVITIES COMPARED TO RISKS FROM THE DESIGN ALTERNATIVES

Activity (cause of cancer)[a]	Lifetime Risk (chances in a million)
Cosmic Rays - Radiation Risk (generally voluntary)	
One transcontinental flight/year	35
Airline pilot - 50 hr/mo at 35,000 ft	3,500
Frequent airline passenger	1,100
Living in Denver, Colorado compared to New York, New York	700
Other Radiation Risks (involuntary and voluntary)	
Living in brick building compared to wood (due to release of radon from bricks)	350
Natural radiation background at sea level	1,400
One chest x-ray every five years beginning at age 20 (ten total)	10
Cancer Risks in Eating and Drinking (involuntary and voluntary)	
One diet soda/day (saccharin)	700
Four tablespoons peanut butter/day (aflatoxin)	2,800
One pint of milk per day (aflatoxin)	700
Miami or New Orleans drinking water (chloroform)	84
Half-pound charcoal-broiled steak - one per week (benzo (a)pyrene) (cancer risk only)	28
Tobacco (voluntary)	
Smoker (cancer only)	84,000
Smoker (all effects)	210,000
Person in room with smoker	700
Air Pollution (involuntary and voluntary)	
Average over U.S., all cause	17,500
Cancer risk only	1,050
<u>DWTF Alternative Designs</u>[b]	
Level II Design (preferred alternative)	3.1
Level I Design	6.2
No-Action Alternative	10.9

[a] Crouch and Wilson, 1980.

[b] Assumes continuous 70-year exposure at the location of maximum impact under worst-case conditions.

(SO_2), and particulate matter less than 10 microns in diameter (PM_{10}). Noncriteria pollutants include heavy metals, organic compounds, acid gases, and radionuclides.

Soils act as a significant sink for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and particulates, all of which are removed from the air and absorbed into the soil and plant surfaces. The rate of absorption depends upon distance from the source, ambient pollutant concentrations, density of vegetative cover, and prevailing hydrological and meteorological conditions.

Ground-level concentrations of NO_2, CO, SO_2, particulate matter (PM), and PM_{10} at the point of maximum DWTF impact were estimated. As shown in Table 4.2-5, the maximum concentrations of these pollutants associated with the proposed DWTF were estimated to be insignificant compared to background levels that have been measured near the site. As Table 4.2-5 also shows, the combined impacts of the estimated DWTF emissions and background levels would not exceed established National and California Ambient Air Quality Standards (NAAQS and CAAQS). These standards are based on levels of air quality necessary, with an adequate margin of safety, to protect the public health and welfare from any known or anticipated effects of criteria pollutants, including effects on vegetation and wildlife. Due to the low concentrations of criteria pollutants emitted by the proposed facility, and the resulting compliance with ambient air quality standards and DOE orders, no significant boilogical impacts from criteria pollutants are expected.

As shown in Table 4.2-6, there would not be any significant increase in radionuclide emissions from the Level I and Level II design alternatives, relative to the no-action alternative. The results of LLNL's environmental monitoring program, as discussed in Section 3.5, do not indicate any impacts from radionuclide emissions to flora and fauna in the Livermore area from existing LLNL operations, including the existing HWM facilities. Therefore, since there would be a minor increase in radionuclide emissions from the proposed facility, there would not be any significant impacts to flora and fauna in the Livermore region from radionuclides.

The pathway for damage to vegetation from heavy metals (noncriteria pollutants) is through uptake from the soil. Therefore, the estimated concentrations of heavy metals in soils resulting from deposition of emissions from the alternatives were compared (Table 4.2-10) to average concentrations of these heavy metals found in California soils. This comparison indicates that there would be no significant impact to vegetation from heavy metals emitted from the proposed facility because the concentrations are at least 1,000-fold under levels naturally occurring in the soil. A comparison of acid gases that would be emitted from the proposed facility to plant damage thresholds is shown in Table 4.2-11. These emissions would also not present a significant impact to vegetation because the concentrations of the gases would be much less than the lower plant damage thresholds.

Impacts to wildlife from heavy metals would occur only by accumulation through the food chain. As discussed above, the concentrations that would accumulate in the soil from the proposed facility are only a very minute fraction of what naturally occurs in the soil. Therefore, there would not be any impacts to wildlife due to plant uptake of heavy metals that would be emitted from the proposed facility. Because organics do not accumulate through the food chain, wildlife can become impacted only by very high levels of exposure to organic pollutants. The Health Risk Assessment concluded that there would not be any effects to humans from emissions of organic compounds, in addition to all other compounds that would be emitted from the existing and proposed facility; therefore, it can be anticipated that there would also not be any impacts to wildlife from emissions of criteria and noncriteria pollutants.

The results of LLNL's environmental monitoring program, as discussed in Section 3.5, do not indicate any impacts to flora and fauna from radionuclide emissions at LLNL. Because current levels of noncriteria and radionuclide pollutants from LLNL are less than significant, the additional levels of these pollutants from the proposed DWTF, which would also be less than significant, would not have a significant impact on flora and fauna in the Livermore area.

TABLE 4.2-10. CONCENTRATION OF SELECTED NONCRITERIA POLLUTANTS IN SOIL

Pollutant	Average Concentration In California Soils[a] (mg/kg)	Estimated Soil Concentration at Point of Maximum Impact[b] (mg/kg)		
		No Action	Level I	Level II
Arsenic	4.2	1.11×10^{-5}	4.99×10^{-6}	6.38×10^{-7}
Beryllium	0.94	5.43×10^{-4}	2.44×10^{-4}	2.20×10^{-6}
Cadmium	1.3	1.11×10^{-5}	4.99×10^{-6}	2.30×10^{-7}
Chromium (total)	24.7	8.39×10^{-5}	3.78×10^{-4}	1.97×10^{-7}
Lead	53.3	2.25×10^{-3}	1.01×10^{-3}	2.20×10^{-6}
Mercury	<0.05	1.11×10^{-5}	4.99×10^{-6}	6.13×10^{-5}
Nickel	13.7	3.10×10^{-4}	1.40×10^{-4}	1.91×10^{-5}
B(a)P (organic)	0.001 - 1.0	0	1.52×10^{-7}	1.52×10^{-7}
B(a)A (organic)	0.001 - 1.0	0	7.61×10^{-7}	7.61×10^{-7}
Dioxins	1×10^{-6} - 4.0×10^{-5}	0	4.96×10^{-9}	4.96×10^{-9}

[a] Envirosphere Company, 1985.

[b] Radian, 1988b.

B(a)P = Benz(a)pyrene

B(a)A = Benz(a)anthracene

TABLE 4.2-11. COMPARISON OF EMISSIONS OF ACID GASES TO PLANT DAMAGE THRESHOLDS

	Threshold Concentrations Shown to Cause Plant Damage	Estimated Concentration at Point of Maximum Impact[a]		
		No Action	Level I	Level II
Hydrogen Fluoride	0.00012 - 0.00058 ppm[b] (24-hour average)	0	0.000018 ppm (24-hour average)	0.000011 ppm (24-hour average)
Hydrogen Chloride	4 - 13 ppm[c] (approximately 3-hour exposure)	0	0.00068 ppm (1-hour exposure)	0.00037 ppm (1-hour exposure)

[a] Radian, 1988b.

[b] Greenhalgh and Brown, 1982; National Research Council of Canada, 1977; National Academy of Sciences, 1971.

[c] U.S. Environmental Protection Agency, 1978.

4.2.6 Socioeconomics and Land Use

4.2.6.1 Socioeconomics

Currently, 35 employees work in HWM. The proposed DWTF would require 47 employees (12 new employees) for facility operation. The net increase in employment from the present level, if all new employees moved to the Livermore area from outside the area and had an average family size of 3, would generate a population increase of 36. This increase represents less than 0.1 percent of the 1985 population in the City of Livermore. Because the employment generated by the proposed DWTF would only have a small impact on the Livermore area's population, detailed analyses of labor conditions, housing, utilities, and other socioeconomic impacts are not warranted.

4.2.6.2 Land Use

Land use impacts resulting from the operation of the proposed DWTF would differ for each of the three alternative sites.

The LLNL Site Development and Facilities Utilization Plan (LLNL, 1984) recommends that facilities with continuous truck traffic, such as the DWTF, be located away from light laboratories and offices to separate truck traffic from automobile, pedestrian, and bicycle traffic. Other land use concerns regarding operation of the proposed DWTF include the separation of the proposed DWTF from residential areas, visual aesthetics, and consistency with LLNL's site development plan (LLNL, 1984).

Operation of the proposed DWTF at Site D would have less of an impact on nearby residential land uses than the other two alternative sites (see Figure 3.8-1) because Site D is located farther from planned residential areas (5,200 feet). The existing trees surrounding Site D would provide a visual buffer. The proposed DWTF operation on Site D would be consistent with LLNL's site development plan. Trucks coming to the DWTF at Site D would not have to cross any major roads or pedestrian and bicycle paths.

Site F, located in LLNL's buffer zone, is close (about 800 feet) to a planned residential area. Additionally, locating a DWTF at Site F would require that trees be planted to make the facility less visible from Vasco Road. Development on the buffer zone is inconsistent with LLNL's site development plan. However, Site F has adequate traffic segregation, and truck traffic would not have to cross any major roads and would not affect existing pedestrian and bicycle paths.

If the proposed DWTF were to operate at Site I, access to the facility from LLNL would require trucks to cross East Avenue and the Alameda County bicycle path on the south side of East Avenue. Site I is closest to existing residential development (1,900 feet) and would be visible from both East Avenue and Vasco Road.

4.2.6.3 Utilities

The Level I and Level II designs would use approximately 22 million cubic feet per year of natural gas (6 percent of total LLNL use) for DWTF heating, steam generation, incineration, and hot water processing. Five million kilowatt hours per year of electricity (2 percent of total LLNL use) would be used to run process equipment, and 8.5 million gallons of water (3 percent of total LLNL use) would be used for process operations and cooling. Maximum average DWTF wastewater flows to the City of Livermore wastewater treatment plant would be approximately 40 gallons per minute (4 percent of total LLNL peak wastewater discharge). An adequate supply and capacity of these utilities are available, with no significant impact anticipated.

4.2.7 Noise

The induced draft (ID) fans in the incinerator stack would be the most likely source of off-site noise from the proposed DWTF. Noise from the ID fans in the incinerator stack for the Level II design has been evaluated for its potential noise impact for receptors adjacent to Site D. This evaluation includes estimating the sound power level of the gases exiting the incinerator stack, estimating the directional effects of noise from the top at the stack horizontally (i.e., towards receptors in line of sight), and accounting for losses in the path between the stack and the nearest receptors.

Sound energy would not emanate uniformly from the vertical stack opening. For receptors in a direct line of sight, the propagation angle is assumed to be horizontal or 90 degrees. A correction factor of 6 dBA is applied to the total sound power level to account for the directivity effect. This factor is the correction factor recommended for noise sources at 250 hertz (hz) and a 90 degree propagation angle from a vertical source (Edison Electric Institute, 1978).

Therefore, the overall sound power level at the stack openings would be:

source		109 dBA
tonal effects	+	3
directivity effects	-	6
		106 dBA

Ldn is a measure of noise that has been correlated with public annoyance in different land uses. Ldn values are typically adopted by local planning agencies to quantify the level of noise considered acceptable for each land use within its jurisdiction. Portions of the Noise Element of the Alameda County Plan were reviewed for information concerning any local noise criteria. These criteria establish that exterior noise levels should not exceed:

- 60 Ldn for single family residential uses;
- 65 Ldn for multi-family residential uses and transient lodging;
- 70 Ldn for schools, libraries, churches, hospitals, nursing homes, playgrounds, and neighborhood parks;

- 70 Ldn for commercial uses;

- 75 Ldn for industrial uses and agricultural areas; and

- 75 Ldn for active outdoor recreation areas, such as golf courses, water recreation areas, and riding stables, etc.

Assuming 24-hour operation during campaigns of the Level II incinerator at Site D, the resulting noise level at the nearest residential receptor (1,600 feet east of the site) would be a Ldn of 42. This level is less than noise levels specified in the Noise Element of the local community's land use plan for single family residential areas, and well below the criteria identified for commercial/industrial/agricultural areas (70-75 Ldn), which more closely describe the land use immediately adjacent to the LLNL facility. On-site noise levels within the DWTF process buildings would be limited to 8-hour exposures of 85 dBA, which is equivalent to 84 Ldn (Bechtel, 1987). The major sources of on-site noise at the DWTF facility would be the the induced draft fans and the combustion air fans. Equipment specifications for these units will require the vendor to supply units which have sound-deadening devices that will meet LLNL Requirements for Occupational Exposure to Noise (85 dBA at three feet) (Bechtel, 1987, pp. 1117-43 and 1117-50). This sound power level at the stack opening would result in a sound power level of approximately 66 dBA at ground level near the stack.

Operation of the Level I design incinerator is estimated to be similar to Level II noise impacts.

4.2.8 Transportation Impacts

Department of Transportation (DOT) regulations (49 CFR 161), Nuclear Regulatory Commission (NRC) regulations (10 CFR 71), and Department of Energy regulations (DOE Orders 5480.1B; 5480.2; and 5480.3) apply to all hazardous and radioactive materials transferred from LLNL. Table 4.2-12 presents a comparison of the estimated quantities of waste requiring off-site disposal, the vehicle miles traveled (VMT), and truck trips generated by the two design

TABLE 4.2-12. ESTIMATED TRANSPORTATION IMPACTS OF ALTERNATIVES

Waste Type	No Action			Level I			Level II (preferred alternative)			Increased Off-Site Treatment and Disposal[a]		
	Quantity Shipped Off-Site	Truck Trips[b]	VMT[c]	Quantity Shipped Off-Site	Truck Trips[b]	VMT[c]	Quantity Shipped Off-Site	Truck Trips[b]	VMT[c]	Quantity Shipped Off-Site	Truck Trips[b]	VMT[c]
Solidified liquid mixed waste[d] (lb/yr)	544,575[e]	14	7,840	2,156,150	54	30,240	2,181,850	55	30,800	3,979,000	100	56,000
Radioactive solid waste (lb/yr)	659,000	17	9,520	659,000	17	9,520	446,000	12	6,720	666,000	17	9,520
Solidified hazardous liquid waste (lb/yr)	0	0	0	632,500	16	10,000	550,000	14	8,750	83,000[f]	3	1,880
Hazardous liquid waste (gal/yr)	823,250	256	160,000	10,000	4	2,500	10,000	4	2,500	666,400	208	130,000
TOTAL (per year)		287	177,360		91	52,260		85	48,770		328	197,400

a Increased off-site treatment and disposal is included for comparison purposes only. The analysis of this alternative discussed in Chapter 2.0 concluded that this is not a viable alternative.

b Truck load size for radioactive solids was assumed to be 40,000 lbs, the average load size for solid radioactive wastes from fiscal year 1986 LLNL manifests. Average truck load size for liquids, 3218.4 gal (Environment Reporter, 1983).

c Vehicle miles traveled (VMT). Radioactive and mixed wastes were assumed to be hauled to Mercury, Nevada, 560 miles from LLNL. Nonradioactive wastes were assumed to go to U.S. Pollution Control in Clive, Utah, 625 miles.

d These liquid wastes are solidified before being shipped off site. The projected volume flows were converted to weight using the following assumptions:

- Incinerator ash density is 5.35 lb/gal;
- Each 55-gallon drum contains 37 gallons of waste; and
- Density of the solidification waste is 125 lb/ft^3.

One gallon of waste, therefore, becomes 25 lbs of solidified waste. The quantity listed includes the weight of the solidification agent.

e These solidified wastes are currently stored on site pending EPA approval of the Nevada Test Site to receive solidified mixed wastes. These flows are projected to increase with the Level I and Level II designs primarily because of the scrubber blow down associated with incinerator flue gas treatment.

f Nonradioactive solid waste.

alternatives and the no-action alternative. These values include the weight of the cement and binder used to solidify the wastes where appropriate. Truck trip numbers were generated by dividing the waste flow by an assumed load size. Drums of cement and binder were assumed to require no additional shielding. The load volume for liquid hazardous wastes is the value calculated by ICF, Inc., of Washington, DC, in a study prepared for EPA's Office of Solid Waste. It is the average value from manifests collected in California, Massachusetts, New York, and Texas (Environment Reporter, 1983). VMT values were estimated by multiplying the total truck loads by the distance to Clive, Utah for the nonradioactive liquids and to Mercury, Nevada for the radioactive solids.

The incidence of traffic accidents involving trucks in California in 1985 was 4.66 accidents per million miles travelled (California Highway Patrol, 1986). This number was generated from California Highway Patrol (CHP) data, which define an accident as causing human death or injury or more than $4,000 damage. Vehicle miles travelled for trucks was estimated by the Highway Patrol based on diesel fuel purchases reported by truckers to the Board of Equalization. Figure 4.2-2 illustrates the trend in truck accident rates in California over the 1982-1985 time period.

Using the 1985 truck accident rate and the design waste throughput volumes, truck traffic from the no-action alternative would be expected to produce one accident each 1.2 years. The Level I design would reduce the accident rate by 70 percent, to one accident each 4.1 years. The Level II design would be expected to reduce the accident rate by 72 percent, to one accident each 4.4 years. Off-site transport of all wastes would be expected to increase the accident rate by 11 percent, to one accident each 1.1 years.

Wastes listed as mixed in Table 4.2-12 must currently be stored on site pending approval of the Nevada Test Site to receive solidified wastes containing hazardous materials. A small fraction (less than one percent) of the nonradioactive liquids contain hazardous waste solvents that, when untreated, are banned from landfilling by the EPA. These solvents are also

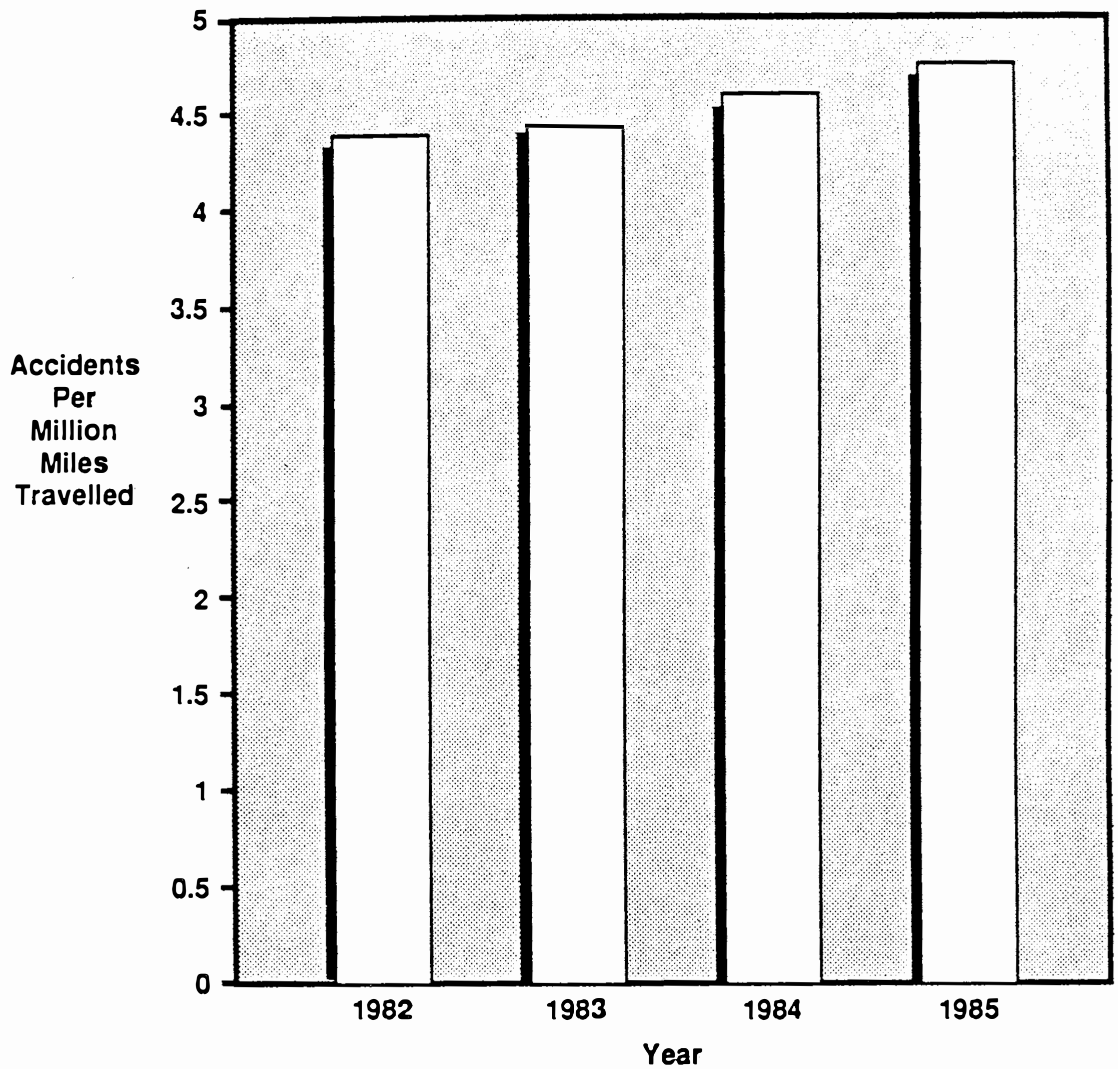


Figure 4.2-2. California Truck Accident Rate - Accidents per Million Miles Travelled

Source: California Highway Patrol, 1986.

currently solidified and stored on site pending the availability of facilities to dispose of them.

Any unintended spill or release of hazardous wastes from a highway transporter is classified by the California Highway Patrol as a hazardous waste "incident." Figure 4.2-3 summarizes the number of hazardous waste incidents reported in California during the past four years. Typically, about one-half of these incidents are the result of traffic accidents. The remainder are the result of intentional "midnight dumpers" and damaged or defective valves and containers (Hannahs, personal communication, 1987).

It should be noted that transporting waste solids accounts for 95 percent of the projected truck trips from the level II facility, and that 86 percent (by weight) of this solid waste is the result of solidification of mixed and hazardous wastes in concrete or gypsum binder (see Table 4.2-12). Drums of solidified material would be less likely to release hazardous materials to the environment in the event of a traffic mishap than liquid-filled containers.

Improved solidification agents are currently being evaluated as substitutes for concrete and gypsum. Truck transport values in Table 4.2-10 assume the use of concrete since this is the heaviest solidification agent available; thus, a conservatively high estimate of truck loads of solidified mixed wastes results. In spite of this conservative estimate, projected truck trips from the Level I and Level II alternatives would be approximately two-thirds less than those from the no-action alternative.

Another factor to be considered in projecting LLNL truck traffic is the projected population growth in the Livermore-Amador Valley area. This growth is expected to result in a 92 percent increase in total vehicle trips by the year 2005, compared to the 1980 vehicle trips. This demand will exceed current and planned capacity on some segments of I-580 and I-680. The most severely congested locations will be on I-680 southbound from Walnut Creek to Crow Canyon Road and between Pleasanton and Fremont, and on I-580 between Vasco Road in Livermore and I-680 (Alameda County Planning Department, 1986b).

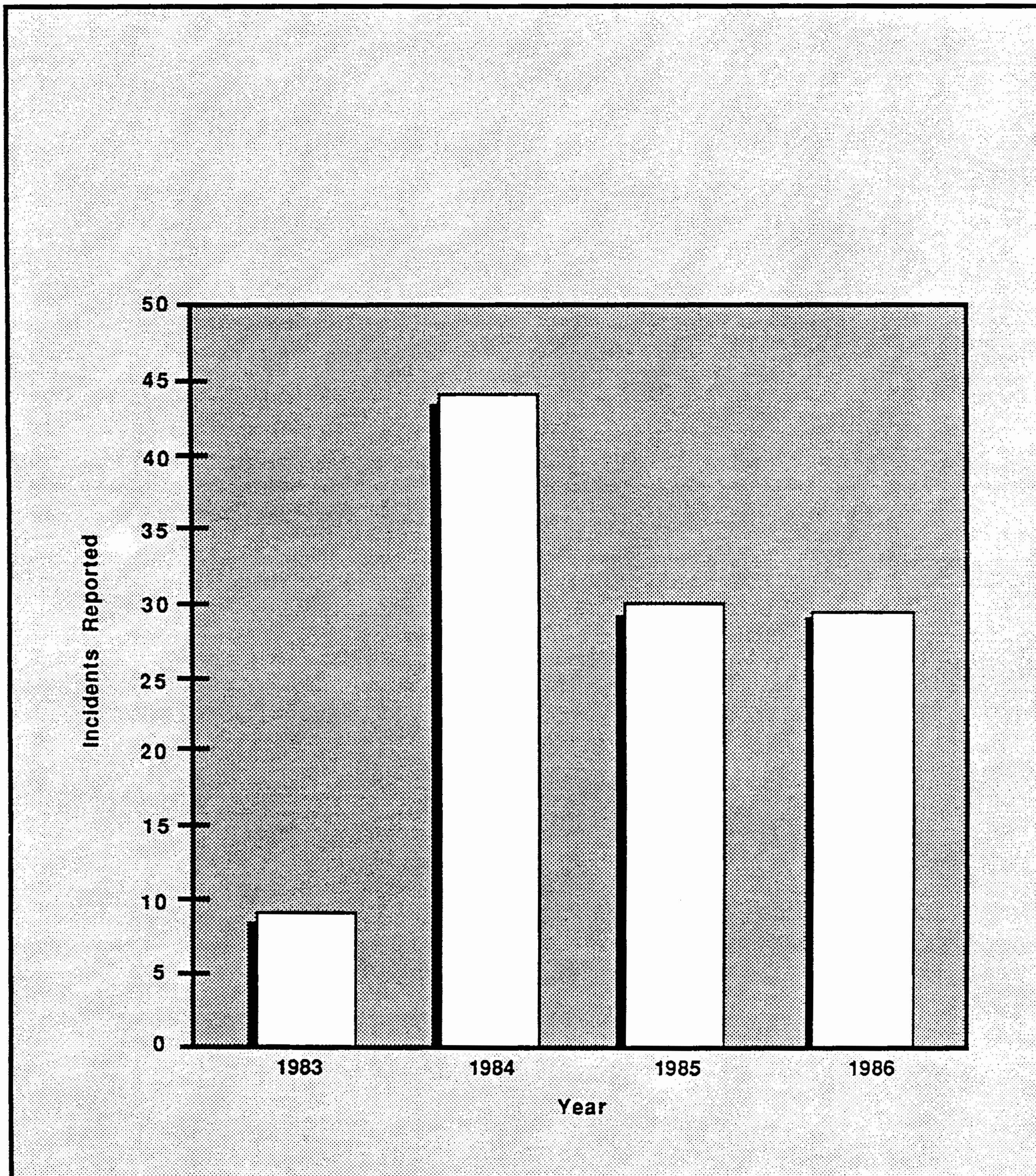


Figure 4.2-3. California Hazardous Waste Incidents Reported by the California Highway Patrol

Source: Hannahs, personal communication, 1987.

Hazardous waste transport from LLNL over these sections of I-580 and I-680 is now and should continue to be an insignificant fraction of total off-site hazardous waste transport. LLNL waste that is currently shipped over these routes would be incinerated in the proposed DWTF. Two thousand gallons per month of this waste is currently shipped to California Oil Recyclers in San Carlos; 1,250 gallons per month is transported to Romic Chemical in East Palo Alto.

The Level II design would result in an estimated 288 fewer shipments of hazardous waste each year to U.S. Pollution Control in Clive, Utah relative to the no-action alternative. Shipments to the Nevada Test Site in Mercury, Nevada, would increase by approximately 36 trips per year. Because trucks would travel I-580 east from Livermore to I-5 for shipments to both Utah and NTS, the impact of the Level II design (preferred alternative) on these highways would be 202 fewer truck trips per year relative to the no-action alternative. Trucks transporting all types of hazardous wastes from LLNL normally leave the facility in the late morning or early afternoon. Therefore, the trucks normally reach their destinations or are beyond metropolitan areas during peak traffic volume hours.

4.2.9 Cultural Resources

No impacts to cultural resources are expected. There is no evidence of sensitive cultural resources on or adjacent to the LLNL site (University of California, 1986).

If subsurface artifacts are found on site, a qualified archaeologist would evaluate the findings and determine appropriate mitigation measures.

4.3 Analysis of Postulated Accidents

Accidents can be postulated that have the potential to affect individuals and populations outside the DWTF buildings during facility operations. These postulated accidents were considered for the purpose of evaluating maximum potential consequences and to determine if an accidental release of radionuclides or hazardous chemicals would result in an unacceptable dose to on-site workers or the public. Engineered safety features will be designed into the DWTF to fulfill their safety functions and maintain the integrity of the proposed facility should a design basis accident (DBA) occur. Additionally, a postulated accident more severe than a DBA has been evaluated to assess the consequences of an extremely low probability accident event.

Of the accident events that were examined in the DWTF, the two postulated accidents with the most serious potential consequences were a fire in the Decontamination Building and a major spill in the liquid waste feed tank area of the Incinerator Building. These two postulated accidents were examined in detail and found to have an insignificant impact to on-site workers and the public. The radiological doses to the on-site worker and the public from a Decontamination Building fire, even in the event of a severe accident, were several times below the dose guidelines as shown in Tables 4.3-2 and 4.3-4. It was also concluded that chemical releases resulting from a major spill of hazardous chemicals in the liquid waste feed tank area would be several times below the Immediately Dangerous to Life and Health (IDLH) values as indicated in Table 4.3-3.

If an accident did occur at the proposed DWTF, LLNL's emergency response organization would respond to initiate appropriate action to protect life and property at LLNL and within the vicinity. Fire control, spill response, and coordination with county and city emergency services would be conducted in accordance with the LLNL Emergency Preparedness Plan (LLNL, 1988b). The material presented in Sections 4.3.1 and 4.3.2 will be factored into emergency planning and preparedness for the DWTF.

4.3.1 Potential Impacts of Postulated Accidents

To determine potential DWTF accidents that could have adverse consequences, an accident evaluation was initially performed to identify hazards (such as industrial and mechanical hazards, and potential exposures to radiological and hazardous substances) that could possibly result from malfunctions of systems, improper operating conditions, operator error, or natural phenomena (LLNL and Radian, 1988). This accident evaluation was then used to determine the appropriate engineered safety measures, which needed to be incorporated into the design of the proposed facility, in order to mitigate the potential hazards.

The postulated accident events associated with each DWTF building that could result in the largest releases of radionuclides and/or hazardous chemicals are listed in Table 4.3-1 and bound the consequences of potential facility accidents. For example, a postulated fire in the shredder was assumed to occur as a result of ignitable material (such as waste oil) being mistakenly fed into the shredder and the failure of the fire control system. The source of this postulated fire was assumed to be a spark generated by the shredder from metal-to-metal contact and friction heating by electrical equipment. Because the maximum amount of hazardous material available for a shredder fire would be limited to 55 gallons, this type of accident would result in less severe consequences than the other postulated accidents described in this section.

Two postulated DBAs with the highest or most serious potential consequences were evaluated in detail. These postulated DBAs are a fire in the Decontamination Building and a major spill of hazardous chemicals in the liquid waste receiving and tank feed area of the Incinerator Building. These postulated accident events and their associated consequences are discussed in Section 4.3.1.1 and Section 4.3.1.2. Section 4.3.2 further describes the consequences of an extremely low-probability accident more severe than a DBA.

4.3.1.1 Postulated Fire in the Decontamination Building - Single Area

Contaminated material containing various radionuclides, equivalent in radiological hazard to a maximum of 100 grams of plutonium (Pu-239), could

TABLE 4.3-1. POSTULATED DWTF ACCIDENT EVENTS

DWTF Building	Accident Event
1. Decontamination Building	Fire
2. Incinerator Building	Shredder Fire Shredder Hopper Fire Staging Area Fire Liquid Waste Feed Tank Spill Liquid Waste Feed Tank Spill and Fire
3. Liquid Waste Processing Building	Liquid Waste Storage Tank Spill
4. Radioactive Waste/Clean Storage Building	Fire
5. Solid Waste Processing and Waste Receiving/Classification Building	Fire
6. Reactive Materials Building	Process Vessel Fire Storage Area Fire
7. Truck/Tanker Parking Area	Spill
8. Boiler/Chiller Building	Fire

Source: LLNL and Radian, 1988.

be stored or processed in the Decontamination Building which is a single area within the proposed DWTF. For this postulated accident, this radioactive material was assumed to be brought into the building in carboys and as contaminated equipment or material. The aqueous contents in the carboys would be solidified in one of the small decontamination hoods, while the contaminated equipment and material (e.g., tools, laboratory equipment) would be decontaminated in other portions of the building including the larger walk-in hoods. For this postulated accident, a design basis earthquake (DBE) was assumed to occur, followed by a fire spreading to most areas of the building such that all 100 grams of the plutonium-equivalent material within the building would become involved in the fire.

The Decontamination Building will be designed for a high level of protection and structural integrity because of its potential radioactive inventory. Multiple levels of protection, including nonflammable construction material, will be incorporated into the building design to prevent the occurrence of fire in the Decontamination Building. The majority of the work performed in the Decontamination Building would be performed in individual decontamination or walk-in hoods. The work would not be concentrated in one location but dispersed throughout the building. A seismically-qualified, automatic fire-sprinkler system designed to remain operational during and after a DBE will serve the entire building, including the last stage of the HEPA filters on the building exhaust system. Releases of radionuclides from hoods, equipment, and the main ventilation system will be filtered by two stages of testable HEPA filtration systems and would be discharged 50 feet above ground. Engineered safety features which will be incorporated in the Decontamination Building are listed in Section 2.8.3 and Table 2.8-2.

For this postulated accident, it was assumed that if a fire were to follow a DBE, the products of combustion would migrate into the main room of the Decontamination Building and into the air filtration system. Radioactive material equivalent in radiological hazard to 100 grams of Pu-239 would be the maximum quantity allowed in the building at any one time. This quantity was assumed to be available during the postulated fire. The fraction released in a fire would be 5×10^{-4} (Mishima and Schwendiman, 1973). The total amount of radioactive material that would reach the filtration system is equivalent in radiological hazard to 50 milligrams of Pu-239.

In order to determine the total amount of radioactive material that would be emitted through the HEPA system, two cases were analyzed by varying the HEPA filter control efficiency. Case 1 conservatively assumed that the building and equipment exhaust systems would only be filtered by one of the two stages of HEPA filters. This one stage is assumed to have a filter efficiency of 99.9 percent (Elder et al., 1986, p.22), which is less than the normal operation efficiency of HEPA filters of 99.97 percent. To determine the consequences of the HEPA filtration system degradation, Case 2 was postulated, again using one functional HEPA filter with an efficiency of only 90 percent (i.e., an additional degradation by a factor of 100).

The potential consequences of the DWTF accidents were calculated using the MATHEW/ADPIC dispersion models (Lange, 1978; Sherman, 1978). These are three-dimensional models that calculate the dispersion of material in the atmosphere taking into account turbulent diffusion, radioactive decay, gravitational settling (based on particle size), and dry deposition. Air concentrations and ground deposition are calculated and are subsequently converted to radioactive dose for various pathways using dose factors.

The inhalation dose factors used are based on International Commission on Radiological Protection (ICRP) Publications 26 and 30 (ICRP, 1977 and 1979) and calculate 50-year committed dose equivalents. External (air immersion and ground exposure) dose factors are based on NUREG/CR-1918 (Kocher, 1981). A comparison of dose factors for the nuclides of concern showed that air immersion and ground exposure pathways were insignificant relative to the inhalation pathway. Chronic exposure pathways, which depend primarily on ground deposition, were also found to be insignificant relative to the inhalation pathway. The doses presented in this accident analysis are committed effective dose equivalents (i.e., they account for the total dose received over 50 years due to the uptake of radioactive material as a result of the accident). A more detailed discussion of the assumptions and models used in the accident analyses is presented in "Analysis of Postulated Accidents at the Proposed Decontamination and Waste Treatment Facility at the Lawrence Livermore National Laboratory" (LLNL and Radian, 1988).

The calculated consequences (i.e., radiological doses) from this postulated accident are presented in Table 4.3-2. The committed effective dose equivalent is well below the on-site and off-site guidelines. The maximum off-site committed effective dose equivalent would be 3.1×10^{-2} rem compared to the EPA Protective Action Guides for whole-body exposure to airborne radioactive material of 1 rem (U.S. Environmental Protection Agency, 1980).

4.3.1.2 Postulated Incinerator Liquid Waste Receiving and Feed Tanks Spill

For this postulated accident scenario, on-site and off-site exposures to hazardous chemical vapors were evaluated. These exposures were assumed to be the result of a major spill of organic solvents and solutions from the liquid waste receiving and feed tanks caused by a DBE. It was assumed for this scenario that the tanks, at maximum storage, would instantaneously rupture, spilling approximately 6,000 gallons of organic liquid waste within the liquid waste receiving and feed tank area of the Incinerator Building. All organic compounds, except oil and diesel fuel, were assumed to evaporate.

Specific safety features will be incorporated into the design of the liquid waste receiving and feed tank area of the Incinerator Building to control liquid and vapor releases in case of a spill of liquid wastes. The waste receiving and feed tanks will be placed in a seismically-qualified room inside the Incinerator Building that would remain functional during and after a DBE. This room would confine a spill and the resulting chemical vapors. Dampers will be installed in all openings (approximately 9 square feet) to the

TABLE 4.3-2. CONSEQUENCES OF A POSTULATED DECONTAMINATION BUILDING FIRE

Location	Distance (meters)	Committed Effective Dose Equivalent (rem) Case 1[a]	Case 2[b]	Dose Guidelines
On Site	100	4.0×10^{-5}	4.0×10^{-3}	0.5 - 25[c]
Off Site	225[d]	1.2×10^{-4}	1.2×10^{-2}	1[e]
Off Site	700[f]	3.1×10^{-4}	3.1×10^{-2}	1[e]

[a] Case 1 assumed 99.9 percent HEPA filter efficiency.

[b] Case 2 assumes 90 percent HEPA filter efficiency.

[c] Radiological whole body dose guideline for extremely unlikely accidents (i.e., accidents that will probably not occur during the operational life of the facility). This category includes design basis accidents (Elder et al., 1986, Table VI, p. 17).

[d] Nearest LLNL site boundary distance.

[e] Source: U.S. Environmental Protection Agency, 1980, p. 2.3.

[f] Location of maximum dose.

liquid waste receiving and feed tank area, including an air supply duct and louver opening of the room and two exhaust fan ducts in the ceiling. These dampers would close automatically in the event of a fan shutoff, fire, or liquid entering the room sump as detected by a sensor. A seismically-qualified, automatic system for suppressing fire with expanded foam will be incorporated in the building design. This system would control potential spills or fire and prohibit hazardous vapors from spreading. An additional back-up fire sprinkler system with high temperature sprinkler heads (that would automatically activate if the foam system does not suppress the fire) will also be included in the building design. These safety features will be designed to prevent releases of hazardous chemical vapors to the environment and to remain operational during a DBA.

The postulated spill following a DBA would result in hazardous organic liquid spreading to the tank storage room floor. The tank storage room would have the capacity to retain a maximum spill volume plus fire sprinkler water. Although the intake and exhaust dampers would be seismically-qualified, it was conservatively assumed in this postulated accident that there would be a complete failure of all intake and exhaust air dampers to close in the incinerator tank room, allowing the hazardous vapors to be released. It was also assumed that no spill response or cleanup actions would be taken and that liquid evaporation would continue long enough for maximum downwind concentrations of each spill component to occur. For some of these liquid spill components, it would take up to two and a half hours of evaporation for the maximum downwind concentration to occur.

The consequences of the postulated spill were evaluated using the Complex Hazardous Air Release Model (CHARM®), which is a Gaussian Puff model used to estimate impacts from accidential releases of hazardous chemicals (Radian, 1987b). CHARM® uses the chemical and thermodynamic properties of the substance spilled to determine the emission characteristics of each spill scenario. For both liquid and gaseous releases, the model allows phase transitions to occur. For liquid releases, the spill pool size and resulting evaporation rates are computed. The evaporation rate then determines the mass emission rate. The CHARM® model predicts the location and concentration of a gas cloud resulting from a postulated accidental release of hazardous material. The CHARM® model has been validated in several test spill experiments conducted at DOE facilities in California (Balentine and Eltgroth, 1985).

The estimated on-site and off-site concentrations of these various hazardous chemicals are listed in Table 4.3-3. These calculations indicate that on-site and off-site concentrations would be approximately 10 to 1,000 times less than Immediately Dangerous to Life and Health (IDLH) values. IDLH values represent the maximum concentration of these hazardous chemicals that a person could be exposed to for 30 minutes without any escape-impairing symptoms or any irreversible health effects (National Institute of Occupational Safety and Health, 1985).

The potential health impacts associated with additive exposure from the chemical vapors were evaluated by the Hazard Index approach (51 FR 34019). The Hazard Index is the sum of the ratios of the individual chemical exposure to the acceptable exposure limit (in this case, the IDLH) for that chemical. A Hazard Index less than one indicates that potential adverse effects from the chemical mixture are unlikely. A Hazard Index is calculated for chemical mixtures that produce the same type of toxic effect. The major acute effect from exposure to high concentrations of solvent vapors is depression of the central nervous system; the IDLH is then assumed to be representative of central nervous system depression. Ethylene glycol is not considered in the Hazard Index because the primary acute effect is respiratory irritation. A loss of 13 gallons of ethylene glycol, which corresponds to a predicted concentration of 5.9 parts per million (ppm) on site and 3.3 ppm off site, was assumed for the spill scenario. These concentrations are below the IDLH of 80 ppm for ethylene glycol. The Hazard Index values presented in Table 4.3-3 indicate that for both on-site and off-site exposure, adverse health impacts from the mixture of the chemical vapors would not be significant.

TABLE 4.3-3. CONSEQUENCES OF A HAZARDOUS WASTE SPILL IN THE INCINERATOR LIQUID WASTE FEED TANK AREA

Chemical	Quantity Spilled (gallons)	IDLH[a] (ppm)	On-Site Concentration[b] (ppm)	On-Site Hazard Index[c]	Off-Site Concentration[d] (ppm)	Off-Site Hazard Index[c]
1,1,1-trichloroethane	388	1,000	23	0.023	13	0.013
Acetone	105	10,000	29	0.0015	16	0.008
Acetonitrile	5	4,000	0.73	0.00018	0.40	0.0001
Benzene	7	2,000	1.2	0.0006	0.70	0.00035
Ethylene glycol	13	80	5.9	---	3.3	---
Fluorotrichloromethane	80	10,000	2,200	0.22	1,100	0.11
Isopropanol	168	20,000	1.8	0.00009	0.99	0.000049
Methyl ethyl ketone	279	3,000	12	0.004	6.5	0.0022
Methanol	135	25,000	11	0.00044	5.9	0.00024
Methylene chloride	125	5,000	63	0.013	35	0.007
Methyl Isobutyl ketone	5	3,000	0.10	0.000033	0.057	0.000019
Pentane	13	5,000	74	0.015	48	0.0096
Perchloroethylene	140	500	0.19	0.00038	0.10	0.00020
Tetrachloroethane	80	150	0.047	0.00031	0.026	0.00017
Toluene	140	2,000	0.61	0.00031	0.34	0.00017
Trichloroethylene	211	1,000	3.4	0.0034	1.9	0.0019
Trichlorotrifluoroethane	451	4,500	180	0.04	100	0.022
Xylene	4	10,000	0.50	0.00005	0.28	0.000028
[Oil, kerosene][e]	3,650	---	---	---	---	---
TOTAL GALLONS	6,000					
HAZARD INDEX TOTAL				0.33		0.17

a IDLH - Immediately Dangerous to Life and Health values (National Institute of Occupational Safety and Health, 1985).

b Location of on-site personnel assumed to be 328 feet (100 m) from the accident source.

c The Hazard Index is a method for evaluating potential toxic effects from exposure to mixtures of hazardous chemicals. The Hazard Index is the sum of the ratios of the individual chemical exposure to the acceptable exposure limit (IDLH) for that chemical. Hazard Index values less than one indicate that potential adverse health impacts from chemical mixtures is unlikely (51 FR p. 34019). The Hazard Index for all chemicals except ethylene glycol is based on the assumption that central nervous system effects occur from exposure at the IDLH concentration. The IDLH for ethylene glycol is based on respiratory irritation and is considered separately from the other chemicals. Estimated concentrations of ethylene glycol are below the respective IDLH.

d The maximum off-site exposure location is assumed to be 764 feet (233 m) from the accident source at the LLNL fenceline.

e Heavy organics (oil, spent kerosene) assumed not to evaporate during spill.

4.3.2 Consequences of a Postulated Severe Accident

In order to provide a broader perspective of the consequences of potential accidents associated with the proposed DWTF project, an accident scenario more severe than the DBAs in Section 4.3.1 was evaluated and is described in this section. This scenario represents a severe accident, in which further degradation of engineered safety features is assumed, and takes no credit for emergency response action. This scenario is described in this EIS because 1) it represents an extremely low probability type of occurrence and 2) detailed probabilistic data on equipment failure, from which more mechanistic accident scenarios could be developed, are not available. The discussion presented in this section is not an indication that a severe accident will occur. Rather, this approach is used to place in perspective the consequences associated with a severe accident of sufficiently low probability of occurrence that goes beyond design bases.

The initiating event in this scenario was assumed to be a major fire in the Decontamination Building with total failure of all engineered safety systems. For this scenario to occur, the following events must take place:

- A building-wide fire occurs;
- The seismically-qualified fire sprinkler system fails completely;
- The final filtration system's fire protection system, which is seismically qualified, fails;
- The building filtration system fails completely (HEPA filter control is zero);
- No corrective action (waste removal, fire control, etc.) is undertaken by DWTF workers; and

- No response is made by the LLNL Emergency Response Team or fire department.

It was assumed for this postulated accident that all of the radioactive material (equivalent in radiological hazard to 100 grams of plutonium [Pu-239]) would come in contact with the fire. The fraction released in a fire would be 5×10^{-4} (Mishima and Schwendiman, 1973). Dispersion of the radionuclide plume was calculated using the MATHEW/ADPIC models with conservative meteorological assumptions (e.g., a wind speed of one meter per second and F class stability). The on-site and off-site radionuclide doses that would result from this postulated accident are presented in Table 4.3-4. The committed effective dose equivalent values were well below the exposure guidelines indicating that the consequences of a severe accident would not be significant.

To date, only one serious building fire involving plutonium, the Rocky Flats fire in 1969, has occurred. In that fire, no plutonium was released from the building except for some very small amounts tracked out of the building by personnel entering and leaving during the fire and subsequent cleanup. There have been several fires involving uranium from which some understanding can also be gained concerning radionuclide plumes (Walker, 1978). In these events, uranium contamination inside the buildings occurred, but other than slight amounts, no outside contamination took place. Because of near equal mass, uranium and plutonium have similar transport characteristics if oxides are formed at the same temperature.

In summary, with the installation of engineered safety and environmental control features into the proposed DWTF and the implementation of mandated operation procedures, the probability of an accidental release of radionuclides and hazardous chemicals from the proposed DWTF is extremely low, and the consequences of such an event would be insignificant. Therefore, the environmental impact from such an accidental release would also be insignificant.

TABLE 4.3-4. CONSEQUENCES OF A SEVERE POSTULATED FIRE IN THE DECONTAMINATION BUILDING

Location	Distance (meters)	Committed Effective Dose Equivalent[a] (rem)	Dose Guidelines (rem)
On Site	100	3.7×10^{-2}	25[b]
Off Site	225[c]	1.1×10^{-1}	1[d]
Off Site	700[e]	2.8×10^{-1}	1[d]

[a] Assumes zero percent control efficiency of the HEPA filtration system.

[b] Radiological whole body dose guideline for a severe accident (Elder et al., 1986, Table VI, p. 17).

[c] Nearest LLNL fenceline distance.

[d] Source: U.S. Environmental Protection Agency, 1980, p. 2.3.

[e] Location of maximum dose.

4.4 Facility Closure and Decommissioning

This section describes the procedures that LLNL would use to close and decommission both the existing HWMF operations after the proposed DWTF is operational and the proposed DWTF at the end of its lifetime. Under the closure program, all existing HWM facilities would close with the exception of Building 625 (PCB Storage) and the recently constructed Building 693 (Chemical Waste Storage).

The proposed closure plans are in accordance with California Code of Regulations, Title 22, Division 4, Chapter 30, Article 23, Sections 67210-67215. In general, the approach to closure and decontamination of both existing and proposed hazardous waste management facilities would be as follows:

- Remove the entire hazardous waste inventory by normal operating procedures;
- Dismantle equipment;
- Decontaminate equipment, building interiors, tanks, sumps, outdoor concerete slabs, etc., using brooms and brushes and appropriate cleaning agents. Cleaning agents will include detergents, degreasers, chelating agents, sandblasting, and steam;
- Verify completeness of decontamination of steel, concrete, and other surfaces by chemically testing rinsewaters from these surfaces; wipe-test facilities and equipment used for storage or decontamination of radioactive materials;
- Treat wash and rinsewaters at an approved liquid waste processing system or, if the water meets pretreatment standards, discharge to the City of Livermore wastewater treatment plant, bury radioactive equipment and fixtures, sandblasting sand and

the residues from treatment of radioactive wash waters at a low-level disposal facility; and

- Submit closure certification to California DHS.

Additional details regarding the closure plans can be found in "Hazardous Waste Incinerator and Storage Facility, RCRA Part B Application" (Radian, 1983) and "Lawrence Livermore National Laboratory Decontamination and Waste Treatment Facility Operation Plan" (Radian, 1987a).

4.4.1 Existing HWMF Closure and Decommissioning

With the exception of Building 625 (PCB storage) and its adjacent yard, and Building 693 (Chemical Waste Storage), the existing HWMF would be closed once the proposed DWTF was operational. These three areas would remain open and continue to be used as currently permitted. The HWMF would be closed in accordance with the closure plans found in "Hazardous Waste Incinerator and Storage Facility, RCRA Part B Application" (Radian, 1983). This process is summarized below.

The closure and decommissioning of the existing HWMF would not represent a significant adverse impact to the environment. The closure procedures described in the closure plans are designed to:

- Minimize the need for further maintenance;

- Remove, package, and dispose off site all contaminated material and equipment;

- Eliminate post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or waste decomposition products into the ground water, surface waters, or the atmosphere; and

- Allow future beneficial use of the existing HWMF site and decontamination building.

To accomplish these objectives, LLNL intends to close the HMWF by removing all waste and waste residues from the hazardous waste management units and nearby vicinity. The proposed closure plans assume that the HMWF waste management units at LLNL would be closed once the proposed DWTF was fully operational.

4.4.1.1 Closure of Drum Storage Area

The contents of all the drum containers in the LLNL drum storage area would first be transferred to the proposed DWTF storage facilities. The container storage area would then be decontaminated with a series of solvent and steam washes. All wastewater and residues generated in the cleaning process would be collected in the depressed area of the pad and pumped to holding drums for immediate analysis. If laboratory analysis indicates that the waste is hazardous, the material would be pumped from the drums and treated in the incinerator or shipped to off-site disposal. If laboratory analysis shows no evidence of contamination, wastewater and residues in the drums would be discharged to the sewer system.

Approximately 300 gallons of wastewater and residue are anticipated to result from the container storage area decontamination process.

4.4.1.2 Closure of Incinerator

The existing HWM incinerator will be closed as a hazardous waste facility but would remain available for nonhazardous use. The steps involved in the closure of the hazardous waste incinerator facility and decontamination of all incinerator facility equipment include:

- Incinerating all accumulated waste at the incinerator site.

- Flushing the pump and the feed lines into the incinerator with a solvent, such as kerosene or fuel oil. This flush solvent would be burned in the incinerator. The tank and piping would then be flushed with water. The flush water would be treated in an approved wastewater treatment facility at the proposed DWTF.

- Burning all stored wastes and flushing solvents to decontaminate the incinerator. After receiving the last of the solvent, the incinerator would continue to burn for a minimum of four hours on natural gas to ensure that all waste residue has been burned. The primary and secondary combustion chambers would be cleaned of any residue ash by physically removing the ash from the refractory. Any water used to clean the chambers would be treated in an approved wastewater treatment facility at the proposed DWTF. Since the incinerator would no longer be a hazardous waste incinerator following decontamination, it would be left in place for incineration of nonhazardous material.

- Packaging and disposing of ash in an approved hazardous waste landfill. Any residual ash would be removed from the system by flushing the area with water. All flush water would be treated in the proposed DWTF.

4.4.1.3 Closure of Other HWM Facilities

All HWM building components, equipment, piping, and tanks would be decontaminated. Process components would be dismantled and shipped off site for disposal after decontamination. After decontamination is complete, buildings would remain for future use by other LLNL activities. Building 625 would not be closed and would continue to be used as permitted for PCB storage.

After all the equipment and piping has been decontaminated and cleaned, all areas would be carefully inspected for previously undetected spills or contamination. If evidence of possible areas of soil contamination is found or if cracks are observed in the storage pad, a soil sampling and analysis program would be instituted to determine the extent of soil contamination in those areas. At least two soil samples would be taken from the drum storage area and two samples near the incinerator area, where waste feed operations occur. Soil samples collected with augur borings would be tested in a laboratory. If contamination is found in the soil, those areas would be excavated to the depth at which no contamination is detected. All contaminated soils, equipment, and solid residue would be loaded and transported by truck to an approved hazardous waste landfill.

4.4.2 DWTF Closure and Decommissioning

The design lifetime of the proposed DWTF is estimated to be 25 years; therefore, closure is expected in the year 2016. Closure and decommissioning of the proposed DWTF would follow similar procedures previously described for the HWM facilities. After closure activities are complete, the proposed DWTF would no longer contain or be contaminated by hazardous, mixed, or radioactive waste and would no longer be regulated as a hazardous waste management unit. After decontamination, the buildings could be used by LLNL for other purposes.

Table 4.4-1 presents the specific closure actions for the DWTF. A detailed closure plan has been developed for submission to the California Department of Health Services as part of the Operation Plan permit application (Radian, 1987a). The closure plans would be in accordance with California Code of Regulations Title 22, Article 23, Sections 67210-67215.

4.5 Beneficial and Adverse Environmental Impacts

4.5.1 Beneficial Environmental Impacts

Beneficial impacts of the proposed action include increased safety and environmental protection, enhanced management and operational efficiency,

TABLE 4.4-1. PROCEDURES FOR CLOSURE OF THE UNITS COMPRISING THE PROPOSED DWTF

Facility (Unit) Description	Procedures
Waste Receiving and Classification Area - would receive and classify wastes, distribute wastes to appropriate DWTF unit.	The facility would be decontaminated, including the floor, two unloading stations, and waste handling equipment by scrubbing with water and/or an appropriate cleaning agent (e.g., detergent, degreaser, chelating agent).
Tanker Trailer Parking Area - would store trucks and portable tanks containing hazardous wastes until disposal or treatment is available.	The facility would be decontaminated, including pad, trench, sump, segregated area and sump, portable tanks, tanker trailers, and waste handling equipment by scrubbing with water and/or an appropriate cleaning agent (e.g., detergent, degreaser, chelating agent).
Reactive Materials Building - would store and treat highly reactive materials, such as oxidizing, toxic, reactive, and flammable reactive materials until a disposal or treatment option is available.	Reactive wastes would be deactivated and/or packaged and removed to an off-site disposal facility. The facility would be decontaminated, including shelves, floor slabs, sumps, and storage cells by scrubbing with water and/or an appropriate cleaning agent (e.g., detergent, degreaser, chelating agent). Equipment would be decontaminated, packaged, and shipped to NTS.
Solid Waste Processing Area - would compact wastes in 55-gallon drums and crush empty drums.	The facility would be decontaminated, including a 5-ton crane, a platform scale, a drum crusher/compactor, and the floor area by scrubbing with water and/or an appropriate cleaning agent (e.g., detergent, degreaser, chelating agent).

(Continued)

TABLE 4.4-1. (Continued)

Facility (Unit) Description	Procedures
Incinerator Area - would store and burn hazardous, mixed, and radioactive wastes. Would include include a separate system for oxidizing depleted uranium chips.	The facility would be decontaminated, including the receiving and feed tanks, floor and sumps, drum charger, shredder hopper and ram feeder, sludge waste feed system, rotary kiln, transition chamber, secondary combustion chamber, ash handling system, scrubber blowdown tank, uranium oxidation system, and auxiliary equipment. The incinerator and uranium oxidation system's operating components would be cleaned of any residues or scale by physically removing the residuals from the units. The components would then be flushed with water or appropriate solvent. The remaining equipment and area would be cleaned by scrubbing with water, steam and/or an appropriate cleaning agent (detergent, degreaser, chelating agent, etc.). Process equipment would be decontaminated, packaged, and shipped to NTS.
Liquid Waste Processing Area - would receive and treat aqueous wastes containing heavy metal ions and dissolved anions. Treated wastewater would meet standards for discharge to a publicly owned treatment works. The facility would house two separate systems: one for radioactive liquids and one for nonradioactive waste waters.	The facility would be decontaminated, including the waste unloading stations, the tanks, the evaporators, the pumps, floor platforms, and the pipes by scrubbing with water and/or an appropriate cleaning agent (e.g., detergent, degreaser, chelating agent).

(Continued)

TABLE 4.4-1. (Continued)

Facility (Unit) Description	Procedures
Radioactive Waste Storage Area - would store packaged and prepared radioactive and mixed wastes until they can be shipped to an off-site disposal facility.	Waste inventory would be removed to an off-site disposal facility. The facility would be decontaminated if necessary (no contamination should exist because wastes would be fully containerized) by scrubbing with water and/or an appropriate cleaning agent (e.g., detergent, degreaser, chelating agent).
Clean Storage Area - would store clean equipment to be used at the DWTF. May also be used at times to store packaged and prepared nonradioactive hazardous waste prior to off-site disposal.	Waste inventory (if any) would be removed to an off-site disposal facility. The facility would be decontaminated if necessary (no contamination should exist because any wastes handled would be fully containerized) by scrubbing with water and/or an appropriate cleaning agent (e.g., detergent, degreaser, chelating agent).
Tank Truck Washing and Container Cleaning Area - would provide a wash-out area for trucks and containers which held nonradioactive waste.	Waste inventory would be removed and the sump and surrounding area would be decontaminated by scrubbing with water and/or an appropriate cleaning agent (e.g., detergent, degreaser, chelating agent).
Decontamination Area - would provide a centralized facility to house process equipment for removal of both residual surface and fixed thin-layer radioactive and hazardous contamination from LLNL equipment.	Waste inventory would be removed and the equipment would be dismantled and either reused at another radioactive facility or buried at a low level disposal facility. The building would be decontaminated by sand-blasting and painting, and duct work would be changed. Sand and duct work would be buried at a low level disposal facility.

and more flexible treatment for the wastes generated by LLNL. The proposed DWTF would minimize the potential for spills, leaks, and uncontrolled releases to a greater degree than the present HWM facilities, thereby reducing the potential for impacts to the public and the environment. The proposed DWTF would result in a three-fold reduction in annual off-site truck trips for waste disposal compared to the existing HWM facilities.

Due to the extensive mitigation measures that would allow the proposed DWTF to operate at low risk, the health risk associated with the proposed DWTF operations would be less than the health risk from the existing HWM facility. The risk of facility damage due to seismic events would be reduced by locating the DWTF at Site D, which meets seismic location standards.

4.5.2 Adverse Impacts and Mitigation Measures Summary

The preferred alternative (Level II design at Site D) would potentially have adverse impacts as well as beneficial impacts. However, mitigation measures proposed as a part of the project would reduce these adverse impacts below levels that would be considered significant as defined in the Council of Environmental Quality Regulations, Section 1508.27 and the California Environmental Quality Act Guidelines, Section 15382. The proposed mitigation measures would assure compliance with all regulatory requirements and protection of environmental and public health. Potential adverse effects and mitigation measures are summarized below.

4.5.2.1 Seismicity

Impact

- Possible DWTF structural and equipment damage due to a seismic event.

Mitigation Measures

- Site facility at a location in compliance with RCRA and State of California seismic location standards for hazardous waste facilities.

- Use design standards and construction materials in accordance with LLNL criteria and the Uniform Building Code so that buildings would remain functional during and after a seismic event similar to a design basis earthquake.

- "Moderate hazard" facilities (the decontamination structure and the incinerator liquid waste feed tank structure) would have additional engineering safety features beyond those required by the Uniform Building Code to mitigate adverse impacts (see Table 2.8-2).

4.5.2.2 Soils and Hydrology

Impact

- Potential introduction of hazardous materials, radioactive materials, or both, into soils, surface water, and/or ground water.

Mitigation Measures

- All waste would be stored and treated in enclosed buildings with appropriate spill containment structures.

- The entire outdoor area would be paved on site; a leakproof storm drainage system would be provided with a valved shut-off device to retain accidental spills.

- The outdoor truck parking area would be provided with spill containment, control, and counter measures, including rain-water retention.

- Wet sumps would be provided with double containment and monitoring; no underground tanks would be installed.

- The entire area would be graded to prevent off-site rainwater runoff from entering the DWTF site.

- All process tanks would be elevated above the floor.

- A ground-water monitoring program would be implemented.

4.5.2.3 Air Quality

Impact

- Emission of nonradioactive and radioactive air contaminants from the facility.

Mitigation Measures

- An incinerator off-gas treatment system, including a quench column, venturi scrubber, packed tower, condenser, mist eliminator, and HEPA filtration would be installed.

- The incinerator off-gas treatment system would limit particulate stack emissions of off-gas to less than 180 milligrams/dry standard cubic meter; limit hydrochloric acid stack emissions to less than 1.8 kilogram per hour (99 percent control); restrict visible stack emissions; and continuously monitor facility emissions.

- Prefilters and HEPA filters would be installed on all radioactive exhaust systems in the DWTF; the Decontamination Building would be provided with double HEPA filtration.

- Charcoal filters would be installed on all exhaust systems or vents emitting volatile organic compounds.

- A scrubber system with HEPA filtration would be installed on the exhaust system of the reactive material processing cells.

- Sealless pumps would be used for transferring organics.

- Redundant induced-draft fans supplied with stand-by power would be provided.

- Standby electrical power would be provided to critical components of the incinerator to assure a safe shutdown in case of power failure or other transient events.

- A monthly fugitive organic compounds inspection and maintenance program would be implemented.

4.5.2.4 Occupational and Public Health

Impact

- Potential health and safety impacts on proposed DWTF workers, other LLNL employees, and the public from accidental releases or routine operations of the proposed DWTF.

Mitigation Measures

- Facility design would be based on results of a safety analysis and would incorporate safety controls and engineered safety features to maintain the proposed DWTF as a low risk operation.

- A fire protection system would be provided in all proposed DWTF buildings to assure the expedient suppression of fires and minimize the potential for release of toxic fumes.

- A nitrogen gas system would be provided in the incinerator shredder, waste hopper, and organic liquid feed tanks to create an oxygen deficient atmosphere and minimize fire potential.

- Spill containment structures would be provided to prevent the release of leaks or spills to the environment.

- Incompatible wastes would be stored in separate cells or containment structures to assure proper segregation.

- A tank and container-rinsing facility would be provided to assure that incompatible wastes would not be mixed.

- Process tanks would be provided with a water purge system to assure that incompatible wastes would not be mixed.

- Standby electrical power would be provided to all critical components to assure continued operation and/or safe shutdown in the event of power failure.

- Facility and equipment would be designed to limit noise levels to 85 dBA.

- Security fencing and administrative access controls, such as change rooms, access control points barriers, and hand-and-foot radioactive contamination counters, would be provided.

- Emergency showers and eye washes, protective clothing, continuous radioactive contamination air monitors, and other personnel safety equipment would be provided.

- Engineered process ventilation systems would be provided.

- Emissions and discharges from the proposed DWTF would be monitored.

- A comprehensive training program, a detailed inspection and maintenance strategy, and thorough operational safety procedures for the proposed DWTF would be developed and implemented.

- The Decontamination Building and the liquid feed tank area of the Incinerator Building, the two areas in the proposed DWTF classified as "moderate hazard", would be upgraded as detailed in Section 2.8.3 to assure that accidental spills or toxic fume generation would be confined within the structure and have a negligible impact on the public and the environment.

- The LLNL Emergency Preparedness Plan would be implemented in case of emergencies.

4.5.2.5 Transportation

Impact

- Potential for traffic accidents and spills or releases of wastes being transported.

Mitigation Measures

- Nonradioactive (hazardous and nonhazardous), mixed, and radioactive waste would be solidified to the maximum extent possible to provide safer transportation.

- All wastes would be packaged in DOT-approved containers and transported by registered hazardous waste haulers.

- Waste treatment would minimize the volume and toxicity of waste transported off site.

4.5.2.6 Construction Activities

Impact

- Potential for elevated dust concentrations and increased soil erosion from major construction activities.

Mitigation Measures

- Water would be applied twice each day to minimize dust during construction grading.

- Runoff control would be provided for outside construction activity during the rainy season.

4.5.3 Unavoidable Adverse Environmental Impacts

While every effort has been made to mitigate potential environmental impacts, certain adverse impacts would be unavoidable, regardless of the alternative chosen. The unavoidable impacts of constructing and operating the proposed DWTF are:

- Disturbance of the six-acre site with removal of the majority of the vegetation and paving over the native soil;

- Potential low-level exposure of DWTF workers to radiation and hazardous materials during routine operations;

- Public exposure to very low levels of radiation and hazardous materials from DWTF operations including incinerator emissions.

4.6 Growth-Inducing Impacts

The net change in work force required for operation of the proposed facility (an additional 12 employees) would not result in significant impacts to housing or public services. The wastes to be processed in the proposed DWTF would be limited to LLNL-generated wastes only. Wastes from other facilities in the region would not be accepted by LLNL for treatment in the proposed DWTF.

Future waste generation from LLNL programs is not dependent on the proposed DWTF construction. Wastes will be generated regardless of whether or not the proposed DWTF is constructed. However, the proposed DWTF would have the capacity and process flexibility to treat nonradioactive (hazardous and nonhazardous), mixed, and radioactive waste quantities that may be generated by new LLNL program operations in the future. This would allow wastes from future LLNL programs to be treated in a safe, environmentally acceptable manner on site prior to shipment for off-site disposal. If the DWTF is not constructed, wastes from new LLNL programs would not have the benefit of on-site treatment and unprocessed toxic liquid or solid wastes would have to be shipped off site for treatment and disposal using public roads.

4.7 Cumulative Impacts

The cumulative impacts that would result from the construction and operation of the DWTF adjacent to the existing Chemical Waste Storage Building and the newly constructed Northeast utilities would be insignificant. Air emissions (Table 4.7-1) and the volume of wastewater discharged to the sanitary sewer would increase slightly (maximum DWTF wastewater flow equivalent to four percent of the total LLNL peak wastewater flow). The potential for accidental discharges to sewer or ground water and transportation of waste on public roads would, however, be reduced.

TABLE 4.7-1. LLNL CUMULATIVE EMISSIONS OF CRITERIA POLLUTANTS AND RADIONUCLIDES

Source	Criteria Pollutants (ton/yr)					Radionuclides (curies/yr)
	Organics[a]	SO_2	NO_x	CO	PM	
Existing LLNL Operations[b]	25.44	0.01	19.25	2.53	0.56	1,363.2[c]
No-Action Alternative	1.33	0.50	0.28	0.03	0.08	3.90
Level I Design[d]	2.51	0.26	8.29	1.55	0.46	0.78
Level II Design[d] (preferred alternative)	2.51	0.30	13.54	1.99	0.75	1.05
Cumulative Total (existing + preferred alternative)	27.95	0.31	32.79	4.52	1.31	1,364.25

[a] Includes precursor and nonprecursor organics as defined by the Bay Area Air Quality Management District (BAAQMD).

[b] Includes permitted sources based on BAAQMD Facility Emission Inventory for LLNL dated July 30, 1987, plus a printing press, 25 solvent cleaners, and 12 small boilers that are not yet permitted (BAAQMD, 1987; Pfeifer, 1987). Emissions from existing HWM facilities were subtracted out of this and are indicated as the no-action alternative.

[c] Estimated total LLNL radionuclide airborne emissions in 1986 from all LLNL facilities (Holland et al., 1987).

[d] Values are based on maximum operating rates and capacities.

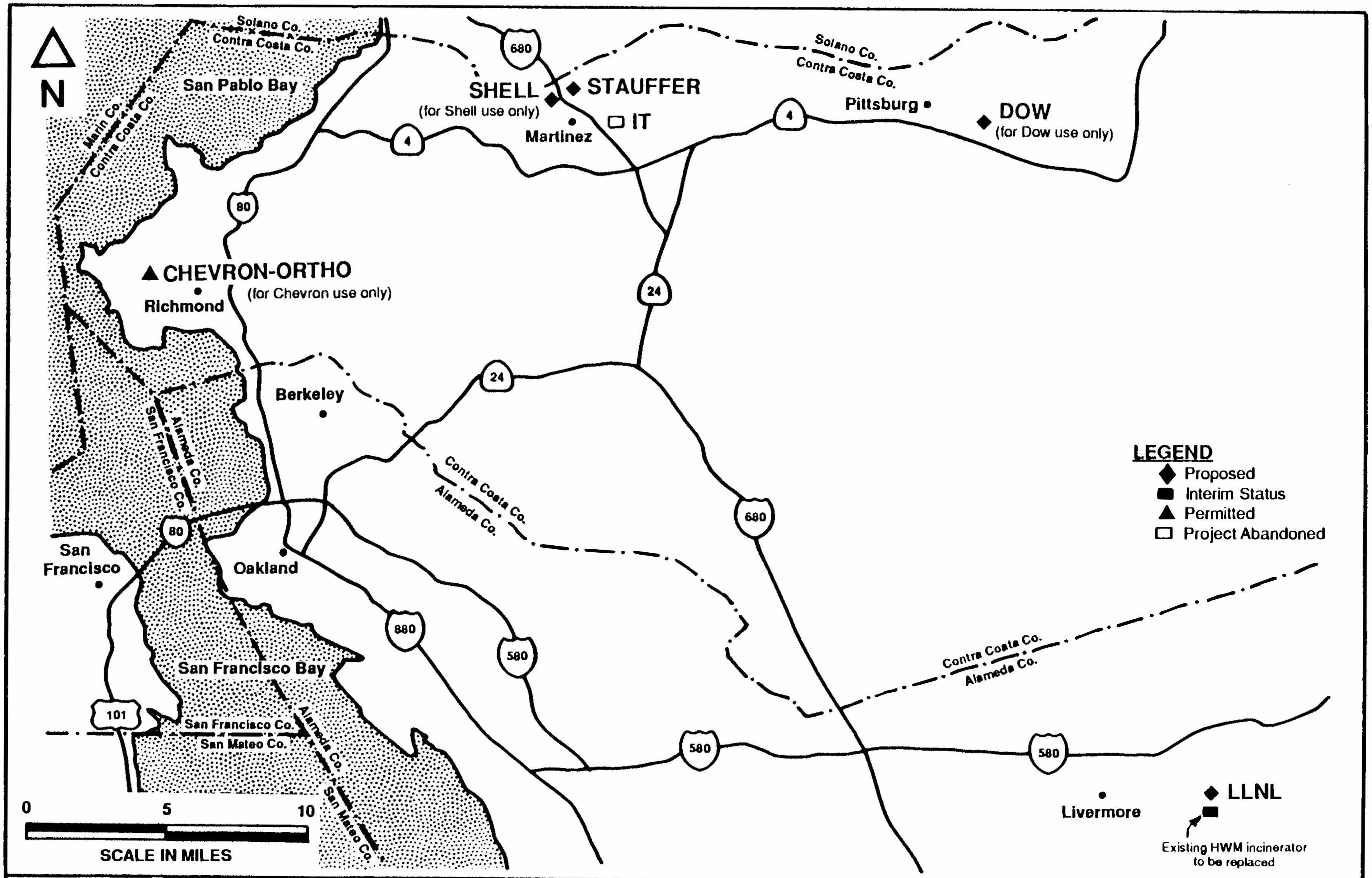
4.7.1 Soils and Ground Water

Accidental releases of hazardous materials to soils and ground water at LLNL, which have been contaminated in the past, would increase the cumulative environmental impacts at these sites. Past accidential releases of hazardous materials to soils and ground water are currently being corrected through a ground-water correction action program. The CERCLA Superfund interagency agreement and the scope of the soil and ground-water cleanup are currently being decided. Existing HWM facilities, with the exception of the PCB Storage Building 625, would be closed after the proposed DWTF is constructed and operating. Design mitigation features incorporated as part of the proposed DWTF (curbing, pavement, spill containment, etc.), including a periodic inspection and maintenance program for the proposed DWTF, would prevent hazardous materials from contaminating soils or ground water, or both.

4.7.2 Air Quality

Table 4.7-1 presents the cumulative total airborne criteria pollutant and radionuclide emissions from the existing LLNL operations and the estimated emissions from the proposed DWTF. The proposed DWTF would result in an insignificant increase in cumulative emissions. Decommissioning the existing HWM facility incinerator for hazardous waste operations when the proposed DWTF becomes operational would result in a small decrease in cumulative radionuclide emissions.

Figure 4.7-1 shows the location of proposed and existing hazardous waste incinerators in the San Francisco Bay region. Because none of these incinerators are located near the Livermore area, their emissions would disperse in the atmosphere, preventing accumulation. Therefore, no cumulative impacts of air emissions from Bay Area incinerators would occur. The quantity of emission for the existing (interim status) incinerator and the proposed incinerator are also not great enough to cause a cumulative impact to the Livermore area.



0288-023-6

Figure 4.7-1. Location of Existing and Proposed Hazardous Waste Incinerators in the East San Francisco Bay Region

4.8 Short-Term Use Versus Long-Term Productivity of the Environment

The construction and operation of the proposed facility would impact six acres of grassland. The site would not be available for any use other than waste management during the lifetime operation of the proposed DWTF. After final decommissioning and closure, grassland vegetation could become reestablished and the site made available for other uses by LLNL.

4.9 Irreversible or Irretrievable Commitment of Resources

The construction and operation of the proposed DWTF would result in the commitment of various natural and man-made resources. Some of the resource commitment would be irreversible or irretrievable. Resources that may be considered irreversibly or irretrievably committed in the construction and operation of the proposed DWTF are:

- Construction materials that cannot be recovered or recycled with current technology;
- Materials consumed or reduced to unrecoverable forms of waste;
- Energy consumed; and
- Materials that are rendered radioactive but cannot be decontaminated.

This commitment of resources would be offset by the following benefits resulting from the construction and operation of the proposed DWTF:

- A modern and centralized hazardous waste management facility that would be safer and more environmentally acceptable;
- Reduction in the toxicity and volumes of wastes to be transported on public roads;

- Expanded flexibility and capability for managing the diverse LLNL waste streams; and

- Decreased use of off-site treatment and disposal sites.

[THIS PAGE INTENTIONALLY LEFT BLANK]

CHAPTER 5.0

ENVIRONMENTAL PERMITS, REGULATIONS, AND APPROVALS

The proposed action would require a variety of permit approvals and reviews from federal, state, and local regulatory agencies prior to its construction and operation. Table 5.1-1 summarizes the agencies, permits and approvals, affected project elements, and regulatory authority associated with the proposed action.

This document meets the requirements of the National Environmental Policy Act (NEPA) for the proposed action. The U.S. Department of Energy is the designated lead agency under NEPA for this project and, as such, is responsible to ensure the preparation and review of appropriate environmental documentation. The California Department of Health Services (DHS) was extended the opportunity to actively participate in the preparation of this draft environmental impact statement (DEIS); however, DHS chose to be a reviewer rather than a cooperating agency under NEPA. This DEIS will be reviewed by interested federal, state, and local agencies and by the public. Following the public comment period on this DEIS and preparation of a final EIS (FEIS), in which responses to all comments on the DEIS will be incorporated, the FEIS will be published and DOE will submit its findings in a Record of Decision. DOE will then certify and use the FEIS in its decision-making process on the proposed action.

The California Environmental Quality Act (CEQA) entails a process similar to NEPA, including environmental assessment and documentation, public review, and response to comments. This DEIS and the FEIS to be prepared under NEPA are also intended to meet the needs of the CEQA process for permitting the proposed DWTF.

In addition to the comprehensive environmental documentation required by NEPA and CEQA, the proposed action must obtain permit approvals from federal, state, and local agencies. These permit acquisition processes involve the preparation, agency review, and agency approval of extensive

TABLE 5.1-1. PERMITS AND APPROVALS REQUIRED FOR THE PROPOSED ACTION

Permit/Approval	Affected Project Elements	Authority	Agency
<u>Federal</u>			
Hazardous and Mixed Waste Incinerator	Rotary kiln incinerator, solids shredder, liquid storage tanks, ash pit, afterburner, offgas treatment system.	Resource Conservation and Recovery Act of 1976 (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA) (42 USC §6901, et seq.); 40 CFR Parts 124, 260, 261, 262, 264, 270.	U.S. Environmental Protection Agency, Region IX. (permit review and issuance)
Hazardous and Mixed Waste Containers, Tanks, and Treatment Facility	Waste receiving and classification area, solid waste processing area, liquid waste processing area, decontamination building, reactive materials building, radioactive/mixed waste storage area, clean storage area, tanker/trailer parking area, tank and container washing and rinsing area.	RCRA, as amended by HSWA (42 USC §6901, et seq.); 40 CFR Parts 124 260, 261, 262, 264, and 270.	U.S. Environemntal Protection Agency, Region IX. (permit review and issuance)
National Environmental Policy Act (NEPA)	All project components.	National Environmental Policy Act (NEPA) of 1969 (42 USC §4371, seq.); 40 CFR, Parts 1500-1508, NEPA Guidelines; Final DOE Guidelines for Compliance with NEPA (45 FR 20694).	U.S. Department of Energy. U.S. Environmental Protection Agency. (approval)

(Continued)

TABLE 5.1-1. (Continued)

Permit/Approval	Affected Project Elements	Authority	Agency
State			
Hazardous and Mixed Waste Incinerator	Rotary kiln incinerator, solids shredder, liquid storage tanks, ash pit, afterburner, offgas treatment system.	California Hazardous Waste Control Act as amended (Health and Safety Code, Section 25100 e.s.); California Hazardous Waste Management Regulations (CCR Tit. 22, Section 66001 e.s.).	California Department of Health Services, Toxic Substances Control Division, North Coast California Section. (technical review, draft permit, permit issuance)
Hazardous and Mixed Waste Containers, Tanks, and Treatment Facility	Waste receiving and classification area, solid waste processing area, liquid waste processing area, decontamination building, reactive materials building, radioactive/mixed waste storage area, clean storage area, tanker/trailer parking area, tank and container washing and rinsing area.	California Hazardous Waste Control Act, as amended (Health and Safety Code, Section 25100 e.s.); California Hazardous Waste Management Regulations (CCR Tit. 22, Section 66001 e.s.).	California Department of Health Services, Toxic Substances Control Division. North Coast California Section. (technical review, draft permit, permit issuance)
California Environmental Quality Act (CEQA) Review (EIS will be provided to state and local agencies for use as a CEQA document)	All project components.	CEQA of 1970, as amended. PRC Div. 13, Sections 21083.5 and 21083.7 and Article 14 of the CEQA guidelines.	California Department of Health Services; Bay Area Air Quality Management District. (review information and use in state permitting process)

(Continued)

TABLE 5.1-1. (Continued)

Permit/Approval	Affected Project Elements	Authority	Agency
<u>Local</u>			
Permit to Construct (air emission source)	Incinerator, boiler/chiller plant, storage/treatment tanks, decontamination operations, emergency generator, uranium burn pan, liquid waste processing area.	California Health and Safety Code, div. 26 and 27; California Air Pollution Control Regulations (CCR Tit. 17, Public Health, Part III, Air Resources, Ch.1--Air Resources Board, Subch. 1-8); Bay Area Air Quality Management District (BAAQMD) Regulation 2, Rule 1: Section 2-1-301; National Emission Standards for Hazardous Air Pollutants (NESHAP); National Emission Standard for Radionuclide Emissions from U.S. Department of Energy (DOE) facilities, 40 CFR 61, Subpart H.	Bay Area Air Quality Management District (Permit); U.S. Environmental Protection Agency, Region IX (NESHAP review for radionuclides)
Permit to Operate (air emission source)	Incinerator, boiler/chiller plant, storage/treatment tanks, decontamination operations, emergency generator.	California Health and Safety Code, div. 26 and 27; California Air Pollution Control Regulations (CCR Tit. 17, Public Health, Part III, Air Resources, Ch. 1--Air Resources Board, Subch. 1-8); BAAQMD Regulation 2, Rule 1: Section 2-1-302.	Bay Area Air Quality Management District. (permit)
Sewer Use Ordinance Review	Wastewater discharges from liquid waste processing and other DWTF components to the Livermore sewer system.	City of Livermore Sewer Use Ordinance; Federal Water Pollution Control Act of 1972, as amended by the Clean Water Act of 1977. (33 USC §1251, et seq.).	City of Livermore. (review)

information documents and technical analyses. The technical information analyses must show that the proposed action would comply with all applicable rules and regulations of that permitting agency.

Other permits and approvals indicated in Table 5-1 include the NESHAPs for radionuclides and the sewer use ordinance. These requirements would involve review and approval by the EPA and the City of Livermore, respectively.

[THIS PAGE INTENTIONALLY LEFT BLANK]

CHAPTER 6.0

REFERENCES AND STANDARDS

6.1 References (Cited in the EIS)

Alameda County Planning Department (1986a), "Alameda County General Plan Review for the Livermore-Amador Valley Planning Unit: Draft Population Background Report," Policy Planning and Research Division, Hayward, CA, February 7, 1986.

Alameda County Planning Department (1986b), "Alameda County General Plan Review for the Livermore-Amador Valley Planning Unit: Draft Land Use Background Report," Policy Planning and Research Division, Hayward, CA, February 7, 1986.

Arthur D. Little, Inc. (1984), Waste Management Study-Process Development at Lawrence Livermore National Laboratory, Arthur D. Little, Inc., Cambridge, MA, December 1984, UCRL-21051.

Association of Bay Area Governments (1985), Projections '85: Forecasts for the San Francisco Bay Area to the Year 2005, Oakland, CA, July 1985, pp. 57-74.

Bahm, W. (1988), personal communication with Walter Bahm, California Department of Health Services, Alternative Technology Section, North Coastal California Section, regarding identifying commercial incinerators, February 8, 1988.

Balentine, H.W. and M.W. Eltgroth (1985), "Validation of a Hazardous Spill Model Using N204 and LNG Spill Data," presented at the 78th Annual Meeting of the Air Pollution Control Association, Detroit, MI, June 16-21, 1985, Paper 85-25B.1.

Basso, M. (1987), personal communication with Mike Basso, Bay Area Air Quality Management District (BAAQMD), (notes of meeting with BAAQMD) regarding LLNL mixing height data, August 6, 1987.

Baxter, S. (1988), personal communication with Steve Baxter, California Department of Health Services, Alternative Technology Section, Southern Califoria Section, regarding identifying commercial incinerators, February 8, 1988.

Bay Area Air Quality Management District (1987), Source Emissions for Lawrence Livermore National Laboratory, July 30, 1987.

Bechtel National, Inc. (1986), Geotechnical Investigation for a Decontamination and Waste Treatment Facility, Lawrence Livermore National Laboratory, Livermore, CA, prepared for Lawrence Livermore National Laboratory, Livermore, CA, by Bechtel National Inc., San Francisco, CA, July 1986, UCRL-21046.

Bechtel National, Inc. (1987), "Design Specifications for the Lawrence Livermore National Laboratory Decontamination and Waste Treatment Facility," prepared for Lawrence Livermore National Laboratory, Livermore, CA, by Bechtel National, Inc., San Francisco, CA, Volume I: pp. 1117-1 through 1117-67.

Beckwith, R. (1988), personal communication with Russ Beckwith, U.S. Environmental Protection Agency, Region IX, Toxic Waste Management Division, regarding identifying commercial incinerators, February 12 and 15, 1988.

Begovich, C.L., K.F. Eckerman, E.C. Schlatter, S.Y. Ohr, and R.O. Chester (1981), DARTAB: A Program to Combine Airborne Radionuclide Environmental Exposure Data with Dosimetric and Health Effects Data to Generate Tabulations of Predicted Health Impacts, prepared by Oak Ridge National Laboratory, Oak Ridge, TN, August 1981, ORNL-5692.

California Air Resources Board (1982 through 1985), California Air Quality Data, Annual Summary, Volumes XIV through XVII, data for Livermore and Pittsburg monitoring stations, prepared by the California Air Resources Board, Sacramento, CA.

California Department of Fish and Game (1987), Natural Diversity Data Base Nongame-Heritage Program, search performed for Radian Corporation regarding threatened and endangered species in the Livermore area, March 16, 1987.

California Division of Mines and Geology (1982), State of California Special Studies Zones, Map of Altamont quadrangle, State of California, the Resources Agency, Department of Conservation, Sacramento, CA, January 1982.

California Highway Patrol (1986), "Commercial Vehicle Activities," Department of California Highway Patrol, Sacramento, CA, June 1986.

Carpenter, D.W., J.J. Sweeney, P.W. Kasameyer, N.R. Burkhard, K.G. Knauss, and R.J. Schlemon (1984), Geology of the Lawrence Livermore National Laboratory Site and Adjacent Areas, Lawrence Livermore National Laboratory, Livermore, CA, August 1984, UCRL-53316.

City of Livermore (1981), Public Facilities and Services Element of the City of Livermore General Plan re Park and Recreation Facilities, City of Livermore, Livermore, CA, October 13, 1981.

Cockerham, R.S., F.W. Lester, and W.L. Ellsworth (1980), A Preliminary Report on the Livermore Valley Earthquake Sequence, January 24 - February 26, 1980, U.S. Geological Survey, Menlo Park, CA, Open File Report 80-714.

Crouch, E. and R. Wilson (1980), "Estimates of Risks," Journal of Business Administration, 11(1-2):299-317.

Davis, J.T. (1986), letter from James T. Davis, Director; Environment, Safety, and Quality Assurance Division; U.S. Department of Energy, to Robert O. Godwin, Associate Director, Plant and Technical Services, Lawrence Livermore National Laboratory, regarding policy on off-site treatment, storage, and disposal of nonradioactive hazardous wastes; November 13, 1986.

Davis, J.T. (1987), letter from James T. Davis, Director; Environment, Safety and Quality Assurance Division; U.S. Department of Energy, to Dr. Richard H. Kropschot, Associate Director, Engineering Division, Lawrence Berkeley Laboratory, University of California, Berkeley, CA, regarding disposal of nonradioactive hazardous wastes, July 8, 1987.

DeGrange C.E., M. Sledge, and J.M. Hirabayashi (1987), Guidelines for Waste Accumulation Areas, Lawrence Livermore National Laboratory, Livermore, CA, March 1987, UCAR-10192.

Dibblee, T.W., Jr. (1980), Preliminary Geologic Map of the Midway Quadrangle, Alameda and San Joaquin Counties, California, Scale: 1:24,000, U.S. Geological Survey, Menlo Park, CA, Open File Report 80-535.

Dibblee, T.W., Jr. and R.L. Darrow (1981), "Geology of the Northern Diablo Range and Livermore Valley Area," in V. Frizzell, ed., Geology of Central and Northern Diablo Range, California, Pacific Section of SEPM, Los Angeles, CA pp. 77-112.

Edison Electric Institute (1978), Electric Power Plant Environmental Noise Guide, prepared by Bolt, Baranek, and Newman, Inc., Cambridge, MA, for Edision Electric Institute, No. 3637, Volume I, pp. 4-53 through 4-64.

Elder, J.C., J.M. Graf, J.M. Dewart, T.E. Buhl, W.J. Wenzel, L.J. Walker, and A.K. Stoker (1986), A Guide to Radiological Accident Considerations for Siting and Design of DOE Nonreactor Nuclear Facilities, Los Alamos National Laboratory, Los Alamos, NM, January 1986, LA-10234-MS, UC-41.

Environment Reporter (1983), "Truck Transport of Wastes as Risky as Treatment, Disposal, Consultant Says," September 2, 1983, Volume 14, p. 733.

Envirosphere Company (1985), Biomass Ash Study (draft), prepared for the California Energy Commission, by Envirosphere Company, Contract No. 500-81-037, April 1985.

Erickson, D. (1988), personal communication with Dick Erickson, California Department of Health Services, Alternative Technology Section, Main Office, Sacramento, CA, regarding identifying commercial incinerators, February 8, 1988.

Federal Emergency Management Agency (1981), "Flood Insurance Rate Map, Alameda County, California," April 15, 1981, Community Panel Number 06 0001 0230A.

Federal Emergency Management Agency (1986), "Flood Insurance Rate Map, Alameda County, California," February 19, 1986, Community Panel Number 060001 0210B.

Fontus, F. (1988), personal communication with Fred Fontus, California Department of Health Services, Alternative Technology Section, Northern California Section, regarding identifying commercial incinerators, February 8, 1988.

Freeland, G.E. (1984), Lawrence Livermore National Laboratory Earthquake Safety Program, Lawrence Livermore National Laboratory, Livermore, CA, August 21, 1984, UCAR-10129.

Geomatrix Consultants, Inc. (1985a), "Seismic Exposure Comparison Report and Spectra Report," prepared by Geomatrix Consultants, Inc., San Francisco, CA, for Lawrence Livermore National Laboratory, Livermore, CA, July 8, 1985, UCRL-15858.

Geomatrix Consultants, Inc. (1985b), "Summary of Exploratory Trench Review, Proposed Hazardous Waste Facility Site, Lawrence Livermore National Laboratory," letter report, March 25, 1985, UCRL-21049.

Godwin, R.O. (1987), letter from Robert O. Godwin, Associate Director for Plant and Technical Services, Lawrence Livermore National Laboratory, to Dwight Hoenig, California Department of Health Services, regarding HWM facility operation plan, July 1, 1987.

Graham, J.B. (1972), "How to Estimate Fan Noise," Sound and Vibration, May 1972, pp. 231-234.

Greenhalgh, W.J. and Brown, G.S. (1982), "Effect of Airborne Fluorides on Grapevines," in F. Murray, editor, Fluoride Emissions: Their Monitoring and Effects on Vegetation and Ecosystems, Academic Press, NY, pp. 125-138.

Griggs, K.S. and R.W. Buddemeier (1986), Environmental Monitoring at the Lawrence Livermore National Laboratory: 1985 Annual Report, Lawrence Livermore National Laboratory, Livermore, CA, February 1986, UCRL-50027-85.

Hannahs, Seargent S. (1987), personal communication with Seargent Stan Hannahs, California Highway Patrol, Sacramento, CA, regarding annual California traffic-related hazardous waste incidents, April 22, 1987.

Hayes, T.P., J.J.R. Kinney, and N.J.M. Wheeler (1984), California Surface Wind Climatology, California Air Resources Board, Aerometric Data Division, Sacramento, CA, June 1984, p. D-48.

Hoffman, F., M.D. Dresen, W.A. McConachie, D.S. Thompson, and D.N. Homan (1986), LLNL Ground Water Project: Monthly Progress Report, October 15 - November 15, 1986, Lawrence Livermore National Laboratory, Livermore, CA, UCAR-10160-86-12.

Hoffman, F., M.D. Dresen, W.A. McConachie, E.M. Nichols, R.O. Devany, W.F. Isherwood, M.W. Small, D.N. Homan, and D.S. Thompson (1987), LLNL Ground Water Project, Monthly Progress Report, June 15 - July 15, 1987, Lawrence Livermore National Laboratory, Livermore, CA, UCAR-10160-87-8.

Holland, R.C., R.W. Buddemeier, and D.D. Brekke (1987), Environmental Monitoring at the Lawrence Livermore National Laboratory: 1986 Annual Report, Lawrence Livermore National Laboratory, Livermore, CA, April 1987, UCRL-500027-86.

Holzworth, G.C. (1972), Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1972, AP-101, p. 111.

Horen, J. (1987), personal communication with Jim Horen, Alameda County Flood Control and Water Conservation District, regarding disposal of treatment residuals, November 16, 1987.

Horst, L. (1987), personal communication with Leon Horst, Associate Planner, City of Livermore, regarding land use changes west of Lawrence Livermore National Laboratory, October 20, 1987.

Hoyt, D. (1988), personal communication with Dan Hoyt, Hazardous Waste Management Division, Lawrence Livermore National Laboratory, regarding 1986 mixed solid wastes, February 4, 1988.

International Commission on Radiological Protection (1977), Annals of the ICRP: Recommendations of the Internal Commission on Radiological Protection, ICRP Publication No. 26, Pergamon Press, Oxford, U.K., Volume 1, No. 3.

International Commission on Radiological Protection (1979), Annals of the ICRP: Limits for Intakes of Radionuclides by Workers, ICRP Publication 30, Pergamon Press, Oxford, U.K., Volume 2, No. 3/4.

Kobetich, G.C. (1987), letter from G.C. Kobetich, Field Supervisor, U.S. Department of the Interior, Fish and Wildlife Service, Sacramento Endangered Species Office, Sacramento, CA, to W.W. Warner, Chief, Nuclear Safety Branch, San Francisco Operations Office, U.S. Department of Energy, Oakland, CA, regarding intent to prepare EIS on decontamination and waste treatment facility at the Lawrence Livermore National Laboratory, May 5, 1987.

Kocher, D.C. (1981), "Dose-Rate Conversion Factors for External Exposure to Photons and Electrons," prepared for the U.S. Nuclear Regulatory Commission, by Oak Ridge National Laboratory, Oak Ridge, TN, August 1981, NUREG/CR-1918.

Lange, R. (1978), "ADPIC - A Three-Dimensional Particle-in-Cell Model for the Dispersal of Atmospheric Pollutants and Its Comparison to Regional Tracer Studies," Journal of Applied Meteorology, 17:320-329.

Lawrence Livermore National Laboratory (1984), Site Development and Facilities Utilization Plan, Livermore, CA, November 1984, UCAR-10276.

Lawrence Livermore National Laboratory (1985), "DWTF Siting Presentation" (unpublished data), June 1985.

Lawrence Livermore National Laboratory (1987), LLNL TRU Waste Certification Program: TRU Waste Certification Plan, Quality Assurance Manual, M-078, Revision 1, Supplement 2, Lawrence Livermore National Laboratory, Livermore, CA, February 1987.

Lawrence Livermore National Laboratory (1988a), LLNL Waste Minimization Projections (unpublished data), Livermore, CA, February 1988.

Lawrence Livermore National Laboratory (1988b), "Lawrence Livermore National Laboratory's Emergency Preparedness Plan," M-014, Lawrence Livermore National Laboratory, Livermore, CA, May 1988.

Lawrence Livermore National Laboratory and Radian Corporation (1988), "Analysis of Postulated Accidents at the Proposed Decontamination and Waste Treatment Facility at the Lawrence Livermore National Laboratory," Lawrence Livermore Laboratory, Livermore, CA, Radian Corporation, Sacramento, CA, April 1988, UCID-21397.

Mishima, J. and L.C. Schwendiman (1973), "Fractional Airborne Release of Uranium (Representing Plutonium) During the Burning of Contaminated Waste," prepared by Pacific Northwest Laboratories, Richland, VA, April 1973, BNWL-1730.

National Academy of Sciences (1971), Fluorides, National Academy of Sciences, Committee on the Biological Effects of Atmospheric Pollutants, Washington, DC, pp. 77-132.

National Institute of Occupational Safety and Health (1985), NIOSH Pocket Guide to Chemical Hazards, U.S. Government Printing Office, Washington, DC, NIOSH Publication, September 1985, No. 85-114, pp. 14, 42, 44, 56, 122, 128, 144, 156, 160, 162, 186, 218, 228, 230, and 236.

National Research Council of Canada (1977), Environmental Fluoride, 1977, National Research Council of Canada, Associate Committee on Scientific Criteria for Environmental Quality, Ottawa, Ontario, Canada, pp. 29-38.

Page, B.M. (1982), "The Calaveras Fault Zone of California - An Active Plate Boundary Element," in E.W. Hart, S.E. Hirschfeld, and S.S. Schultz, eds., Proceedings, Conference on Earthquake Hazards in the Eastern San Francisco Bay Area, California Division of Mines and Geology, Sacramento, CA, Special Publication 62, pp. 175-184.

Page, W.D., I. Wong, A. Ridley, M. Hemphill-Haley, and K. Fraese (1986), "Seismological and Geological Assessment of the 31 March 1986 Mt. Lewis Earthquake, Santa Clara, California," Woodward-Clyde Consultants, Walnut Creek, CA.

Pfeifer, H. (1987), personal communication with Harold Pfeifer, Environmental Analyst, Environmental Protection Department, Lawrence Livermore National Laboratory, Livermore, CA, regarding HC emissions (cumulative) from LLNL, December 17, 1987.

Prescott, W.H., M. Lisowski, and J.C. Savage (1981), "Geodetic Measurement of Crustal Deformation on the San Andreas, Hayward, and Calaveras Faults Near San Francisco, California," Journal of Geophysical Research, November 10, 1981, (86): 10853-10869.

Radian Corporation (1983), "Hazardous Waste Incinerator and Storage Facility Part B Permit Application," prepared for Lawrence Livermore National Laboratory, Livermore, CA, by Radian Corporation, Sacramento, CA, Volume II, pp. 12-1 to 12-9.

Radian Corporation (1987a), "Lawrence Livermore National Laboratory Decontamination and Waste Treatment Facility Operation Plan," prepared for Lawrence Livermore National Laboratory, Livermore, CA, by Radian Corporation, Austin, TX, November 1987, Volumes I through V.

Radian Corporation (1987b), "Description of the Radian Complex Hazardous Air Release Model (CHARM™), Version 4.0, Austin, TX, June 1987.

Radian Corporation (1988a), "Lawrence Livermore National Laboratory Decontamination and Waste Treatment Facility Design Waste Characterization," prepared for Lawrence Livermore National Laboratory, Livermore, CA, by Radian Corporation, Sacramento, CA, February 9, 1988, UCRL-21047.

Radian Corporation (1988b), "Lawrence Livermore National Laboratory, Decontamination and Waste Treatment Facility, Documentation of Impact Analysis for Design Alternatives Presented in the Draft Environmental Impact Statement," prepared for Lawrence Livermore National Laboratory, Livermore, CA, by Radian Corporation, Sacramento, CA, May 1988, UCRL-21048.

Radian Corporation (1988c), "Lawrence Livermore National Laboratory Decontamination and Waste Treatment Facility, Authority to Construct Air Permit, Responses to BAAQMD Comments, December 11, 1987," prepared for Lawrence Livermore National Laboratory, Livermore, CA, by Radian Corporation, Sacramento, CA, March 1988.

Rege, A. (1988), personal communication with Anand Rege, California Department of Health Services, Alternative Technology Section, North Coastal California Section, regarding identifying commercial incinerators, February 5, 1988.

Roberts, R. (1988), memorandum from Russ Roberts, U.S. Department of Energy, regarding DWTF status for mixed waste disposal at NTS, February 12, 1988.

Scheimer, J.F. (1985), Lawrence Livermore National Laboratory Site Seismic Safety Program - Summary of Findings, Lawrence Livermore National Laboratory, Livermore, CA, July 1985, UCRL-53674.

Sherman, C.A. (1978), "A Mass-Consistent Model for Wind Fields Over Complex Terrain," Journal of Applied Meteorology, (17): 312-319.

Speth, D. (1988), personal communication with Dr. David Speth, California Department of Health Services, Environmental Health Division, Sanitary Engineering Branch, regarding drinking water action levels, February 25, 1988.

Springer, J.E. (1984), Structural Development of the Livermore Basin, California, Lawrence Livermore National Laboratory, Livermore, CA, August 28, 1984, UCRL-91431.

State of California (1974), Evaluation of Ground-Water Resources: Livermore and Sunol Valleys, Department of Water Resources (in cooperation with Alameda County Flood Control and Water Conservation District, Zone 7), Sacramento, CA, June 1974, Bulletin 118-2.

Steenhoven, J. (1985), Hazardous Waste Operation Plan: Livermore Site, March 1985, Lawrence Livermore National Laboratory, Livermore, CA, CA2890012584, Volume II, Part VIII, pp. 37-43 and Appendices A through C.

Stone, R., M.R. Ruggieri, L.L. Rogers, D.O. Emerson, and R.W. Buddemeier (1982), Potential for Saturated Ground-Water System Contamination at the Lawrence Livermore National Laboratory, Lawrence Livermore National Laboratory, Livermore, CA, December 14, 1982, UCRL-53426.

Stone, R. and M.R. Ruggieri (1983), Ground-Water Quality and Movement at Lawrence Livermore National Laboratory, Livermore, CA, UCRL-53474.

Tonnessen, K. and H.A. Tewes (1982), Environmental Assessment Report: Nuclear Test Technology Complex, Lawrence Livermore National Laboratory, Livermore, CA, August 1982, UCID-19439.

Towse, D.F. and D.W. Carpenter (1986), Geology of the LLNL Decontamination and Waste Treatment Facility Site, Lawrence Livermore National Laboratory, Livermore, CA, August 1986, UCID-20811.

U.S. Department of Energy (1982), Final Environmental Impact Statement, Incineration Facility for Radioactively Contaminated Polychlorinated Biphenyls and Other Wastes, Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, U.S. Department of Energy, Washington, DC, June 1982, pp. 4-49 through 4-51.

U.S. Department of Energy (1984), Environmental Assessment of a Proposal to Acquire Land for a Buffer Zone Around Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore, U.S. Department of Energy, Washington, DC, June 1984, DOE/EA-0236, pp. iii, 1, 33, 35, and 36.

U.S. Environmental Protection Agency (1978), Diagnosing Vegetation Injury Caused by Air Pollution, prepared by Applied Science Associates, Inc., Valencia, PA, for U.S. Environmental Protection Agency, Research Triangle Park, NC, EPA-68-02-1344, pp. 5-1 to 6-32.

U.S. Environmental Protection Agency (1979), AIRDOS-EPA: A Computerized Methodology for Estimating Environmental Concentrations and Doses to Man from Airborne Releases of Radionuclides, EPA 520/1-79-009.

U.S. Environmental Protection Energy (1980), Manual of Protective Guides and Protective Actions for Nuclear Incidents, Washington, DC, September 1975, revised June 1980, EPA-520/1-75-001.

U.S. Environmental Protection Agency (1985), Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, NC, AP-42, September 1985, pp. 11.2-1 and 11.2.4-1.

U.S. Geological Survey (1985), Water Quality Conditions and an Evaluation of Ground- and Surface-Water Sampling Programs in the Livermore-Amador Valley, California, U.S. Geological Survey, Washington, DC, prepared in cooperation with the Alameda County Flood Control and Water Conservation District, Zone 7, Water Resources Investigations Report 84-4352.

University of California (1986), Draft Environmental Impact Report for the University of California Contract with the U.S. Department of Energy for Operation and Management of Lawrence Livermore National Laboratory, University of California, Berkeley, CA, December 22, 1986, SCH-85112611.

University of California (1987), Final Environmenal Impact Report for the University of California Contract with the U.S. Department of Energy for Operation and Management of Lawrence Livermore National Laboratory, University of California, Berkeley, CA, July 28, 1987, SCH-85112611.

Vaughan, William A. (1985), letter from William A. Vaughan, Assistant Secretary, Environmental Safety and Health, U.S. Department of Energy (DOE), to all DOE offices, regarding off-site radiation protection standards for the public, August 5, 1985.

Wackter, D.J. and J.A. Foster (1986), Industrial Source Complex (ISC) Dispersion Model User's Guide - Second Edition, Volume 1, prepared by TRC Environmental Consultants, Inc., East Hartford, CT, for the Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC, June 1986, EPA-450/4/86/005a.

Wagner, K.K. (1984), User's Guide to the California Air Resources Board Air Quality Modeling Section Fumigation Models, California Air Resources Board, Sacramento, CA, December 1984.

Walker, E. (1978), A Summary of Parameters Affecting the Release and Transport of Radioactive Material from an Unplanned Incident, Bechtel National, Inc., San Francisco, CA, BNFO-81-2, September 1978, reissued August 1981.

Walker, M.L. (1986), memorandum from Mary L. Walker, Assistant Secretary; Environment, Safety, and Health; U.S. Department of Energy, to Secretarial Officers, Heads of Field Organizations, U.S. Department of Energy; regarding U. S. Department of Energy policy on off-site treatment, storage, and disposal of nonradioactive hazardous wastes; June 24, 1986.

Weiss Associates (1985), "Report of Exploratory Trenching for the Decontamination and Waste Treatment Facility," prepared for Lawrence Livermore National Laboratory, Livermore, CA, by Weiss Associates, Berkeley, CA, December 1985, UCRL-15839.

Woodward-Clyde Consultants (1985), Lawrence Livermore National Laboratory Seismic Exposure Analysis, prepared for Lawrence Livermore National Laboratory, Livermore, CA, by Woodward-Clyde Consultants, Walnut Creek, CA, UCRL-15853.

6.2 DWTF Design Standards

The design for the proposed DWTF would comply with all of the applicable requirements of the following codes, standards, handbooks, and guides.

6.2.1 DOE Manual

DOE/TIC-1106, BNL-51444, Nonreactor Nuclear Facilities: Standards and Criteria Guide.

6.2.2 DOE Orders

	Title	Issue Date	Latest Review Date
DOE 4330.2B	In House Energy Management	02/08/85	02/08/87
DOE 5440.1C	Implementation of NEPA	04/09/85	04/09/87
DOE 5480.xx (draft)	Radiation Protection of the Public and the Environment	03/31/87	
DOE 5480.4	Environmental Protection, Safety, and Health Protection Standards	05/15/84	05/15/86
DOE 5480.1A	Environmental Protection, Safety, and Health Protection Program for DOE Operations	08/13/81	11/02/83
DOE 5480.2	Hazardous & Radioactive Mixed Waste Management	12/13/82	12/12/84
DOE 5481.1B	Safety Analysis & Review System	05/19/87	
DOE 5483.1A	Occupational Safety and Health Program for Government-Owned, Contract-Operated Facilities	06/22/83	06/21/85
DOE 5484.1	Environmental Protection, Safety, and Health Protection Information Reporting Requirements	02/24/81	08/13/83
DOE 5700.6A	Quality Assurance	08/13/81	08/13/83
DOE 5820.2	Radioactive Waste Management	02/06/84	02/05/86
DOE 6430.1A	General Design Criteria	12/12/83	12/11/85

6.2.3 Codes

American National Standards Institute (ANSI) -- Code Requirements.

American Society of Mechanical Engineers (ASME) -- Boiler and Pressure Vessel Code Requirements.

National Fire Protection Associated (NFPA), National Fire Codes.

Uniform Building and Mechanical Codes, International Conference of Building Officials (ICBO).

Uniform Plumbing Code (LAMPO).

6.2.4 Standards

Associated Air Balance Council (AABC).

Air Movement and Control Association (AMCA).

American National Standards Institute (ANSI).

ASHRAE Standard 90A-1980, "Energy Conservation in New Building Design."

American Water Works Association (AWWA).

Caltrans Highway Design Manual.

Construction Specifications Institute (CSI).

Cooling Tower Institute (CTI).

National Electric Code (NEC).

National Electric Manufacturers' Association (NEMA).

National Fire Protection Association (NFPA), National Fire Standards.

Steel Boiler Institute (SBI), Division of IBR, Hydronics Institute.

Sheet Metal and Air-Conditioning Contractors National Assocation, Inc. (SMACNA).

Underwriters' Laboratories, Inc. (UL) and Factory Mutual (FM) Approved Equipment Guide.

Department of Labor (DOL) Occupational Safety and Health Standards (29 CFR Part 1910) promulgated under P.L. 91-596, "Occupational Safety and Health Act" (OSHA) of 1970, as amended.

6.2.5 Guides

American Conference of Government Industrial Hygienists "Industrial Ventilation Manual."

Oak Ridge National Laboratory (ORNL) Nuclear Air-Cleaning Handbook, "The Design, Construction, and Testing of High Efficiency Air-Cleaning Systems for Nuclear Application," ERDA 76-21 (ORNL-NSIC-65-1).

6.2.6 Environmental Statutes and Regulations

Clean Air Act:

- New Source Performance Standards (NSPS).
- National Emission Standards for Hazardous Air Pollutants (NESHAPS).
- Prevention of Significant Deterioration (PSD).
- New Source Review (NSR).
- Bay Area Air Quality Management District (BAAQMD) Rules and Regulations.
- State Air Resources Board Report - District Permit Guidelines for Hazardous Waste Incineration - latest edition.

Clean Water Act:

- Pretreatment Standards for Discharges to Publicly Owned Treatment Works (POTWs).
- National Pollutant Discharge Elimination System (NPDES).
- Spill Prevention Control and Countermeasure (SPCC) Plan.
- California Regional water Quality Control Board (CRWQCB) Water Quality Management Plan.
- City of Livermore Sewer Ordinance No. 1134.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (i.e., Superfund).

National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA), implementing regulations and guidelines.

Resource Conservation and Recovery Act (RCRA):

- Identification and Listing of Hazardous Waste.
- Standards for Generators.
- Standards Applicable to Transporters.
- Standards Applicable to Owners and Operations of Treatment, Storage, and Disposal (T/S/D) Facilities.
- Interim Status Document for LLNL No. CA2890012584 dated May 16, 1983. Regulations for federally administered Hazardous Waste Permit Program (40 CFR 270).

Safe Drinking Water Act (SDWA):

- Underground Injection Control.

California Hazardous Waste Control Act

- California Department of Health Services, Hazardous Waste Management Regulations, Title 22, Chapter 30.

[THIS PAGE INTENTIONALLY LEFT BLANK]

CHAPTER 7.0

GLOSSARY

AIRDOS

A computerized methodology developed by the Oak Ridge National Laboratory for estimating environmental concentrations and dose to humans from airborne releases of radionuclides.

animal biological waste

Animal waste and small dead animals (primarily mice).

as low as reasonable achievable (ALARA)

A U.S. Department of Energy standard referring to radiation exposures to individuals and population groups that are limited to the lowest levels reasonable achievable; may be achieved through considerations in the design or modification to a facility and equipment and by the initiation of appropriate procedures and training.

burn pan

A device that ignites depleted uranium for the purpose of reducing the reactivity of depleted uranium waste.

campaign

The period during which wastes are being incinerated. The proposed DWTF design is based on 12 campaigns per year, with each one lasting 10 days, 24 hours per day.

carboy

A container for liquids that is made of glass, plastic, or metal and is often cushioned and supported in a special container.

Committed Dose Equivalent

The predicted total dose equivalent to a tissue or organ over a 50-year period after an intake of a radionuclide into the body. It does not include the contributions from external dose. Committed dose equivalent is expressed in units of rem (or sievert).

Committed Effective Dose Equivalent

The sum of the committed dose equivalents to various tissues in the body, each multiplied by the appropriate weighting factor. Committed effective dose equivalent is expressed in units of rem (or sievert).

continuous emissions monitoring

Continuous automatic monitoring of emitted pollutants.

criteria pollutant

Pollutants regulated by the U.S. Environmental Protection Agency having National Ambient Air Quality Standards (PM_{10}, CO, NO_x, SO_2, Pb, and ozone).

DARTAB

A computer program developed by the Oak Ridge National Laboratory that combines airborne radionuclide environmental exposure data with dosimetric and health effects data to generate tabulations of predicted health impacts.

decommissioning

Removing facilities such as processing plants, waste tanks, and burial ground from service and reducing or stabilizing radioactive contamination; includes the following concepts:

- The decontamination, dismantling, and return of an area to its original condition without restrictions; and
- Partial decontamination, isolation of remaining residues, and continued surveillance and restrictions.

decontamination (radioactive)

The removal of radioactive contaminants from surfaces of equipment, by cleaning or washing with chemicals, by wet abrasive blasting using glass frit and water, or by chemical processing.

depleted uranium

Uranium containing less uranium-235 than a naturally occurring distribution of uranium isotopes.

Design Basis Accident

A postulated credible accident or natural forces that result in conditions for which confinement structures, systems, components, and equipment must meet their functional goals.

Design Basis Earthquake

The intensity of earthquake that a structure must be designed to withstand. (Also see Table 2.8-1 on page 65.)

destruction and removal efficiency (DRE)

An operation level stipulated by the Resource Conservation and Recovery Act for hazardous waste-burning devices designed to assure the protection of human health and the environment.

dose equivalent

A dose equivalent is the product of absorbed dose in the tissue or organ (in units of radiation absorbed dose) and a quality factor. The ality factor relates the efficiency with which energy from different radioactive particles is transferred to the tissue or organ. Dose equivalent is expressed in units of rem.

dosimeter

An instrument that measures the total dose of nuclear radiation received in a given period.

Envirostone

A trademark gypsum-based solidifying agent used as an alternative to concrete.

half-life (radiological)

The time in which half the atoms of a radioactive substance transform to another nuclear form; varies for specific radioisotopes from mil- lionths of a second to billions of years.

halogenated organic

An organic molecule that has halogen groups attached to it (chlorine, fluorine, and bromide).

Halon

A commercial dry chemical fire extinguishing compound.

Hazard Index

A method for evaluating toxic effects from exposure to mixtures of chemicals.

health risk assessment

An evaluation and interpretation of available scientific evidence on the toxicity of a substance, its presence in the environment at some level, and its accessibility for human exposure, providing a judgement and, if appropriate, and estimate of the probability that risk exists.

High Efficiency Particulate Air (HEPA) filter

A type of filter designed to remove 99.97 percent of the particulates as small as 0.3 microns in diameter from a flowing air stream.

incinerator campaign

The period of time when incineration is continuously in progress followed by periods of shutdowns.

incompatible wastes

Wastes that should not be mixed or come into contact with each other due to the undesirable reactions that would occur.

induced-draft fan

A mechanical fan that produces a draft at the point where air or gases leave the unit.

Interim Status Document

A document issued by the California Department of Health Services and the U.S. Environmental Protection Agency that grants interim status to a hazardous waste facility before final approval for a permit is granted.

ion-exchange resin

Polymeric spheres (usually polystyrene-divinylbenzene copolymers) containing bound groups that carry an ionic charge, either positive or negative, in conjunction with free ions of opposite charge that can be displaced.

lineament (photo) or lineations

A linear feature observed on an aerial photograph that is structurally controlled and may indicate faulting; a linear topographic feature.

low-level waste

Radioactive waste not classified as high-level waste, transuranic waste, spent nuclear fuel, or byproduct material. Waste classified as low-level waste must contain less than 100 nCi/g of radium sources and/or alpha-emitting transuranium nuclides with half-lives greater than 20 years.

nitrogen blanket

An inert gas used to shield material in an oxygen-free environment to minimize the possibility of fire or combustion.

noncriteria pollutant

Pollutants not regulated under National Ambient Air Quality Standards, such as organic compounds, metals, and acid gases.

nonprecursor organics

Hydrocarbons that do not contribute to the formation of ozone in the atmosphere.

offgas

Gas or volatile materials that have escaped from a vent or seal.

organic degreasers

Cleaning agents having organic chemical structures, such as trichloroethane, trichloroethylene, tetrachloroethylene, and tetrachloromethane (carbon tetrachloride).

organic solvent

A liquid organic compound with the ability to dissolve solids, gases, or liquids.

overpack containers

Containers for packing 55-gallon drums for shipment to a hazardous waste disposal facility.

packed tower absorber

An absorber tower filled with small objects (packing) to bring about intimate contact between rising fluid (vapor or liquid) and falling liquid.

particulate matter

Matter in the form of small liquid or solid particles in the air.

precursor organic

Hydrocarbons that contribute to the formation of ozone in the atmosphere.

process gas

The gaseous emissions associated with a process (e.g., flue gas).

process upset conditions

Transient operational events or off-normal operational modes resulting in a minimal release of hazardous or radioactive material to the environment or a minor but evident effect on operations.

PTFUM

A dispersion model that calculates maximum concentrations of pollutants under inversion conditions (U.S. Environmental Protection Agency).

radiation

The emitted particles or photons from radioactive atoms.

radioactive

Having the property of emitting ionizing radiation.

radionuclide

A nuclide that is unstable and releases its excess energy through radiation.

reactive material

A material that reacts violently or generates toxic fumes when exposed to water or is capable of detonation or explosive decomposition.

refractory

A ceramic material of low thermal conductivity that is capable of withstanding extremely high temperatures (3,000° to 4,000°F) without essential change.

Resource Conservation Recovery Act (RCRA)

Federal legislation that regulates the transport, treatment, and disposal of solid and hazardous wastes.

roentgen equivalent man (rem)

The unit of dose equivalent equal to the product of the absorbed dose (in rads), a quality factor.

rotary kiln

A cylindrical kiln lined with refractory, included at a slight angle, and rotated at a slow speed.

scrubber

An air pollution control device that uses a liquid spray to remove pollutants and acid gases from a gas stream by absorption or chemical reaction.

shot blaster

An instrument used to clean and descale metal by shot peening or by means of a stream of abrasive powder blown through a nozzle under air pressure in the range of 30 to 150 pounds per square inch.

sintered metal filter

A filter made of a bonded mass of metal formed by heating metal powders without melting.

sludge

The precipitated solids (primarily oxides and hydroxides) that settle to the bottom of the vessels containing liquid wastes.

specific activity

The activity of a radionuclide per unit mass of the element. For example, the specific activity of plutonium-239 is 0.062 curies per gram.

Threshold Limit Value

The airborne concentration of a substance to which workers may be exposed without adverse health effects.

transuranic (TRU) waste

Solid radioactive waste contaminated with alpha-emitting transuranium (heavier than uranium) radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/gram.

vapor degreaser

A structure for cleaning metal parts through exposure to heated volatile organic solvents.

venturi scrubber

A gas cleaning device in which liquid injected at the throat of a venturi is used to scrub dust and mist from the gas flowing through the venturi.

volatile organic compounds (VOCs)

A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures, such as benzene, acetone, chloroform, and methyl alcohol.

CHAPTER 8.0

LIST OF PREPARERS

This chapter presents a brief biographical description of those persons who contributed to the preparation and review of this DEIS.

8.1 Preparers from Radian Corporation

Name	Education/Experience	EIS Contribution
Shauna Y. Bachman	A.A.S. in Word/Information Processing and Management.	Word Processing, Document Production
Pamela Beekley	M.S. in Biology; 9 years experience in hazardous waste management and environmental assessment.	Scoping, Waste Management Alternatives
Donald T. Bishop	Ph.D., Geology, 23 years experience in remediation and assessment programs.	Geology, Ground water
John Collins	B.S. in Chemical Engineering; 5 years in air quality studies including source characterization, air permitting, and control technology evaluations.	Engineering Design Alternatives, Air Quality
R. Wyatt Dietrich	M.A., Geography; 10 years experience in meteorology, environmental assessment, and project management.	Project Management, Accident Analysis
Kara Dowdy	B.S. in Chemical Engineering; 1 year experience in air quality studies.	Accident Analysis
Ann Fornes	M.A. in Geography; 16 years experience as a graphic artist and cartographer.	Cartography
Russell C. Henning	B.S. in Mechanical Engineering; 1 year experience in mobile source emissions studies and air permitting.	Air Quality, Transportation
Jeffery B. Hicks	M.P.H. Industrial Hygiene; 12 years experience in industrial hygiene and and regulatory analysis and compliance.	Occupational Health
Douglas B. Holsten	B.S., Geology; 10 years experience in geology and hydrogeology.	Geology, Seismicity

Richard E. Honrath	M.S. in Civil Engineering; 2 years experience in environmental science and air quality modeling.	Air Quality
Stuart N. Husband	B.S., Environmental Engineering; 8 years experience in air quality impact analysis and project management.	Project Management, Air Quality
Ray Kapahi	M.E. in Chemical Engineering; 14 years experience in air quality impact analysis.	Air Quality Modeling
Ron S. Leiken	B.S. in Natural Resource Management; 2 years experience in vegetation and wildlife impact analysis.	Vegetation and Wildlife
R. Leon Leonard	Ph.D. in Aeronautics and Astronautics; 25 years experience directing enviro-mental analysis projects.	Project Management
John A. Lowe	B.S. in Environmental Toxicology, Certified Industrial Hygienist; 7 years experience in industrial hygiene toxicology and health risk assessment.	Public Health
Gary Lucks	J.D. in Environmental Law, B.S. Biology; 4 years experience in environmental law.	Regulatory Analysis
Ellyn Miller	M.E.M. (Master of Environmental Management); 1 year experience in environmental assessment and regulatory analysis.	Land Use, Socioeconomics, Vegetation and Wildlife
Lora M. Moerwald	B.S. in Environmental Policy Analysis and Planning; 1 year experience in writing and editing.	Technical Editing
William I. Odem	M.S. in Civil Engineering; 9 years experience with hydrogeological assessment and ground-water contamination.	Hydrogeology
Gina Pack	B.S. in Geology; 2 years experience in geology and hydrology.	Geology and Soils
Susan M. Scheibel	M.S. in Library Science; 5 years experience in research and information management.	Information Management

Melinda J. Thiessen	M.T.S.C. in Technical and Scientific Communication; 3 years experience in technical writing and editing.	Technical Editing

8.2 Reviewers from LLNL

NAME	Education/Experience	Area of Review
Connie De Grange	M.S. Environmental Health Sciences, Certified Industrial Hygienist; 9 years experience in industrial hygiene, and environmental protection.	Entire Document
William F. Isherwood	Ph.D. Geological Sciences; California Registered Geophysicist; 25 years experience, including geophysical and ground-water investigations.	Hydrogeology, and LLNL Ground-Water Project
C. Susi Jackson	B.S. in Mechanical engineering; 12 years experience in environmental compliance and management.	HWM Operations
Roland Quong	M.S. in Chemical Engineering; 26 years experience in process development and design, and project management.	Entire Document
Roberto Salazar	M.S. in Engineering; Registered Professional Engineer; 37 years experience in environmental protection, general engineering, and project management.	Entire Document
Donald Towse	Ph.D. in Geology; California Registered Geologist; over 35 years experience, including plant site evaluation, seismic studies, and ground water investigations.	Geology, Seismicity
Janet Tulk	J.D. Environmental Law; 8 years experience in environmental law.	Regulatory Analysis

8.3 Reviewers from DOE

NAME	Education/Experience	Area of Review
William Holman	Ph.D. Geology; 12 years experience in ground water and reservoir studies.	Entire Document
Gerald Katz	M.P.A. Environmental Management; 17 years experience in air quality programs and environmental management.	Entire Document
Russell S. Roberts	M.S. Radiation Physics; 11 years experience in hazardous waste management.	Entire Document

CHAPTER 9.0

DISTRIBUTION LIST FOR DRAFT ENVIRONMENTAL IMPACT STATEMENT

9.1 United States

United States Senate

Honorable Quentin N. Burdick
Chairman, Committee on
Public Works
United States Senate
Washington, DC 20510

Honorable John H. Glenn, Jr.
Chairman, Committee on
Governmental Affairs
United States Senate
Washington, DC 20510

Honorable Mark O. Hatfield
Ranking Minority Member
Committee on Appropriations
United States Senate
Washington, DC 20510

Honorable Mark O. Hatfield
Ranking Minority Member
Subcommittee on Energy and
Water Development
Committee on Appropriations
United States Senate
Washington, DC 20510

Honorable J. Bennett Johnston
Chairman, Committee on Energy
and Natural Resources
United States Senate
Washington, DC 20510

Honorable J. Bennett Johnston
Chairman, Subcommittee on
Energy and Water Development
Committee on Appropriations
United States Senate
Washington, DC 20510

Honorable James A. McClure
Ranking Minority Member
Committee on Energy and Natural
Resources
United States Senate
Washington, DC 20510

Honorable William V. Roth, Jr.
Ranking Minority Member
Committee on Governmental
Affairs
United States Senate
Washington, DC 20510

Honorable Robert T. Stafford
Ranking Minority Member
Committee on Environment and
Public Works
United States Senate
Washington, DC 20510

Honorable John C. Stennis
Chairman, Committee on
Appropriations
United States Senate
Washington, DC 20510

Honorable John Warner
Ranking Minority Member
Committee on Armed Services
United States Senate
Washington, DC 20510

United States House of Representatives

Honorable Robert Badham
Ranking Minority Member
Subcommittee on Procurement
and Military Nuclear
Systems
Committee on Armed Services
House of Representatives
Washington, DC 20515

Honorable John D. Dingell
Chairman, Committee on
Energy and Commerce
House of Representatives
Washington, DC 20515

Honorable Tom Bevill
Chairman, Subcommittee on
Energy and Water Development
Committee on Appropriations
House of Representatives
Washington, DC 20515

Honorable John D. Dingell
Chairman, Subcommittee on
Oversight and Investigations
Committee on Energy and
Commerce
House of Representatives
Washington, DC 20515

Honorable Jack Brooks
Chairman, Committee on
Government Operations
House of Representatives
Washington, DC 20515

Honorable Frank Horton
Ranking Minority Member
Committee on Government
Operations
House of Representatives
Washington, DC 20515

Honorable William F. Clinger, Jr.
Ranking Minority Member
Subcommittee on Environment,
Energy and Natural Resources
Committee on Government
Operations
House of Representatives
Washington, DC 20515

Honorable Norman Lent
Ranking Minority Member
Committee on Energy and
Commerce
House of Representatives
Washington, DC 20515

Honorable Silvio Conte
Ranking Minority Member
Committee on Appropriations
House of Representatives
Washington, DC 20515

Honorable Norman Lent
Ranking Minority Member
Subcommittee on Oversight
and Investigations
Committee on Energy and
Commerce
House of Representatives
Washington, DC 20515

Honorable William L. Dickinson
Ranking Minority Member
Committee on Armed Services
House of Representatives
Washington, DC 20515

Honorable Carlos J. Moorhead
Ranking Minority Member
Subcommittee on Energy and
Power
Committee on Energy and
Commerce
House of Representatives
Washington, DC 20515

Honorable John Myers
Ranking Minority Member
Subcommittee on Energy and
Water Development
Committee on Appropriations
House of Representatives
Washington, DC 20515

Honorable Philip R. Sharp
Chairman, Subcommittee on
Energy and Power
Committee on Energy and
Commerce
House of Representatives
Washington, DC 20515

Honorable Samuel Stratton
Chairman, Subcommittee on
Procurement and Military
Nuclear Systems
Committee on Armed Services
House of Representatives
Washington, DC 20515

Honorable Mike Synar
Chairman, Subcommittee on
Environment, Energy and
Natural Resources
Committee on Government
Operations
House of Representatives
Washington, DC 20515

Honorable Jamie Whitten
Chairman, Committee on
Appropriations
House of Representatives
Washington, DC 20515

9.2 Federal Agencies

Mr. Richard E. Sanderson, Director
Office of Federal Activities
U.S. Environmental Protection
Agency
Room 2119, Waterside Mall, A-104
401 M Street, S.W.
Washington, DC 20460

Mr. Robert Fairweather, Chief
Environmental Branch
Office of Management and Budget
Room 8222. NEOB
726 Jackson Place, N.W.
Washington, DC 20503

Mr. Richard Guimond, Director
Office of Radiation Programs
U.S. Environmental Protection
Agency
401 M Street, S.W.
Washington, DC 20460

Rolf L. Wallenstrom
Regional Director
U.S. Department of Interior
Fish and Wildlife Service
Lloyd 500 Building, Suite 1692
500 N.E. Multnomah Street
Portland, OR 97232

Mr. Russell Beckwith
Permit Division
U.S. Environmental Protection
Agency
215 Fremont Street
San Francisco, CA 94105

Susan Brechbill
DOE/SAN
Office of Chief Counsel
1332 Broadway
Oakland, CA 94612

Ms. Loretta Barsanian
Environmental Review
Coordinator
U.S. Environmental Protection
Agency
215 Fremont Street
San Francisco, CA 94105

Ms. Dinah Bear, General
Council on Environmental
722 Jackson Place, N.W.
Washington, DC 20006

Sandia National Laboratories
Attention: Bruce Hawkinson
Editor, Lab News
Albuquerque, NM 87175

9.3 State Officials and Legislators

Honorable George Deukmejian
Governor
State Capitol
Sacramento, CA 95814

Honorable William P. Baker
Member of the Assembly
State Capitol, Room 3013
Sacramento, CA 95814

Honorable Bill Lockyear
Member of the Senate
State Capitol, Room 2032
Sacramento, CA 95814

9.4 State Agencies

State Single Point of Contact
Office of Planning and Research
1400 Tenth Street
Sacramento, CA 95814

Dwight Hoenig
Department of Health Services
Toxic Substances Control Division
North Coast California Section
5850 Shellmound
Emeryville, CA 95715

Lawrence Berkeley Laboratory
University of California
Public Information Department
Attention: Chuck Hurley, B80C
One Cyclotron Road
Berkeley, CA 94720

Ms. Susan Bertken
Department of Health Services
1029 J Street, Suite 500
Sacramento, CA 95814

Secretary for Resources
Room 1311
1416 9th Street
Sacramento, CA 95814

Dr. James Kane
Office of the President
University of California
Office of General Counsel
590 University Hall
Berkeley, CA 94720

Mr. Anand Rege
Department of Health Services
North Coast California Section
5850 Shellmound
Emeryville, CA 95715

9.5 Local Officials

Honorable Dale M. Turner, Mayor
City of Livermore
1052 South Livermore Avenue
Livermore, CA 94550

Lee Horner, City Manager
City of Livermore
1052 South Livermore Avenue
Livermore, CA 94550

Honorable Richard Hastie, Mayor
City of Tracy
325 East Tenth Street
Tracy, CA 95376

Joseph P. Bort, Chairman
Alameda County Board of Supervisors
1221 Oak Street
Administration Building, Room 536
Oakland, CA 94612

9.6 Local Agencies

Revn Tranter
Executive Director
Association of Bay Area Governments
P.O. Box 2050
101 8th Street
Oakland, CA 94604

Bill Adams, Superintendent
Livermore Water Reclamation Plant
1250 Kitty Hawk Road
Livermore, CA 94550

Milton Feldstein
Air Pollution Control Officer
Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109

Gerald Winn, Director
Alameda County Health Agency
Public Health Service
Division of Environmental Health
470 27th Street
Oakland, CA 94612

Mr. Hari S. Doss
Permit Division
Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109

Barbara Guarienti
Executive Director
Livermore Chamber of Commerce
2157 First Street
Livermore, CA 94550

Yogi Khanna
Air Pollution Control Officer
San Joaquin County Air Pollution Control District
1601 East Hazelton Avenue
Stockton, CA 95201

Scott Raty
Executive Manager
Pleasanton Chamber of Commerce
411 Main Street
Pleasanton, CA 94556

Roger B. James
Executive Director
Regional Water Quality Control
San Francisco Bay Region
1111 Jackson Street
Oakland, CA 94607

Hugh Walker, Chairman of the Board
Alameda County Flood Control District
Zone 7
5997 Parkside Drive
Pleasanton, CA 94566

Nancy Feeley
Dublin Chamber of Commerce
7986 Amador Valley Boulevard
Dublin, CA 94568

9.7 Organizations and Individuals

Defenders of Wildlife
1244 19th Street, N.W.
Washington, DC 20036

Gwen Bjorkman
Ebasco Services, Inc.
10900 N.E. 8th Street
Bellevue, WA 98004

Ms. M.R. Hardee
Energy Research Foundation
2600 Devine Street
Columbia, SC 29205

Environmental Defense Fund, Inc.
1616 P Street, N.W.
Suite 150
Washington, DC 20006

Ms. Melinda Kassen
Environmental Defense Fund
1405 Arapahoe Avenue
Boulder, CO 80302

Environmental Policy Institute
Nuclear Waste Project
218 D Street, S.E.
Washington, DC 20003

Greenpeace USA, Inc.
1611 Connecticut Avenue, N.W.
Washington, DC 20009

Ms. Carol Kriz
League of Conservation Voters
5617 Randolph Drive
Boise, ID 83705

League of Women Votors of the
1730 M. Street, N.W.
Washington, DC 20036

Jan Price, President
League of Women Voters of the Livermore Amador Valley
P.O. Box 702
Livermore, CA 94550

National Audubon Society
Science Division
950 Third Avenue
New York, NY 10022

National Wildlife Federation
Public Lands and Energy Division
1412 Sixteenth Street, N.W.
Washington, DC 20036-2266

Friends of the Earth
530 Seventh Street, S.E.
Washington, DC 20003

Barry Stear, President
Friends of the Vineyards
P.O. Box 1191
Livermore, CA 94550

The Nature Conservancy
Suite 800
1800 N. Kent Street
Arlington, VA 22209

People for a Nuclear Free Future
870 Linden Lane
Davis, CA 95616

Sierra Club
330 Pennsylvania Avenue, S.E.
Washington, D.C. 20003

Sierra Club
730 Polk Street
San Francisco, CA 94109

UC Nuclear Weapons Labs
Conversion Project
944 Market Street, Room 509
San Francisco, CA 94102

Robert Several
The Independent
2219 First Street
Livermore, CA 94550

Keith Rogers
Valley Times
P.O. Box 607
Pleasanton, CA 94566

Millisa Sacca
1046 Bluebell Drive
Livermore, CA 94550

Felicia Wiezbicki
325 South M Street
Livermore, CA 94550

Mr. Dan W. Reicher
Natural Resources Defense Council
1350 New York Avenue, N.W.
Washington, DC 20009

Natural Resources Defense Council
1350 New York Avenue, N.W.
Washington, DC 20C09

Perry W. Cole
5807 Lawton Avenue
Oakland, CA 94618

Marjorie Gonzalez
713 South I Street
Livermore, CA 94550

Thomas J. Hill
P.O. Box 1625
Idaho Falls, ID 83401

W.D. Jensen
798 Brandon
Idaho Falls, ID 83402-2936

Marylia Kelley
5720 East Avenue, #116
Livermore, CA 94550

Vincent Kiernan
P.O. Box 3000
Dublin, CA 94568

Ken Nightingale
3044 Wisconsin Street
Oakland, CA 94602

James D. Werner
Senior Lead Scientist
International Square
1850 K Street, N.W.
Washington, DC 20006

[THIS PAGE INTENTIONALLY LEFT BLANK]