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Final Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement

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Abstract: The National Nuclear Security Administration (NNSA), a separately organized agency within DOE, has the responsibility to maintain and enhance the safety, reliability, and performance of the U.S. nuclear weapons stockpile to meet national security requirements. NNSA manages DOE's nuclear weapons programs and facilities, including those at Lawrence Livermore National Laboratory (LLNL). The continued operation of LLNL is critical to NNSA's Stockpile Stewardship Program and to preventing the spread and use of nuclear weapons worldwide. LLNL maintains core competencies in activities associated with research and development, design, and surveillance of nuclear weapons, as well as the assessment and certification of their safety and reliability.

This *Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (LLNL SW/SPEIS) prepared pursuant to NEPA, analyzes the potential environmental impacts of continued operation, including near term proposed projects of LLNL. Alternatives analyzed in this LLNL SW/SPEIS include the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative. This document is also a Supplement to the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* for use of proposed materials at the National Ignition Facility (NIF). This combination ensures timely analysis of the reasonably foreseeable environmental impact of NIF experiments using the proposed materials concurrent with the environmental analyses being conducted for the site-wide activities and will be referred to as the LLNL SW/SPEIS.

This document assesses the environmental impacts of LLNL operations on land uses and applicable plans, socioeconomic characteristics and environmental justice, community services, prehistoric and historic cultural resources, aesthetics and scenic resources, geology and soils, biological resources, water, noise, traffic and transportation, utilities and energy, materials and waste management, human health and safety, site contamination, and accidents. For this Final LLNL SW/SPEIS the Proposed Action has been identified as the preferred alternative for the continuing operations of LLNL.

Public Comments: The Draft LLNL SW/SPEIS was issued for public review and comment on February 27, 2004. The public comment period was held from February 27, 2004 to May 27, 2004. Public meetings to solicit comments on the Draft LLNL SW/SPEIS were held in Livermore, California; Tracy, California; and Washington, D.C. All comments were considered during the preparation of the Final LLNL SW/SPEIS, which also incorporates additional and new information received since the issuance of the Draft LLNL SW/SPEIS. In response to comments on the Draft LLNL SW/SPEIS, the Final LLNL SW/SPEIS contains revisions and new information. These revisions and new information are indicated by a sidebar in the margin. Volume IV contains the comments received during the public comment period on the Draft LLNL SW/SPEIS and NNSA's responses to these comments. NNSA will use the analyses presented in this Final LLNL SW/SPEIS as well as other information in preparing the Record of Decision (ROD). NNSA will issue this ROD no sooner than 30 days after the U.S. Environmental Protection Agency publishes a notice of availability of this Final LLNL SW/SPEIS in the *Federal Register.*

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ABBREVIATIONS AND ACRONYMS

1, 1-DCA	1, 1-dichoroethane
1, 1-DCE	1, 1-dichloroethylene
1, 2-DCA	1, 2-dichloroethane
1, 2-DCE	1, 2-dichloroethylene
AAQS	Ambient Air Quality Standards
ABAG	Association of Bay Area Governments
ACDEH	Alameda County Department of Environmental Health
ACE	Altamont Commuter Express
ACGIH	American Conference of Governmental Industrial Hygienists
ACHCS	Alameda County Health Care Services
ACHP	Advisory Council on Historic Preservation
ACL	Ambient concentration limit
ADS	Associate Directors
ADT	Average daily traffic
AET	Applied Energy Technologies
AIHA	American Industrial Hygiene Association
ALARA	As low as reasonably achievable
^{241}Am	Americium-241
Am/Pu button	Americium/plutonium metal button
AMP	Advanced Materials Program
ANSI	American National Standards Institute
APDS	Autonomous Pathogen Detection System
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARES	Amateur Radio Emergency Services
ARF x RF	Airborne release fraction and respirable fraction
ARM	Assembly, resupply, and maintenance
ARO	Assurance Review Office
ARPA	Archaeological Resources Protection Act
ASCI	Advanced Simulation and Computing Initiative
ATA	Advanced Test Accelerator

ATSDR	Agency for Toxic Substances and Disease Registry
ASD	Atmospheric Sciences Division
AVLIS	Advanced Vapor Laser Isotope Separation
AWQC	Ambient water quality criteria
BAAQMD	Bay Area Air Quality Management District
BACT	Best Available Control Technology
BART	Bay Area Rapid Transit
BASIS	Biological Aerosol Sentry and Information System
BBRP	Biology and Biotechnology Research Program
BCP	Business commercial park
BDRP	Biological Defense Research Program
BEIR	Biological Effects of Ionization
BMP	Best management practice
BSL	BioSafety Level
CAA	*Clean Air Act*
CAAQS	California Ambient Air Quality Standards
$CaCl_2$	Calcium Chloride
CAIC	Computer Incident Advisory Center
CAIRS	Computerized Accident/Incident Report
Cal-EPA	California Environmental Protection Agency
CaO	Calcium Oxide
CAR	Computing Applications and Research
CARB	California Air Resources Board
CBD	Chronic beryllium disease
CBNP	Chemical and Biological National Security
CCAA	California Clean Air Act
CCB	Change Control Board
CCP	Central Characterization Project
CCR	California Code of Regulations
CD	Critical Decision
CDC	Center for Disease Control
CDFG	California Department of Fish and Game

CEDD	California Employment Development Department
CEDE	Committed Effective Dose Equivalent
CEPRC	Chemical Emergency Planning and Response Commission
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act of 1970
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFES	Community facility elementary school
CFF	Contained Firing Facility
CFR	Code of Federal Regulations
CHEW	Chemical Exchange Warehouse
CHP	California Highway Patrol
Ci	Curie
Cl_2	Chloride
CIAC	Computer Incident Advisory Center
CIMIS	California Irrigation Management Information System
CMGRAMS	Controlled materials group
CMS	Chemistry and Materials Science
CNEL	Community Noise Equivalent Level
CNPS	California Native Plant Society
CO	Carbon monoxide
CRD	Catalytic reductive dehalogenation
CSA	Container storage area
CSO	Council on Strategic Operations
CSU	Container storage unit
CT	California toxic
CWSC	California Water Service Company
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CWG	Community Work Group
CY	Calendar year
DARHT	Dual Axis Radiographic Hydrodynamic Test
dB	Decibel

dB(A)	A-weighted decibel
D&D	Decontamination and Decommissioning
DC	Direct current
DCG	Derived Concentration Guide
DDO	Deputy Director of Operations
DDSO	Deputy Director for Strategic Operations
DEAR	Department of Energy Acquisition Regulation
DHS	Department of Health Services
DLM	Designated level methodology
DNT	Defense and Nuclear Technologies
DOD	United States Department of Defense
DOE	United States Department of Energy
DOE/OAK	DOE Oakland Operations Office
DOF	California Department of Finance
DOR	Direct Oxygen Reduction
DOT	United States Department of Transportation
DP	Office of Defense Programs
DR	Damage ration
DRB	Drainage Retention Basin
DTSC	Department of Toxic Substances Control
DWTF	Decontamination and Waste Treatment Facility
DU	Depleted uranium
E2	Energy Efficiency
EA	Environmental assessment
ECAP	East (Alameda) County Area Plan
EDD	California Employment Development Department
EDE	Effective dose equivalent
EDO	Environmental Duty Officer
EDS	Engineering Demonstration System
EED	Energy and Environment Directorate
EIR	Environmental impact report
EIS	Environmental Impact Statement

EML	Effluent pollutant limit
EMPC	Energetic Material Processing Center
EMRL	Environmental Monitoring Radiation Laboratory
EO	Executive Order
EOG	Environmental Operations Group
EOO	Emergency Operations Office
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act of 1986
EPD	Environmental Protection Department
EPDTG	Environmental Protection Department Training Group
EPL	Effluent pollutant limit
EPTP	Environmental Protection Training Department
ER	Environmental restoration
ERPG	Emergency Response Planning Guidelines
ERD	Environmental Restoration Division
ES&H	Environment, Safety, and Health
ES&H WG	ES&H Working Group
EST	Environmental support team
EUV	Extreme ultraviolet
EUVL	Extreme ultraviolet lithography
EWSF	Explosives Waste Storage Facility
EWTF	Explosives Waste Treatment Facility
°F	Fahrenheit
FAC	Equally Likely to Occur in Wetlands for Uplands
FACU	Usually Occurs in Uplands
FACW	Usually Occurs in Wetlands
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FESSP	Fission Energy and Systems Safety Program
FFA	Federal Facility Agreement
FFCA	*Federal Facilities Compliance Act*
FHC	Fuel hydrocarbon

FIRP	Facility Infrastructure Recapitalization Project
FONSI	Finding of no significant impact
FPOC	Facility Point of Contact
FR	Federal Register
FR/O	Federal Reserve/Open Space
Freon 11	trichlorofluoromethane
Freon 113	trichlorotrifluoroethane
FSP	Facility safety plan
FTE	Full Time Equivalent
FY	Fiscal year
GAB	Gross alpha and gross beta
GET	Geosciences and Environmental Technology
GGS	Geophysics and Global Security
GIS	Geographic Information System
GPS	Global positioning system
GRR	Guidance Request Response
GSA	General Service Area
GSF	Gross Square Feet
GWH	Giga-watts per hour
GWP	Ground Water Project
GWPMP	Ground Water Project Management Program
GWTF	Groundwater treatment facility
GWTS	Groundwater treatment system
HAC	Hazard Assessment and Control
HAP	Hazardous air pollutants
HAZMAT	Hazardous Material
HCAL	Hazards Control Department's Analytical Laboratory
HCD	Hazards Control Department
HCI	Hydrochloric Acid
HE	High explosives
HEA	Health and Ecological Assessment
HEAF	High Explosives Application Facility

HEDC	High Explosives Development Center
HEDP	High-energy-density physics
HEPA	High-efficiency particulate air (filter)
HHI	Health Hazard Index
HOV	High occupancy vehicle
HR	Human Resources
HSD	Health Services Department
HSWA	Hazardous and Solid Waste Amendments
HQs	Hazard quotients
HVAC	Heating, Ventilation, and Air Conditioning
HW	Hazardous Waste
HWCA	*Hazardous Waste Control Act*
HWM	Hazardous Waste Management Division
IBIS	Innovative Business and Information Services
I & C	Instrumentation and Control
ICC	Integrated Computing and Communications
ICF	Inertial Confinement Fusion
ICRP	International Commission on Radiological Protection
IDLH	Immediately-Dangerous to Life or Health
INEEL	Idaho National Engineering and Environmental Laboratory
INL	Idaho National Laboratory
IQR	Interquartile Range
IS/EA	Initial Study/Environmental Assessment
ISCT	Industrial Source Complex Short Team
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
ISRF	International Security Research Facility
ITP	Integrated Technology Project
IWS	Integration work sheet
IWS/SP	Integrated Work Sheets/Safety Plan
JCATS	Joint Conflict and Tactical Simulation
LANL	Los Alamos National Laboratory

LBNL	Lawrence Berkeley National Laboratory
LCF	Latent Cancer Fatalities
LCW	Low Pressure Cooling Water
LDRD	Laboratory Directed Research and Development
LEDO	Laboratory Emergency Duty Officer
LEPC	Local Emergency Planning Committee
Leq	Equivalent-Continuous Sound Level
LINAC	Linear Accelerator
LLNL	Lawrence Livermore National Laboratory
LLW	Low-Level Waste
LOEC	Lowest observed effect concentration
LOS	Limit of sensitivity
LPF	Leak Path Factor
LPT	Lymphocyte proliferation test
L/RWD	Lost/Restricted Work Day
LSA	Low Specific Activity
LSO	Laser Safety Officer
LSO	Livermore Safety Officer
LS&T	Laser Science and Technology
LWC	Low work day cases
LWD	Lost work days
LWRP	Livermore Water Reclamation Plant
m	meter
MAPEP	Mixed Analyte Performance Evaluation Program
MAR	Materials at Risk
mCi	Millicurie
MCL	Maximum contaminant level
MDC	Minimum detectable concentration
MDD	Materials Distribution Division
MEI	Maximally exposed individual
mg	milligram
MLLW	Mixed low-level waste

MJ	Megajoules
MM	Modified Mercalli
MOU	Memorandum of understanding
MPL	Maximum permitted level
MRP	Monitoring and Reporting Program
MSDS	Material safety data sheet
mrem	millirem
MSE	Molten-salt extraction
MSR	Materials and Storage Retrieval
mSv	Millisievert
MTBE	Methyl tertiary-butyl ether
MTC	Metropolitan Transit Commission
MVM	Million vehicle miles
MWH	Megawatt hours
MWMP	Medical Waste Management Plant
NAAQS	National Ambient Air Quality Standards
NAI	Non-Proliferation, Arms Control and International Security
NARAC	National Atmospheric Release Advisory Center
NCR	Nonconformance report
NCRP	National Council on Radiation Protection and Measurements
NEPA	*National Environmental Policy Act*
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NEUMA	Neutron Multiplying Assembly
NHPA	*National Historical Preservation Act*
NIF	National Ignition Facility
NNSA	National Nuclear Security Administration
NO_2	Nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOD	Notice of deficiency
NOEC	No observed effect concentration
NOI	Notice of Intent
NO_x	Nitrogen oxide

NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPOC	Non-precursor organic compounds
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
N&S	Necessary and Sufficient
nSv	Nanosievert
NTS	Nevada Test Site
NWP	Nationwide permit
O_2	Oxygen
O_3	Ozone
OAASIS	Occupational Accident Injury/Illness Analysis Support and Information System
OAB	Optics Assembly Building
OBT	Organically bound tritium
OCRWM	Office of Civilian Radioactive Waste Management
OES	Office of Emergency Services
ORAD	Operations and Regulatory Affairs Division
OSHA	Occupational Safety and Health Administration
OSP	Operational space and parks
OU	Operable unit
P2	Pollution Prevention
PA	Programmatic agreement
PAAA	*Price-Anderson Amendments Act*
PAG	Protective Action Guide
PAT	Physics and Advanced Technologies
PCB	Polychlorinated biphenyl
PCE	Perchloroethylene (or perchloroethene tetrachloroethene)
PDD	Presidential Decision Directive
PEIS	Programmatic Environmental Impact Statement
PG&E	Pacific Gas and Electric
PHA	Public health assessment

pHMS	pH Monitoring Station
PL	Public Law
PM	Performance measure
PMCL	Primary maximum contaminant level
POC	Precursor Organic Compounds
POTW	Publicly owned treatment works
ppb	Parts per billion
ppm	Parts per million
PPE	Personal protective equipment
PPOA	Pollution prevention opportunity assessment
PPVS	Plant Performance Verification Series
PQL	Practical quantitation limit
PSA	Project-Specific Analysis
PSI	Pounds per square inch
PTU	Portable treatment unit
Pu	Plutonium
PVC	Polyvinyl chlorides
QA	Quality assurance
QC	Quality control
R&D	Research and Development
RAIP	Remedial Action Implementation Plan
RCRA	*Resource Conservation and Recovery Act* of 1976
RDWP	Remedial Design Work Plan
RD	Remedial Design
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
rem	Radiation equivalent man
RG	Risk Group
RHWM	Radioactive and Hazardous Waste Management Complex
RI/FS	Remedial investigation/feasibility study
RL	Reporting limit
RMA	Radioactive Materials Area
RMMA	Radioactive Materials Management Area

ROD	Record of Decision
ROI	Region of Influence
ROW	Right of Way
RTW	Return to Work Program
RWQCB	Regional Water Quality Control Board
SAA	Streambed alteration agreement
SAAQS	State Ambient Air Quality Standards
SAER	Site Annual Environmental Report
SBSSMP	Stockpile Stewardship and Management Program
SHPO	State Historic Preservation Officer
SNL/CA	Sandia National Laboratories/California
SAR	Safety analysis report
SARA	*Superfund Amendment and Reauthorization Act* of 1986
SAT	Space Action Team
SCIF	Sensitive Compartmented Information Facility
SDF	Sewer Diversion Facility
SE	Standard error
SEP	Safety and Environmental Protection
SERC	State Emergency Response Commission
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SHARP	Super High Altitude Research Project
SHPO	State Historic Preservation Officer
SI	Système International d'Unités
SIS	Special Isotope Separator
SJEHD	San Joaquin Environmental Health Department
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
SMC	Senior Management Council
SMCL	Secondary maximum contaminant level
SME	Subject matter expert or Safety Management Evaluation
SMS	Sewer Monitoring Station
SNL/CA	Sandia National Laboratories, California
SNM	Special nuclear material

SO_2	Sulfur dioxide
SOP	Standard operating procedures
SOV	Summary of violations
SPCC	Spill Prevention Control and Countermeasure
SRS	Savannah River Site
SSM PEIS	Stockpile Stewardship and Management PEIS
SST/SGT	Safe Sescure Trailers/Safeguards Transport
STP	Site treatment plant
STU	Solar treatment unit
Sv	Sievert
SVE	Soil vapor extraction
SWEA	Site-Wide Environmental Assessment
SWEIS	Site-Wide Environmental Impact Statement
SW-MEI	Site-wide maximally exposed individual member (of the public)
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TBACT	Toxic best available control technology
TBD	To Be Determined
TBOS	Tetrabutyl orthosilicate
TCA	trichloroethane
TCE	Trichloroethene (or trichloroethylene)
TCLP	Toxicity characteristic leaching procedure
TCP	Traditional cultural properties
TDS	Total dissolved solids
TEEL	Temporary Emergency Exposure Limit
TF	Treatment facilitie
TKEBS	Tetrakis (2-ethylbutyl) silane
TLD	Thermoluminescent dosimeter
TNT	Trinitrotoluene
TOC	Total organic carbon
TOX	Total organic halides
TPY	Tons per year

TRAGIS	Transportation Routing Analysis Geographic Information System
TRC	Total reportable cases
TRU	Transuranic waste
TRUPACT II	Transuranic Package Transporter II
TSCA	*Toxic Substances Control Act*
TSF	Terascale Simulation Facility
TSMP	Transportation Systems Management Program
TSS	Total suspended solids
TTO	Total toxic organics
TWMS	Total Waste Management System
U	Uranium
UC	University of California
USACE	United States Army Corps of Engineers
USC	United States Code
USFWS	United States Fish and Wildlife Service
UV/H_2O_2	Ultraviolet/hydrogen peroxide
VOC	Volatile organic compound
VTF	Vapor treatment facility
WAA	Waste accumulation area
WDR	Waste Discharge Requirements
WFO	Work For Others
WIPP	Waste Isolation Pilot Plant
WMD	Weapons of mass destruction
WSS	Work Smart Standards
Zone 7	Alameda County Flood Control and Conservation District, Zone 7

UNIT OF MEASURE AND ABBREVIATIONS

ac	acre
BGY	billion gallons per year
cm	centimeters
ft^3	cubic feet
ft^3/s	cubic feet per second
m^3	cubic meters
yd^3	cubic yards
Ci	Curie
dB	decibel
^oC	degrees Celsius
^oF	degrees Fahrenheit
ft	feet
gal	gallon
gpd	gallons per day
g	gram
g/sec	grams per second
g	gravity
ha	hectare
Hz	Hertz
hr	hour
K	kelvin
kg	kilogram
kJ	kilojoule
km	kilometer
km/hr	kilometer per hour
kV	kilovolt
kVA	kilovoltampere
kW	kilowatt
kWh	kilowatt hour
L	liter

MJ	megajoule
MVA	megavolt-ampere
MW	megawatt
MWh	megawatt hour
MWe	megawatt-electric
MWt	megawatt-thermal
m	meter
m/sec	meters per second
µCi	microcurie
µCi/g	microcuries per gram
µg	microgram
$\mu g/m^3$	micrograms per cubic meter
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µm	micron or micrometer
µohms/cm	microohms per centimeter
mPa	micropascal
mi	mile
mph	miles per hour
mCi	millicurie
mCi/g	millicurie per gram
mCi/ml	millicurie per millimeter
mg	milligram
mg/L	milligram per liter
ml	milliliter
mmHg	millimeters of mercury
M	million
MeV	million electron volts
MGD	million gallons per day
MGY	million gallons per year
mrem	millirem
mrem/yr	millirem per year

nCi	nanocurie
nCi/g	nanocuries per gram
ppb	part per billion
ppbv	part per billion by volume
ppm	part per million
PM_{10}	particulate matter of aerodynamic diameter less than 10 micrometers
PM_{25}	particulate matter of aerodynamic diameter less than 25 micrometers
Pa	pascal
pCi	picocurie
pCi/g	picocuries per gram
pCi/L	picocuries per liter
lb	pound
lbm	pounds mass
psi	pounds per square inch
lb/yr	pounds per year
qt	quart
rem[a]	Roentgen equivalent, man
sec	second
ft^2	square feet
km^2	square kilometers
m^2	square meters

CONVERSION CHART

TO CONVERT FROM U.S. CUSTOMARY INTO METRIC			TO CONVERT FROM METRIC INTO U.S. CUSTOMARY		
If you know	**Multiply by**	**To get**	**If you know**	**Multiply by**	**To get**
		Length			
inches	2.540	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.03281	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.6214	miles
		Area			
square inches	6.452	square centimeters	square centimeters	0.1550	square inches
square feet	0.09290	square meters	square meters	10.76	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.4047	hectares	hectares	2.471	acres
square miles	2.590	square kilometers	square kilometers	0.3861	square miles
		Volume			
fluid ounces	29.57	milliliters	milliliters	0.03381	fluid ounces
gallons	3.785	liters	liters	0.2642	gallons
cubic feet	0.02832	cubic meters	cubic meters	35.31	cubic feet
cubic yards	0.7646	cubic meters	cubic meters	1.308	cubic yards
		Weight			
ounces	28.35	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.205	pounds
short tons	0.9072	metric tons	metric tons	1.102	short tons
		Temperature			
Fahrenheit (^oF)	subtract 32, then multiply by 5/9	Celsius (^oC)	Celsius (^oC)	multiply by 9/5, then add 32	Fahrenheit (^oF)
Kelvin (K)	subtract 273.15	Celsius (^oC)	Celsius (^oC)	add 273.15	Kelvin (K)

Note: 1 sievert = 100 rems

APPENDIX A: TABLE OF CONTENTS

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APPENDIX A: DESCRIPTION OF MAJOR PROGRAMS AND FACILITIES

Appendix A describes programs, organizations, infrastructure, facilities, and future plans of the Lawrence Livermore National Laboratory (LLNL). It provides information on existing activities and facilities, as well as information on those activities anticipated to occur or facilities to be constructed in the reasonably foreseeable future. The purposes of this appendix are to:

- Present information that can be used to evaluate the *Final Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (LLNL SW/SPEIS) No Action Alternative, Proposed Action, and Reduced Operation Alternative

- Identify activities conducted at LLNL that are part of the Proposed Action

Figure A–1 illustrates how this appendix interfaces with other sections and appendices of this LLNL SW/SPEIS.

LLNL is a multiprogram laboratory operated by the University of California (UC) for the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA). The LLNL mission is to ensure that the Nation's nuclear weapons remain safe, secure, and reliable and to prevent the spread and use of nuclear weapons worldwide (LLNL 2003cj). This mission enables LLNL to serve as a national resource of scientific, technical, and engineering capability with a special focus on national security.

LLNL conducts operations at the Livermore Site near Livermore, California, at Site 300 near Tracy, California, and at the Nevada Test Site near Las Vegas, Nevada. Limited activities are conducted at leased properties located near the Livermore Site. LLNL also occupies land leased by DOE for the Arroyo Mocho Pump Station located 6 miles south of the Livermore Site. Figure A–2 and Figure A–3 show the regional locations of the Livermore Site and Site 300 and their locations with respect to the cities of Livermore and Tracy.

This appendix provides an overview of the LLNL operations conducted at the Livermore Site and Site 300, including its research programs, a description of the basic infrastructure of the two sites, and information on the activities within major facilities. Detailed descriptions of operations are limited to selected facilities that: have potentially hazardous operations or inventories, are representative industrial facilities, or have operations unique to the site. Facilities are also discussed that are associated with waste management, security, health services, and emergency response and major new facilities that are currently under construction. Administrative buildings, office buildings, most light laboratory buildings, and nonlaboratory-type facilities without hazardous materials, are excluded from detailed descriptions.

Descriptions of the potential hazards and the typical waste streams and effluents generated are presented in this appendix, for each of the selected facilities.

Section A.1 provides a description of the major programs and organizations at LLNL. Section A.2 provides a description of the site infrastructure, selected facilities, and future plans of the Livermore Site, while Section A.3 describes those of Site 300. Section A.4 presents a number of tabular inventories of generated wastes, chemicals and radionuclides, high explosives, and criteria air pollutants for facilities at the two sites. In addition, Section A.4 includes figures showing waste management facilities at the Livermore Site and Site 300.

A.1 MAJOR PROGRAMS AND ORGANIZATIONS AT LAWRENCE LIVERMORE NATIONAL LABORATORY

A.1.1 United States Department of Energy and National Nuclear Security Administration Programs Supported by Lawrence Livermore National Laboratory

LLNL performs work in support of DOE (including NNSA); other government agencies such as the U.S. Department of Defense (DoD), Nuclear Regulatory Commission, U.S. Environmental Protection Agency (EPA), and U.S. Department of Homeland Security; and private industries through Work for Others projects. The majority of LLNL activities support five major DOE and NNSA programs: Defense Programs, Nuclear Nonproliferation, Environmental Management, Science, and Energy Efficiency.

LLNL also provides support and guidance nationally and internationally for emergency assessments in response to chemical, nuclear, and biological incidents. LLNL organization, which is discussed below, fulfills the missions of the LLNL programs through collaborations, both onsite and offsite, with scientific and institutional support organizations throughout the world. LLNL's organization, presented in Sections A.1.2 and A.1.3, is largely structured to support these programs.

A.1.1.1 *Defense Programs*

Defense Programs achieve national security objectives for nuclear weapons established by the President and assist in reducing the global nuclear danger by planning for and maintaining a safe, secure, and reliable stockpile of nuclear weapons and associated materials, capabilities, and technologies in a safe, environmentally sound, and cost-effective manner. The core functions of Defense Programs are as follows:

- Manage the Stockpile Stewardship Program, which encompasses operations associated with maintaining, refurbishing, surveilling, and dismantling the nuclear weapons stockpile; researching, designing, developing, simulating, modeling, and nonnuclear testing nuclear weapons; and planning, assessing, and certifying nuclear weapons safety and reliability.

- Manage the research, development, and computer simulation facilities that maintain the safety and reliability of the nuclear weapons stockpile in the absence of underground testing and ensure the capability for maintaining the readiness to test and develop new warheads, if required.

- Manage establishing and maintaining appropriate partnerships with other NNSA and DOE elements; external scientific, research, and development agencies; industry; and academia.

- Ensure, through close coordination with the DoD, that materials, capabilities, and technologies are available to support the production of certified components necessary to extend the lifetime of the nuclear weapons stockpile.

A.1.1.2 *Nuclear Nonproliferation*

Nuclear Nonproliferation enhances U.S. national security through a four-pronged strategy:

- Enhancing the capability to detect weapons of mass destruction, including nuclear, chemicals, and biological systems

- Preventing and reversing the proliferation of weapons of mass destruction (WMD)

- Protecting or eliminating weapons and weapons-useable material or infrastructure, and redirecting excess foreign weapons expertise to civilian enterprises

- Reducing the risk of accidents in nuclear fuel cycle facilities worldwide

A.1.1.3 *Environmental Management*

Environmental Management provides program policy development and guidance for the assessing and cleaning inactive waste sites and facilities and for waste management operations; develops and implements an aggressive applied waste research and development (R&D) program to provide innovative environmental technologies to yield permanent waste disposal solutions at reduced costs; and oversees the environmental restoration of contaminated facilities from various programs, once the facilities are determined to be surplus to their original mission.

A.1.1.4 *Science*

DOE's Office of Science manages programs in high-energy physics, nuclear physics, and fusion energy sciences. It also manages fundamental research programs in basic energy sciences, biological and environmental sciences, and computational science.

A.1.1.5 *Energy Efficiency*

Energy Efficiency programs strengthen America's energy security, environmental quality, and economic vitality in public-private partnerships that enhance energy efficiency and productivity and bring clean, reliable, and affordable energy technologies to the marketplace.

A.1.2 Lawrence Livermore National Laboratory Program Organizations

A.1.2.1 *Director's Office*

The Director's Office leads LLNL in applying its resources in computing, engineering, science, and technology to DOE's programs to maintain the U.S. nuclear weapons stockpile and reduce the international threats posed by weapons of mass destruction. The Director's office comprises the Office of the Deputy Director for Operations, the Office of the Deputy Director for Science and Technology, and the Laboratory Executive Officer.

Deputy Director for Operations

Working with the institutional support organizations, the Deputy Director for Operations has responsibility for ensuring all operational functions of LLNL and for developing policies and programs to support LLNL's mission and workforce, while promoting excellence in business practices, safety assurances, and facility management in compliance with regulatory and contractual requirements.

Deputy Director for Science and Technology

The Deputy Director for Science and Technology is responsible for overseeing the quality of science and technology in scientific and technical program disciplines. This includes management of the LLNL-directed R&D programs; the University Relations Program Office; the DoD Programs Office; and the Office of Planning, Policy, and Special Studies.

A.1.2.2 *Defense and Nuclear Technologies*

Defense and Nuclear Technologies (DNT) ensures the safety, reliability, and security of the U.S. nuclear stockpile without nuclear testing; develops advanced manufacturing and materials technologies to maintain the enduring stockpile; and assures the DOE complex of the safe dismantlement of retired weapons. Multidisciplinary teams apply expertise towards the development of technologies that reduce the U.S. vulnerability to terrorist nuclear threats, enhance the Nation's conventional defense, and support other national needs (LLNL 2002cf). DNT comprises AX-Division, B-Division, the Nuclear Materials Technology Program (NMTP), and the Weaponization Program.

AX-Division

The AX-Division ensures national and global security by maintaining scientific and technical competence and leadership, in the absence of nuclear testing, in all aspects of thermonuclear weapons physics, design, and operation. This involves applying theoretical, computational, and experimental physics to a wide range of problems relevant to national defense and security. Efforts focus on astrophysics, atomic and nuclear physics, computational physics, fluid dynamics and turbulence, high-energy-density physics, radiation transfer, and particle transport.

B-Division

The B-Division integrates experimental and theoretical expertise in high explosive properties and materials science through the use of hydrodynamic testing. Extensive use will be made of the National Ignition Facility (NIF) when it becomes operational.

Nuclear Materials Technology Program

The NMTP provides the overall management and strategic coordination for all LLNL special nuclear material (SNM) and tritium program elements and Superblock facility operations (NMTP 1999).

Weaponization Program

The Weaponization Program provides support for certification and life prediction, the Stockpile Life Extension Program, and information systems. This is accomplished by providing high quality data and assessment and by implementing improved tools and predictive technologies to identify stockpile issues. The objective of the Weaponization Program is to support continued confidence in the safety, performance, and reliability of LLNL's weapon systems in the U.S. nuclear stockpile.

A.1.2.3 *National Ignition Facility Programs*

The NIF Programs support NNSA's Stockpile Stewardship Program mission of ensuring that the Nation's nuclear weapons remain safe, secure, and reliable. The NIF experiments will access high-energy density and fusion regimes with direct applications to stockpile stewardship, energy research, science, and astrophysics (LLNL 2001w). The NIF Programs are comprised of the NIF Project, the Laser Science and Technology (LS&T) Program, and the Inertial Confinement Fusion (ICF) Program.

National Ignition Facility Project

The NIF is a key component of NNSA's Stockpile Stewardship Program. On the NIF, up to 192 laser beams will compress small targets to conditions where they will ignite and burn, allowing the study of physical processes at temperatures approaching 100 million degrees Celsius and 100 billion times atmospheric pressure. These conditions exist in the interior of stars and in nuclear weapons explosions. The experiments will help scientists sustain confidence in the nuclear weapon stockpile without nuclear tests as a unique element of NNSA's Stockpile Stewardship Program and will produce additional benefits in basic science and fusion energy.

Laser Science and Technology Program

The LS&T Program provides advanced solid-state laser and optics technologies to LLNL, government, and industry to support national needs. The primary activities of the LS&T Program in recent years have been to complete laser technology development and laser component testing for the NIF project, develop advanced solid-state laser systems and optical components for DoD and DOE, and address the needs of other government agencies and U.S. industry.

Inertial Confinement Fusion Program

The ICF Program advances research and technology development in areas of fusion target theory and design, target fabrication, target experiments, and laser and optical science and technology. The mission of the ICF Program is to execute high-energy density physics experiments for the Stockpile Stewardship Program in order to demonstrate controlled thermonuclear fusion in the laboratory. Technical capabilities provided by the ICF Program also contribute to other DOE missions, including nuclear weapons effects testing and developing inertial fusion power.

A.1.2.4 *Nonproliferation, Arms Control, and International Security*

Nonproliferation, Arms Control, and International Security (NAI) provides technology, analysis, and expertise to aid the U.S. Government in preventing the spread of WMD and in defending the U.S. against the use of such weapons. The major NAI programs include Proliferation Prevention and Arms Control, Proliferation Detection and Defense Systems, Counter-terrorism and Incident Response, International Assessments, and Center for Global Security Research.

Proliferation Prevention and Arms Control

The Proliferation Prevention and Arms Control Program focuses primarily on integrating treaty-monitoring technology R&D with policy analysis to support U.S. arms control efforts. Major program areas are supporting arms control, monitoring worldwide nuclear explosions, protecting and controlling nuclear materials, disposing of fissile material, and collaborating with former Soviet Union weapons scientists.

Proliferation Detection and Defense Systems

The Proliferation Detection and Defense Systems Program concentrates on proliferation detection and reversal by integrating LLNL capabilities in weapons design to identify signatures of proliferation-related activities and to develop remote and onsite monitoring technologies to detect those signatures. Major program areas are counter-proliferation analysis, proliferation detection systems, tactical systems, and missile and nuclear technology.

Counter-terrorism and Incident Response

The Counter-terrorism and Incident Response Program focuses on the response phase, including responding to incidents involving WMD. LLNL develops technologies and capabilities to deal with WMD emergencies or terrorist incidents. This program also serves as the focus for local, national, and international emergency response to WMD incidents. Major program areas are nuclear threat assessment, nuclear incident response, chemical and biological detection technologies, and forensic science.

The Forensic Science Center focuses on chemical, nuclear, and explosives counter-terrorism. It provides chemical and analytical science and support to the NAI, as well as to other LLNL and national sponsors.

The multidisciplinary staff provides expertise in organic and inorganic analytical chemistry, nuclear science, biochemistry, and genetics, useful for supporting law enforcement and for verifying compliance with international treaties and agreements.

International Assessments

The International Assessments Program addresses the need to avoid surprise regarding the weapons programs of foreign countries. LLNL conducts analyses and research related to the development and deployment of WMD by countries, states, and groups hostile to the U.S. These assessments provide important input to policy makers and diplomats as they develop strategies for U.S. responses to events affecting national and international security. Major program areas are nuclear weapons states, export control, emerging threats, counterintelligence, and proliferation concerns around the world.

Center for Global Security Research

The Center for Global Security Research brings scientists and technologists together with analysts and others from the policy community to study ways in which technology can enhance national and international security. This program supports independent, multidisciplinary research that considers the integration of technology in defense, arms control, nonproliferation, and peacekeeping. Major program areas are reduction in the threats associated with WMD, security implications of emerging technologies, anticipation and management of threats to international security, and future roles of deterrence and military force.

A.1.2.5 *Homeland Security Organization*

LLNL announced the formation of the Homeland Security Organization on December 10, 2002 (LLNL 2002u). The Homeland Security Organization will be the center for LLNL interactions with the Federal Government's Department of Homeland Security. Initially, this organization will be responsible for those LLNL activities explicitly transferred from NNSA to the new Department. Homeland Security at LLNL is divided into six programs: Chemical and Biological Countermeasures, Nuclear and Radiological Countermeasures, Systems Analysis and Studies, Information Analysis and Infrastructure Protection, Border and Transportation Security, and Emergency Preparedness and Response.

Chemical and Biological Countermeasures

This program focuses on addressing the national needs for technologies to quickly detect, identify, and mitigate the use of chemical and biological threat agents against the U.S. civilian population. The principal program is the Chemical and Biological National Security Program, within which are several notable projects, including the Biological Aerosol Sentry and Information System Project, Autonomous Pathogen Detection System, Advanced Biodetection Technology, Biological Signatures, the Forensic Science Center, In situ Chemical Sensors, and Remote Chemical Sensing.

Nuclear and Radiological Countermeasures

The Nuclear and Radiological Countermeasures Program focuses on developing technical capabilities aimed at countering the threat of terrorist use of a nuclear or radiological device in or near a U.S. population center, or from detecting and tracking nuclear material to forensic attribution in the event of a nuclear incident. Projects include nuclear emergency response, cargo container security, radiation detection, and detection and tracking systems.

Systems Analysis and Studies

This program focuses on identifying and understanding gaps in U.S. preparedness and response capabilities and the associated opportunities for technology. Systems studies are conducted to evaluate the effectiveness of alternative approaches to mitigating the damage and disruption resulting from a full range of catastrophic terrorist threats. Elements of this program include homeland security analysis, vulnerability assessment of the U.S. energy infrastructure, and outreach to operation entities.

Information Analysis and Infrastructure Protection

This program is aimed at developing tools and capabilities for gathering, manipulating, and mining vast quantities of data and information for the purpose of detecting early warnings of terrorist intentions. The program consists of the Computer Incident Advisory Center, operated as DOE's cyber alert and warning center; the Information Operations and Assurance Center; International Assessments; and Nuclear Threat Assessment.

Border and Transportation Security

Activities in this area address opportunities for technology to enhance U.S. border and transportation security, from nuclear detection systems for maritime and air cargo and automated facial screening of airline passengers, to integrated data management systems for immigration and border control. Projects supporting this program include concrete-penetrating radar, baggage-screening technologies, and truck-stopping devices.

Emergency Preparedness and Responses

This program focuses on the development of technical capabilities for minimizing the damage and recovering from any terrorist attacks. The program works with local, regional, state, and Federal first responders to ensure that the tools developed meet real-world needs. This program includes: the National Atmospheric Release Advisory Center (NARAC), a leader in real-time assessment of the atmospheric dispersion of radionuclides and chemical and biological agents; Joint Conflict and Tactical Simulation (JCATS); and the Homeland Operational Planning System, developed in partnership with the California National Guard, for homeland security and analysis.

A.1.2.6 *Energy and Environment*

Energy and Environment performs research in water and environment, energy technology, carbon management and climate change, the national nuclear waste repository, and aspects of homeland and national security. Energy and Environment also provides discipline support in atmospheric, earth, environmental, and energy science to other LLNL programs. The six programs in Energy and Environment are described below.

Carbon Management and Climate Change Program

The Carbon Management and Climate Change Program includes research in the areas of climate science, the carbon cycle, carbon management, and the interrelationships between the fate and effects of carbon in the biosphere, atmosphere, ocean systems, and climate change. Research areas include the DOE Program for Climate Model Diagnosis and Intercomparison; DOE's Atmospheric Radiation Measurement Program; programs in atmospheric chemistry; climate research, especially involving the coupling of models to carbon and the increase in model resolution; and carbon management, including research into ocean carbon sequestration, geologic sequestration, and carbon monitoring.

Energy Technology and Security Program

The Energy Technology and Security Program conducts R&D in fossil, renewable, and nuclear energy technologies to increase the efficiency of existing energy technologies while minimizing environmental impact and developing environmentally responsible technologies.

One project is DOE's Highly Enriched Uranium Transparency Implementation Program, which monitors the down-blending of highly enriched uranium (HEU) from Russian nuclear weapons to low enriched uranium that is sold to the U.S. Examples of other projects include developing solid oxide fuel cells, reducing aerodynamic drag of heavy vehicles, researching homogeneous charge compression ignition engines, and researching the cryogenic storage of hydrogen.

National Security Support Program

This program supports LLNL's mission through research, development, and engineering as it relates to homeland security, weapons programs, stockpile stewardship, nonproliferation, international assessment, and defense-oriented program areas. This program identifies, coordinates, and applies science and technology in the areas of earth, atmospheric, and environmental monitoring; risk assessment; data fusion; energy propagation in complex materials; earth system modeling and simulation; and energy technologies.

Risk and Response Management Program

This program includes research and technology development in systems safety, systems security, natural and anthropogenic hazards, and atmospheric release assessment and modeling. The program includes atmospheric release assessment programs for predicting and assessing the dispersal of hazardous material released into the atmosphere, which also encompasses the NARAC; security and protection programs to enhance human vigilance, decision-making, and control through automation; and risk and safety management, which includes performing risk and hazard assessments, evaluating packaging and transportation safety, and providing regulatory support to government agencies.

Water and Environment Program

This program covers research and development in water security, environmental fate and transport, environmental technologies, and environmental consequence analysis. This program includes work performed by the Center for Accelerator Mass Spectrometry (CAMS); the Marshall Islands Dose Assessment and Radioecology Program, at atolls in the Pacific Ocean contaminated with nuclear fallout from earlier weapons testing; water security projects to protect the Nation's water supplies and distribution systems; projects for protection from global environmental threats; and projects addressing issues of the fate, transport, and consequences of contamination in the environment.

Yucca Mountain Program and Repository Science Program

This program includes materials testing and performance modeling of the storage canister and system of engineered barriers to surround radioactive waste and supports project milestones toward the repository's license application. This program also includes work on international repository initiatives.

A.1.2.7 *Biology and Biotechnology Research Program*

The Biology and Biotechnology Research Program (BBRP) conducts basic and applied research in the health and life sciences in support of national needs to understand causes and mechanisms of ill health, develop biodefense capabilities for national homeland security, improve disease prevention, and lower health-care costs. BBRP work is focused on the following five scientific areas (LLNL 2002an):

- **Biodefense –** Provides the underpinning science and tools needed to combat bioterrorism and infectious disease.
- **Computational and Systems Biology –** Develops a predictive, systems level understanding of biological processes by applying advanced simulation capabilities to complex experimental data.
- **Genome Biology –** Increases understanding of genetic structure, function, regulation and evolution through genome scale approaches to developing, interpreting, and displaying genetic data.
- **Health Effects Genetics –** Increases understanding of the cellular and tissue effects of radiation chemical exposures through novel genomic- and biochemical-based approaches and links this understanding to risk assessments, diagnoses, and treatments.

- **Molecular Biophysics –** Develops and applies tools for measuring biochemical and cellular components and processes, emphasizing data that support predictive understanding through complex simulation and modeling.

A.1.2.8 *Physics and Advanced Technologies*

The Physics and Advanced Technologies (PAT) Program's focus areas include high-energy density physics, astrophysics, condensed matter physics, and nuclear particle and accelerator physics. Program focus areas also include fusion energy, medical technology, imaging and advanced detectors (LLNL 2002bh). The major facilities supporting experimental research include the Ultra-Short Pulse Laser Facility, a two-stage light-gas gun facility, 100-million-electron volt electron-positron linear accelerator, the Electron Beam Ion Trap Facility, and the Experimental Test Accelerator II Facility. To carry out its mission, the PAT is organized into three groups: Physical Data Research, Laboratory-Directed Research and Development (LDRD), and License- and Royalty-Funded Research and Development.

Physical Data Research Program

The Physical Data Research Program provides validated physical data and models for the Stockpile Stewardship Program in the areas of nuclear physics, atomic physics, condensed matter/materials science, plasma physics, and the interaction of radiation with matter.

Laboratory-Directed Research and Development Program

The LDRD Program provides a suitable method for LLNL directors to fund projects that are creative and innovative, but that might not otherwise receive funding via the usual process. LDRD activities are governed by DOE Order (O) 413.2A and other NNSA Headquarters and NNSA Livermore Site Office guidance. Recently, responsibility for the LDRD Program has been transferred to the Laboratory Science and Technology Office.

License- and Royalty-Funded Research and Development Program

The License- and Royalty-Funded Research and Development Program provides private funding for R&D through cooperative research and development agreements (CRADAs) and licensing technologies developed by LLNL. A CRADA is an agreement entered into between the University of California, as operator of LLNL, and one or more participants including at least one non-federal party under which LLNL provides personnel, services facilities, equipment, or other resources towards the conduct of specified Research and Development.

A.1.2.9 *Chemistry and Materials Science*

Chemistry and Materials Science (CMS) provides scientific and technical expertise supporting LLNL's programs, performs work for others under reimbursable contracts, and conducts original research. R&D activities include chemical analysis and characterization, advanced materials, metallurgical science and technology, surfaces and interfaces, energetic materials and chemical synthesis, and energy-related projects. CMS contains three divisions: Chemical Biology and

Nuclear Science Division, Chemistry and Chemical Engineering Division, and Materials Science and Technology Division.

Chemical Biology and Nuclear Science

The Chemical Biology and Nuclear Science Division performs applied research in science at the intersection of biology, chemistry, and nuclear science. Programmatic activities are focused on radiochemistry and nuclear science for the Stockpile Stewardship Program, radiation detection and spectroscopy for proliferation prevention and environmental monitoring, mass spectrometry and ion probe spectrometry, biochemistry and bio-analytical techniques, and state-of-the-art analytical chemistry, including various force and optical microscopy to support LLNL programs. The division also conducts fundamental research in several areas including computational biology, biomolecular and bio-agent interactions and detection and single cell proteomics, heavy element research, transport of actinide colloidal complexes in groundwater, environmental radiochemistry such as cycling of iodine in the environment, isotopically-enhanced molecular targeting, and nanophotonics.

Chemistry and Chemical Engineering

The Chemistry and Chemical Engineering Division conducts fundamental and applied research in chemistry under extreme conditions and on energetic materials and provides chemical engineering in support of national security programs. The division also provides chemistry and chemical engineering support to LLNL programs, including optics development for the NIF, high explosives and energetic materials development for the Stockpile Stewardship Program, and foreign threat assessments and capabilities for development of WMDs.

Materials Science and Technology

The Materials Science and Technology Division conducts fundamental and applied research with a focus on materials properties and performance under extreme conditions. The division also provides metallurgy, ceramics, electrochemical processing, materials science, material characterization, surface science, solid-state chemistry, and materials theory and modeling support to LLNL programs.

A.1.2.10 *Engineering*

Engineering contains two distinct disciplines: Electronics Engineering and Mechanical Engineering. Engineering also operates five technology centers.

Electronics Engineering

Electronics Engineering is responsible for the design and development of the core technologies needed for the development of microtechnologies, laser systems and electro-optics, pulsed-power electronics, diagnostic instrumentation, and advanced computational modeling and simulation. This division also provides instrumentation services, electronics fabrication, design drafting and documentation, computer systems support, and communications systems.

Mechanical Engineering

Mechanical Engineering provides a wide range of design, analysis, fabrication, and testing services to support LLNL programs. This group tests and evaluates engineering materials, designs and develops new experimental hardware and machine tools, fabricates parts, and inspects and assembles mechanical components.

Engineering Technology Centers

Engineering's five technology centers explore future innovations in computational engineering, microtechnology, precision engineering, nondestructive characterization, and complex distributed systems. The centers are responsible for the viability and growth of the core technologies each represents, including designing and building complex instruments and machines ready for production, designing and helping construct most of LLNL's unique test facilities, and conducting research in advanced, broad-application technologies for application across all LLNL programs (LLNL 2003g).

A.1.2.11 *Computation*

Computation provides integrated computing and information environments, scientific visualization facilities, high-performance storage systems, multi-resolution data analysis, scalable numerical algorithms, computer applications, and information management systems in support of LLNL missions and programs. Directorate missions include providing a balanced, seamless, high-performance computing environment that scales from desktop to petaflop; design, development, and delivery of integrated information systems and multidisciplinary applications; and development and implementation of software technologies to optimize software development and maintenance (LLNL 2003h). Computation is a key partner in the execution of the Advanced Simulation and Computing Initiative (ASCI). To carry out its mission, Computation is organized into three groups.

Integrated Computing and Communications

The Integrated Computing and Communications (ICC) group provides computing and networking environments to support stockpile stewardship computational efforts and a variety of other programs at LLNL. This group also undertakes essential computational, communication, and computer security research required to sustain this computing environment. Divisions in this group include High Performance Systems, Science and Development, Computer Systems Support, and Networks and Services.

Computing Applications and Research Department

The Computing Applications and Research (CAR) Department partners with other LLNL programs to develop software technologies and application codes in support of NNSA's mission in the defense, energy, and life sciences. This organization also conducts collaborative R&D in computer science, mathematics, and scientific computing focused on the long-term needs of LLNL and NNSA programs.

Chief Information Officer

The Chief Information Officer for the Computation Directorate provides oversight for information technology (IT) at LLNL. Of chief concerns are maximizing common IT solutions for economy of scale and uniformity of purpose; providing IT solutions; and interacting with DOE, NNSA, and the U.S. Office of Management and Budget on regulatory issues in security, information architecture, and e-government initiatives.

A.1.3 Lawrence Livermore National Laboratory Institutional Support Organizations

A.1.3.1 *Administration and Human Resources*

Administration and Human Resources is responsible for executing the policies affecting LLNL personnel and administrative support functions. Its mission is to promote initiatives that develop and retain a high-quality workforce and create an environment that enhances LLNL's performance. The Directorate includes Human Resources; Office of Strategic Initiatives and Diversity; Financial/Facility Manager; IT and Projects Office; Staffing and Employment Development; Compensation, Benefits and Worklife Programs; Office of Laboratory Council; Public Affairs; Audit and Oversight; Office of Contract Management; and Industrial Partnerships and Commercialization.

A.1.3.2 *Laboratory Services*

Laboratory Services manages a major segment of LLNL infrastructure and provides services in the areas of administrative information systems, plant engineering, procurement and material, innovative business and information services, utilities, and telecommunications systems.

A.1.3.3 *Safeguards and Security Organization*

The Safeguards and Security Organization is responsible for protective force operations; information and personnel security, including clearances, badging, and information and security awareness; physical security systems, alarm design, installation, and maintenance; and program planning for policy, risk management, audits and inspections, order compliance, and contract performance.

A.1.3.4 *Safety and Environmental Protection*

Safety and Environmental Protection supports LLNL programs and employees by providing resources and services to meet its objectives of environmental protection, occupational health, employee safety, emergency response, and quality assurance. Safety and Environmental Protection is divided into three departments to manage operational activities: Environmental Protection, Hazards Control, and Health Services.

Environmental Protection

The Environmental Protection Department is responsible for environmental restoration, environmental monitoring, environmental regulatory compliance, and hazardous waste management.

Hazards Control Department

The Hazards Control Department is responsible for minimizing the risks associated with research and support activities at LLNL. This includes biological, chemical, and physical agents and radioactive and industrial hazards associated with both normal operating conditions and emergencies.

Health Services Department

The Health Services Department provides LLNL personnel with onsite medical treatment for urgent drop-in services, personal counseling, health-risk evaluations, medical surveillance, and library services, to help each employee achieve personal health.

A.2 LIVERMORE SITE

The Livermore Site is located about 40 miles east of San Francisco at the southeast end of the Livermore Valley in eastern Alameda County, California. The city of Livermore's central business district is located about 3 miles to the west. The Livermore Site occupies a total area of approximately 1.3 square miles (821 acres). Figure A–2 and Figure A–3 show the regional location of the Livermore Site and its location with respect to the city of Livermore.

Additionally, LLNL conducts limited activities at various offsite properties near the Livermore Site. These include a childcare facility at the Almond Avenue Site in Livermore; a storage warehouse/shop at Graham Court in the city of Livermore used for equipment component storage and for the assembly of laser components; a storage warehouse on Patterson Pass Road in Livermore for receiving and storing the NIF components; and Arroyo Mocho Pump Station, located 6 miles south of the Livermore Site as the primary source of water supply. These nearby offsite properties are shown in Figure A–3. These properties are considered part of the Livermore Site for purposes of discussion in this appendix.

Although LLNL conducts some operations at the Nevada Test Site, these operations are covered in separate *National Environmental Policy Act* documentation for that site and are not addressed in this LLNL SW/SPEIS.

A.2.1 Existing Infrastructure

Infrastructure that supports Livermore Site's operation includes drainage, parking, pathways, telephones, lighting, landscaping, roads, and utilities. LLNL will continue to maintain, expand, and upgrade this infrastructure under the alternatives described in Chapter 3 of this LLNL SW/SPEIS. Figures A.2.1–1 and A.2.1–2 illustrate the site map and major roadways. Utilities serving the Livermore Site include domestic water, low-conductivity cooling water,

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- The primary source of water at the Livermore Site is the city of San Francisco's Hetch Hetchy Aqueduct, located 6 miles south of the Livermore Site at the Arroyo Mocho Pump Station. Water is pumped 850 feet to the surface by three pumps (two active and one standby) at the rate of 1,500 gallons per minute per pump. This water flows by gravity through a pipeline to storage tanks located at the southern end of the Sandia National Laboratories/California (SNL/CA), site. Both the Livermore Site and SNL/CA, are gravity-fed from these tanks. In addition to LLNL's main water supply from Hetch Hetchy, LLNL has contracted with the Alameda County Flood Control and Water Conservation District for emergency water supply. In 2002, the Livermore Site used approximately 1.2 million gallons per day of domestic water (LLNL 2003cj).

- Low-conductivity cooling water is used for the cooling systems of buildings and equipment. It recirculates in a closed-loop system. The average daily cooling energy used in 2002 was 42.7 megawatts (LLNL 2003cj).

- Demineralized water is generated onsite from domestic water. The average daily load in 2002 was 20,160 gallons (LLNL 2003cj).

- Compressed air is generated onsite. Average use in 2002 was 2,400 cubic feet per minute (LLNL 2003cj).

- Natural gas is supplied at a pressure of 60 pounds per square inch by the Pacific Gas & Electric Company. Peak use in 2002 was 18,700 therms per day (LLNL 2003cj).

- Sanitary sewer discharge goes to the city of Livermore Water Reclamation Plant. A sewer-diversion facility is used to protect against the release of accidentally contaminated sewage to the city of Livermore treatment facilities. In 2002, peak sewer discharges, including discharges from SNL/CA, were 260,000 gallons per day (LLNL 2003cj).

- Electric power is supplied by Pacific Gas & Electric Company's Tesla substation and Western Area Power Administration's Greenville substation. Electric power is distributed throughout LLNL at 13.8 kilovolts. In 2002, the system load was 57 megawatts (LLNL 2003cj).

A.2.2 Existing Facilities

The facilities located at the Livermore Site are shown in Figure A.2.1–1. The descriptions of existing facilities are limited to selected facilities. Facilities were selected because they have potentially hazardous operations or inventories, they are representative industrial or shop facilities, or they have operations unique to the site. Facilities associated with waste management, security, health services, and emergency response are also briefly described.

The selected facilities at the Livermore Site are described in Sections A.2.2.1 through A.2.2.58, and are listed in Table A.2.2–1, with information on area, use, and the principal types of hazards present. Hazards are indicated as radiological, chemical, or other. Examples of radiological hazards include low-level ionizing radiation. Examples of chemical hazards include chemicals that may be toxic, flammable, corrosive, poisonous, and/or carcinogenic. Examples of other hazards include high explosives, non-ionizing radiation, biological, the storage and handling of compressed gas cylinders, and electrical hazards. Figure A.2.2–1 highlights the selected facilities. An overview of all other facilities is included in Table A.2.2–2. Several facilities described in the *Final Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrence National Laboratory and Sandia National Laboratories* (1992 LLNL EIS/EIR) (LLNL 1992a) have been demolished or removed. Facilities that have been demolished or removed are highlighted in Figure A.2.2–2.

Each selected facility is described with location, square footage, and operations; hazards assessment; and generated wastes and effluents. For a more detailed discussion on waste generation and waste management, please refer to Appendix B, Waste Management.

A.2.2.1 *Building 121*

Building 121 is located in the southwest quadrant of the Livermore Site. Prior to 2002, this 91,145-gross-square-foot facility contained machine shops, laboratories, and offices. With the exception of one machine shop, all laboratory and machine shop operations in Building 121 have been removed and the space has been converted to offices for the NAI Directorate. The one remaining machine shop is inactive and scheduled for decommissioning in the near future (LLNL 2002bh).

Hazards Assessment

General industrial hazardous operations in this facility are associated with decommissioning powered machine tools and include using solvents, oils, regulated metals, and compressed gases (LLNL 2002bh). The decommissioning of the machine shop may involve minor hazards from the removal of the equipment and the cleanup of any residual material or contamination.

Generated Wastes and Effluents

Hazardous waste and nonhazardous waste produced during decommissioning of the machine shop would include spent halogenated and nonhalogenated solvent solutions (both organic and inorganic), petroleum and mineral-based oils, empty containers, metal filings, and contaminated equipment (LLNL 2002bh).

TABLE A.2.2–1.—*Overview of Selected Facilities at the Livermore Site*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other	Hazard		
								Chemical	Radiological	Other [a]
121	Physics & Advanced Technology	91,145	Yes	Yes	Yes			Yes		Yes
131	Engineering	287,192	Yes	Yes	Yes	Yes		Yes	Yes	
132N	DPRF	204,559	Yes	Yes	Yes	Yes		Yes	Yes	Yes
132S	NAI/Physics	168,715	Yes	Yes	Yes	Yes		Yes	Yes	
134	Storage (part of B132S Complex)	1,284				Yes				
135	Storage (part of B132S Complex)	1,338			Yes	Yes				
141	Electronics Shop	50,927	Yes	Yes	Yes	Yes		Yes		Yes
151	Isotope Sciences Facility (part of B151 Complex)	87,963	Yes	Yes	Yes	Yes		Yes	Yes	Yes
152	Generator House (part of B151 Complex)	751			Yes	Yes		Yes	Yes	
153	Microfabrication Laboratory	24,967	Yes	Yes	Yes	Yes		Yes	Yes	
154	BioSecurity and NanoSciences Laboratory (part of B151 Complex)	9,504	Yes	Yes	Yes			Yes	Yes	Yes
155	Isotope Sciences Facility (part of B151 Complex)	22,000	Yes							
161	Physics and Advanced Technologies	6,119		Yes	Yes			Yes		Yes
162	Research/Crystal Growth	19,840	Yes	Yes				Yes	Yes	Yes
165	Optics Development Laboratory	8,347	Yes	Yes				Yes	Yes	Yes
166	Development Laboratory	10,864		Yes	Yes	Yes		Yes	Yes	Yes
171	Development Laboratory	8,632		Yes		Yes		Yes	Yes	Yes
173	Welding Shop	413			Yes					Yes
174	Laser Target Research	19,360	Yes	Yes				Yes	Yes	Yes
174A	Laser Target Research	20,365		Yes				Yes	Yes	Yes
176	Shipping/Receiving	3,958	Yes		Yes	Yes		Yes		Yes
179	Development Laboratory	2,720		Yes				Yes		Yes
190	CAMS Facility	10,086		Yes				Yes	Yes	Yes
191	High Explosives Application Facility	120,116	Yes	Yes	Yes	Yes		Yes	Yes	Yes
194	100-MeV Accelerator LINAC Facility	42,031	Yes	Yes	Yes			Yes	Yes	Yes
197	Development Laboratory	10,500		Yes	Yes			Yes		Yes
198	Physics	966		Yes		Yes		Yes		Yes
231	Development and Assembly Engineering	131,454	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
231V	Materials Management Vault	5,426			Yes			Yes	Yes	

TABLE A.2.2–1.—*Overview of Selected Facilities at the Livermore Site (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other	Hazard		
								Chemical	Radiological	Other [a]
232	Fenced Area for Materials Management	1,200			Yes	Yes		Yes	Yes	
233	Materials Management	4,900	Yes		Yes	Yes		Yes	Yes	
235	WMRDF	88,475	Yes	Yes	Yes	Yes		Yes	Yes	Yes
239	Radiography Facility	12,517	Yes	Yes	Yes			Yes	Yes	
241	Material Science	53,935	Yes	Yes	Yes	Yes		Yes	Yes	Yes
243	Energy and Environmental Research Facility	17,884	Yes	Yes	Yes	Yes		Yes	Yes	
251	Heavy Element Facility	31,809	Yes	Yes	Yes	Yes		Yes	Yes	
253	HC Department	32,276	Yes	Yes	Yes			Yes	Yes	Yes
254	Bioassay Laboratory	2,465		Yes				Yes	Yes	Yes
255	Calibration Facility	21,813	Yes	Yes	Yes			Yes	Yes	Yes
261	Office	41,221	Yes	Yes	Yes	Yes		Yes		
262	Development Laboratory	11,976		Yes		Yes		Yes	Yes	
271	Protective Force Office	17,278	Yes			Yes				Yes
272	Electro-Opt. Development Laboratory	9,978	Yes	Yes		Yes		Yes		Yes
280	RHWM Waste TSDF	5,343		Yes		Yes		Yes	Yes	
281	HEA Laboratories	18,549	Yes	Yes	Yes			Yes	Yes	Yes
298	Fusion Target Fabrication	47,780	Yes	Yes	Yes			Yes	Yes	Yes
313	Dispatch Center	4,444	Yes							Yes
321	Materials Fabrication Shop	149,489	Yes		Yes	Yes		Yes	Yes	Yes
322	Plating Shop	5,822	Yes	Yes	Yes			Yes	Yes	
322A	Plating Shop Annex	340			Yes			Yes		
323	Fire Station	18,555	Yes		Yes	Yes				Yes
327	Nondestructive Evaluation Facility	19,052	Yes	Yes	Yes			Yes	Yes	Yes
328	Hazards Control Fire Test	372		Yes						Yes
329	Laser Weld Shop	5,214	Yes	Yes	Yes			Yes	Yes	Yes
331	Tritium Facility	28,493	Yes	Yes	Yes	Yes		Yes	Yes	
332	Plutonium Facility	104,687	Yes	Yes	Yes	Yes		Yes	Yes	
334	HETB	8,600	Yes	Yes				Yes	Yes	
341	Physics and Advanced Technology	44,322	Yes	Yes	Yes	Yes		Yes	Yes	Yes
343	High Pressure Laboratory	25,590	Yes	Yes	Yes			Yes	Yes	Yes
361	Biological Research	67,672	Yes	Yes		Yes			Yes	Yes

TABLE A.2.2–1.—*Overview of Selected Facilities at the Livermore Site (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other	Hazard		
								Chemical	**Radiological**	**Other [a]**
362	Biological Research	3,749	Yes	Yes		Yes			Yes	
363	Biological Research	1,584		Yes					Yes	
364	Biological Research	10,951		Yes					Yes	
365	Biological Research	8,871	Yes	Yes				Yes	Yes	Yes
366	Biological Research	2,620	Yes	Yes					Yes	
368	Biological Research	1,500		Yes						Yes
376	Machine Shop	1,560	Yes		Yes					Yes
377	Biological Research	4,333	Yes	Yes		Yes			Yes	
378	Environmental Radioactivity Analysis Laboratory	3,840	Yes	Yes		Yes		Yes	Yes	Yes
379	Gamma Spectrometry Facility	1,500		Yes				Yes	Yes	Yes
381	Laser Facility	101,598	Yes	Yes		Yes			Yes	Yes
391	ICF Laser Facility	186,594	Yes	Yes	Yes				Yes	Yes
392	Optics Laboratory	8,401		Yes				Yes		Yes
431	Accelerator Research Center	150,366	Yes	Yes	Yes	Yes		Yes	Yes	Yes
432	Mechanical Shop-NIF	34,747	Yes	Yes	Yes	Yes		Yes	Yes	Yes
435	Corrosion Research and the NIF Support	54,768	Yes	Yes	Yes	Yes	Yes	Yes		Yes
446	YMP Experimental Facility	1,730		Yes		Yes		Yes	Yes	Yes
453	Terascale Simulation Facility	253,000	Yes	Yes			Yes	Yes		Yes
511	Crafts Shop	76,552	Yes		Yes			Yes		Yes
513	RHWM Liquid Waste TSDF	5,638		Yes	Yes	Yes		Yes	Yes	
514	RHWM Liquid Waste TSDF	4,957	Yes	Yes	Yes	Yes		Yes	Yes	
518	Gas Cylinder Dock	3,270			Yes	Yes		Yes		Yes
518A	Chem Track Facility	195				Yes		Yes		Yes
519	Shop Facility/Fuel Storage	10,206	Yes		Yes	Yes		Yes		Yes
520	Pesticide Storage	400				Yes		Yes		
531	Custodians and Gardeners Shop	12,589	Yes		Yes			Yes		
581	The NIF LTAB	677,757	Yes	Yes				Yes	Yes	Yes
612	RHWM Waste TSDF	11,308		Yes	Yes	Yes		Yes	Yes	
614	RHWM Waste TSDF	1,188		Yes		Yes		Yes	Yes	
621	CNG Fuel Station	824			Yes					Yes
625	RHWM Waste TSDF	4,800		Yes		Yes		Yes	Yes	

TABLE A.2.2–1.—*Overview of Selected Facilities at the Livermore Site (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other	Hazard		
								Chemical	Radiological	Other [a]
663	Health Services	24,784	Yes					Yes		Yes
681	Optics Assembly Building - NIF	46,885		Yes				Yes		Yes
693	HWM Waste Storage	9,600		Yes		Yes		Yes	Yes	
695	DWTF	33,000	Yes	Yes		Yes		Yes	Yes	
696	DWTF	10,184		Yes	Yes	Yes		Yes	Yes	
696R	DWTF	9,960				Yes			Yes	
697	EPD/RHWM Waste Storage/ Warehouse	3,780	Yes	Yes	Yes			Yes	Yes	
T1527	Bioagent Sensing and Testing Lab	3,841	Yes	Yes	Yes			Yes		Yes
T1879	Electronic Fabrication and Testing (part of 197 Complex)	11,118	Yes	Yes				Yes		Yes
T3203	Materials Fabrication (part of 321 Complex)	632			Yes			Yes	Yes	Yes
T6675	Edward Teller Education Center	3,200		Yes		Yes	Yes	Yes		Yes

Source: Original.

[a] Other hazards include high explosives, accelerators, x-ray machines, lasers, biological, the storage and handling of compressed gas cylinders, and electrical hazards.

CNG = Compressed Natural Gas; DPRF = Defense Program Research Facility; DWTF = Decontamination and Waste Treatment Facility; EPD = Environmental Protection Department; HC = Hydrocarbon; HEA = Health and Ecological Assessment; HETB = Hardened Engineering Test Building; ICF = Inertial Confinement Fusion; LINAC = LLNL Electron-Positron Accelerator; LTAB = Laser and Target Area Building; MeV = million electron volts; NIF = National Ignition Facility; RHWM = Radioactive and Hazardous Waste Management; TSDF = Treatment, Storage, Decontamination Facility; WMRDF = Weapons Materials Research and Development Facility; YMP = Yucca Mountain Project.

TABLE A.2.2–2.—*Overview of All Other Facilities at the Livermore Site*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
11	ERD Treatment Facility	402			Yes		
41S	Security Kiosk	60			Yes		
41	Long-term Storage	24,258	Yes		Yes	Yes	
42	ERD Treatment Facility	402					Yes
71	Westgate Badge Office	4,166	Yes				
71OSN	Security Kiosk	132			Yes		
110	Storage	150				Yes	
111	Offices	105,448	Yes			Yes	
113	Computations/LCC	87,493	Yes	Yes			
113OSE	Security Kiosk	34			Yes		
115	Computer Simulations	16,952	Yes				
116	Offices	7,555	Yes				
117	Computer Simulations	11,087	Yes				
118	Teleconference Facility	1,504			Yes		
119	Telephone Switching Node	2,061			Yes		
122	Offices	1,181	Yes				
122OSS	Guard Kiosk	225			Yes		
123	Auditorium	7,830			Yes		
125	West Cafeteria	12,871	Yes			Yes	
133	Central Plant	5,631				Yes	
164	Preparation/Lasers	207			Yes		
170	National Atmospheric Release Advice Center	43,760	Yes				
170A	NARAC Storage	800				Yes	
172	Telephone Switching Node	675			Yes		
175	MARS Facility	16,183	Yes	Yes	Yes		
181	Office Area Light Laboratory	13,453	Yes	Yes	Yes		
182	Neutrino Mass Experiment	1,958				Yes	
187	ERD Treatment Facility	1,225					Yes
193	Sewer Diversion Facility	72					Yes
193A	SVRC Monitoring Station	144			Yes		
195	EPD/ORAD Shop	400			Yes		
196	EPD/ORAD SVRC Monitor Station	853		Yes			
196A	EPD/ORAD Storage	112				Yes	
211	Offices	14,206	Yes				
212	Vacant	50,753	Yes	Yes	Yes		
213	Offices	2,012	Yes				
214	Assurance Review Office	4,922	Yes				
216	Offices/Computing	18,982	Yes				
217	Offices	18,100	Yes				
218	Offices	18,065	Yes				
219	UC Institutes	17,791	Yes				
221	Computation	1,764	Yes	Yes	Yes		

TABLE A.2.2–2.—*Overview of All Other Facilities at the Livermore Site (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
222	Chem Lab	45,080	Yes	Yes			
230	231 Portal (Part of B231 Complex)	377			Yes		
234	Offices (Part of B231 Complex)	5,261	Yes				
235OSN	Security Kiosk	32			Yes		
252	HC/Shipping and Receiving	192				Yes	
256	Telephone Switching Node	5,615	Yes		Yes		
261OSW	Guard Kiosk	32			Yes		
263	Telephone Filter Facility	77			Yes		
270	UPS B271	433			Yes		
273	Line of Site Vault	832				Yes	
274	Security Administration	21,436	Yes		Yes	Yes	
282	Applied Science Laboratory (mothball)	2,160					Yes
283	Telephone Switching Node	216			Yes		
291	LCW Station	6,979			Yes		
292	CAMS Support	20,709	Yes	Yes			
293	CAMS Storage	800				Yes	
294	CAMS Sample Preparation Laboratory	960		Yes			
295	Pump House	1,128			Yes		
297	Waste Paper Recycling	992			Yes		
297A	Document Destruction	320			Yes		
299	Telephone Switching Node	675			Yes		
311	Offices	42,372	Yes			Yes	
312	South Cafeteria	11,422	Yes		Yes		
312A	Storage Facility	107			Yes		
313A	Telephone Switching Node	216			Yes		
313B	Emergency Communications Center	336			Yes		
314	Offices	13,401	Yes				
315	Offices	17,977	Yes				
316	DOE Offices	14,400	Yes			Yes	
316OSN	Security Kiosk	49			Yes		
317	LLESA Store	1,228			Yes		
318	Pool Change Room	6,034					Yes
319	University Relations Program	17,826	Yes				
3203	Materials Fabrication Division		Yes				
321D	EE Fabrication	2,081	Yes		Yes		
321E	MMED Boiler Room	2,442			Yes		
324	HC Respirator/Fire Science	11,146			Yes		
325	LCW Control	5,034	Yes		Yes		
326	Vacant	3,474	Yes			Yes	
328A	Vacant	720		Yes			
328B	Duct and Filter Storage	288				Yes	
328C	LCW Control Building	300					Yes
335	Support Facility	12,221	Yes	Yes			
335A	Emergency Response Facility	64				Yes	
335B	Emergency Response Facility	64				Yes	
336	South Security Portal	792			Yes		

TABLE A.2.2–2.—*Overview of All Other Facilities at the Livermore Site (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
337	NW Security Portal	792			Yes		
338	Guard Tower	417					Yes
345	Vacant	9,468	Yes	Yes	Yes		
367	Biology and Biotech Research	625	Yes				
373	BBR Warehouse	1,784				Yes	
382	Tech Support	297	Yes				
383	Machine Shop	7,054	Yes		Yes		
394	Chemical Storage	144				Yes	
404N	Warehouse	6,460	Yes		Yes	Yes	
404S	Battery Shop		Yes		Yes		
405	Industrial Electronics	8,702	Yes		Yes	Yes	
406	Offices	345		Yes		Yes	
411	Main Warehouse and Distribution	69,505	Yes		Yes	Yes	
411OSS	Security Kiosk	60					Yes
412	Vacant	28,607	Yes	Yes	Yes	Yes	
415	Science & Technology Education	19,018	Yes			Yes	
415OSW	Guard Kiosk	154					Yes
416	Steam Plant	743					Yes
418	Paint Shop	12,414	Yes		Yes		
419	RHWM Industrial (mothball)	7,687	Yes	Yes	Yes	Yes	
423	Accelerator Research Center	8,710	Yes	Yes	Yes		
424	Electrical Substation	4,456					Yes
430	Telephone Switching Node	675					Yes
433	Vacant	5,784				Yes	
436	Energy Research	9,693		Yes	Yes	Yes	
438	ERD Field Operations	16,097	Yes	Yes	Yes		
439	Computer Center/Archives	11,784	Yes				
442	RHWM Shop/Corp yard/Storage	4,098	Yes		Yes		
443	Storage	8,981	Yes		Yes	Yes	
444	Tel. Equip. Storage	805			Yes		
445	High Field Test Facility (mothball)	5,121		Yes		Yes	
448	Telephone Switching Node	675					Yes
451	Computer Center/Offices	51,232	Yes		Yes		
452	SC&CD Emerg. Power Cover	507					Yes
470	Telephone Switching Node	675					Yes
472	ERD Treatment Facility	1,313					Yes
473	AIS Storage	196				Yes	
481	Office	60,932	Yes			Yes	
482	Office	106,464	Yes				
490	Demonstration	171,162	Yes	Yes	Yes		
491	Vacant	13,138		Yes			
492	Vacant	9,602		Yes	Yes		
493	NIF Storage	18,964	Yes			Yes	
494	NIF Storage	30,873	Yes			Yes	
501	Office	200	Yes				
509	Sheet Metal Shop Storage	254				Yes	

TABLE A.2.2–2.—*Overview of All Other Facilities at the Livermore Site (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
510	UPS Battery Bank	144			Yes		
512	Craft Storage	5,896	Yes			Yes	
515	Crafts Storage/Receiving	8,409	Yes		Yes	Yes	
516	Crafts Facility/Machine Shop	6,333	Yes				
517	Offices	6,090	Yes		Yes		
517A	Custodial Laundry Room	462			Yes		
522	Restroom Facility	508					Yes
523	Weld/Carpentry Work Shed	3,507			Yes		
525	Electrician Shop Area	1,080			Yes		
532	EPD/ORAD Service Building	215			Yes	Yes	
533	EPD/DO Storage	320				Yes	
534	EPD/ORAD Storage	245			Yes		
543	Offices	80,875	Yes		Yes	Yes	
551E	Offices	41,059	Yes		Yes		
551W	Offices/Print Shop	66,423	Yes		Yes		
571	Offices	41,938	Yes				
581Cor	Clean Component Transport Corridor	165,019					Yes
582	Storage	2,933				Yes	
591	NIF Storage	3,200				Yes	
597	EPD/ERD Corp. Yard	260	Yes		Yes		
597A	Restroom and Shower Facility	99					Yes
599	Telephone Switching Node	688					Yes
611	Auto Fleet Maintenance Shop	14,790	Yes		Yes		
615	Training/Outreach Facility	3,421	Yes				
616	Donation, Util. & Salvage	2,216	Yes				
619	Donation, Util. & Salvage	2,047				Yes	
623	Fire Riser Storage	146				Yes	
624	Offices	240	Yes				
639	Storage	448				Yes	
651	Visitor Center	2,390					Yes
651OSN	Guard Kiosk	93					Yes
652	Telescope Building	253				Yes	
664	Telephone Switching Node	216					Yes
665	Medical Triage Area	576					Yes
671	Procurement & Materials	41,978	Yes				
682	Central Plant	8,800					Yes
683	NIF Cooling Plant	3,246					Yes
684	NIF Chemical Storage	310				Yes	
691	LODTM Facility	18,407	Yes	Yes	Yes		
694	Offices	10,590	Yes				
1253	Vacant	1,080	Yes				
1277	DNT Facility	4,058	Yes				
1280	Offices	5,644	Yes				
1401	Offices	5,113	Yes				
1402	Offices	5,113	Yes			Yes	
1403	Offices	5,113	Yes				

TABLE A.2.2–2.—*Overview of All Other Facilities at the Livermore Site (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
1404	Offices	5,226	Yes				
1405	Offices	5,113	Yes				
1406	Office/Computer Areas	5,200	Yes				
1407	Restroom Trailer	520					Yes
1408	Vending Machine Trailer	184					Yes
1413	Offices	1,040			Yes		
1456	Offices	4,914	Yes				
1460	Offices	720	Yes				
1477	Offices	10,749	Yes				
1478	Vacant	9,929	Yes				
1481	Electronics Engineering Department	5,275	Yes			Yes	
1492	Offices	1,040	Yes				
1526	Offices	1,380	Yes				
1541	Offices	2,149	Yes				
1578	Offices	6,385	Yes				
1579	Offices	1,305	Yes				
1601	Offices	2,228	Yes				
1602	Vacant	2,217	Yes		Yes		
1632	Offices	4,261	Yes				
1677	Offices	28,747	Yes		Yes		
1678	Offices	3,550	Yes				
1713	Restroom/Shower Trailer	335					Yes
1714	Restroom/Shower Trailer	270					Yes
1715	Mobile LIDAR Laboratory	528		Yes			
1726	Offices	2,160	Yes				
1727	Technology Support/Laser Development	1,837	Yes				
1730	Offices	2,100	Yes		Yes		
1735	Offices	3,261	Yes				
1736	Security	4,526	Yes				
1739	Offices	5,724	Yes				
1802	Restroom Facility	411	Yes				
1826	Document Archival Storage	3,590				Yes	
1830	Offices	6,470	Yes				
1878	Offices/Computer Space	6,292	Yes				
1879	Training Classrooms	11,118	Yes				
1884	Offices	2,880	Yes				
1885	Offices	4,266	Yes				
1886	Electronics Shop	3,643	Yes		Yes		
1887	Offices	5,108	Yes		Yes		
1888	Telecom Administration	11,520	Yes				
1889	Offices	17,380	Yes				
1925	Offices	2,176	Yes				
1927	Offices	2,160	Yes				
2127	Offices	2,133	Yes				
2128	Offices	2,000	Yes				
2177	Offices	2,160	Yes				

TABLE A.2.2–2.—*Overview of All Other Facilities at the Livermore Site (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
2180	Offices	1,643	Yes			Yes	
2425	Offices	2,704	Yes				
2428	Offices	4,179	Yes				
2512	Offices	359	Yes				
2525	Offices & Electrical Shop	2,160	Yes			Yes	
2526	Offices	1,549	Yes				
2529	Offices	1,040	Yes				
2530	Offices	1,595	Yes				
2552	Offices	2,100	Yes				
2554	Offices	740	Yes				
2580	Communication Center	4,203	Yes				
2598	Storage Tent	600				Yes	
2599	Storage Tent	841				Yes	
2625	Restroom Facility	240			Yes		
2626	Offices	1,591	Yes				
2627	Classroom	1,867	Yes				
2629	Offices	6,377	Yes				
2632	Laser Research Laboratory	2,202		Yes			
2633	Offices	1,595	Yes				
2679	Training Center	12,310	Yes				
2684	Offices	5,284	Yes				
2685	Offices	4,320	Yes				
2687	Offices	2,100	Yes		Yes		
2701	Shower Trailer	720			Yes		
2726	Offices	2,159	Yes				
2727	Offices	4,950	Yes				
2728	Offices	2,130	Yes				
2775	Offices	9,831	Yes				
2777	Training Facility	1,400	Yes		Yes		
2787	Exercise Trailer	2,160	Yes		Yes		
2801	Vacant	2,130		Yes			
2802	Vacant	2,130	Yes	Yes			
2804	Offices	720	Yes				
2806	Rock Preparation Laboratory	221	Yes				
2807	Offices	600	Yes				
2808	Restroom Facility	238			Yes		
2825	Offices	5,922	Yes				
2925	Offices	4,907	Yes				
3175	Offices	1,612	Yes				
3180	Offices	4,300	Yes				
3204	Offices	647			Yes		
3226	NDE Facility	3,077	Yes				
3427	Offices	6,365	Yes				
3502	Offices	684	Yes				
3520	Offices	9,732	Yes				
3526	Offices	2,165	Yes				

TABLE A.2.2–2.—*Overview of All Other Facilities at the Livermore Site (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
3527	Offices	9,792	Yes				
3550	Offices	684	Yes				
3555	Urine Sample Collection Station	508		Yes			
3577	Offices/Computer Space	4,614	Yes				
3629	Offices	2,160	Yes				
3649	Library	4,800					Yes
3703	Offices	10,068	Yes				
3724	Offices	19,810	Yes				
3725	Offices	19,815	Yes				
3726	Offices	19,824	Yes				
3751	Offices	2,240	Yes				
3775	Offices	1,386	Yes				
3777	Offices	6,390	Yes				
3903	Optical Glass Storage	2,130				Yes	
3904	E Technology Support	2,130			Yes		
3905	Test Laboratory/Drafting	2,130	Yes		Yes		
3907	E Technology Support	1,855			Yes		
3925	Meeting Facility	1,081					Yes
4104	Restroom Facility	291					Yes
4107	Science & Technology Education	382				Yes	
4161	Computation	1,229	Yes				
4177	Offices	1,577	Yes				
4180	Offices	3,120	Yes		Yes		
4181	Offices	3,692	Yes				
4182	Offices	5,180	Yes				
4184	Offices	3,799	Yes				
4199	Staging Tent	5,025				Yes	
4297	Chemical Storage	5,253				Yes	
4298	NIF Tent	5,253				Yes	
4299	MFE Tent	5,253				Yes	
4302	Offices	5,022	Yes				
4316	Offices	299	Yes				
4325	Offices	2,130	Yes				
4377	Offices/Computer Space	4,920	Yes				
4378	Offices	5,180	Yes				
4382	Offices	3,600	Yes				
4383	Offices/Computer Space	5,003	Yes				
4384	Offices	1,577	Yes				
4385	Offices	3,744	Yes				
4387	Offices	3,658	Yes				
4388	Restroom Facility	320					Yes
4399	Storage Tent	2,400				Yes	
4406	Control Room (mothball)	1,560	Yes				
4407	EPD/ERD Storage	299	Yes				
4440	Offices	5,276	Yes			Yes	
4442	Offices	5,760	Yes			Yes	

TABLE A.2.2–2.—*Overview of All Other Facilities at the Livermore Site (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
4475	Offices	4,176	Yes		Yes		
4509	Chemical Storage	203				Yes	
4525	Offices	5,713	Yes				
4576	Computing	848	Yes		Yes		Yes
4675	Central Cafeteria	11,236	Yes				
4725	Computer Center	9,265	Yes				
4726	Offices	9,362	Yes				
4727	Library	9,909	Yes				
4728	Library	6,710	Yes		Yes		
4729	Library	9,986					Yes
4905	Offices	322	Yes				
4906	Offices	322	Yes			Yes	
4926	Offices	1,638	Yes				
4997	NIF Storage Tent	5,253				Yes	
4997A	NIF Storage Tent	2,400				Yes	
4998	NIF Storage and Assembly	5,253				Yes	
4999	NIF Storage and Assembly	5,253				Yes	
5104	Industrial Gas Facility	624	Yes				
5105	Lunchroom	510	Yes				
5125	Office Areas	2,912	Yes				
5198	PE M&O Tent	1,500				Yes	
5207	Freon Storage	320				Yes	
5225	Offices	1,960	Yes				
5226	Offices	2,548	Yes		Yes		
5399	NIF Storage Tent	1,858				Yes	
5425	Offices	5,260	Yes				
5426	Offices	5,180	Yes				
5475	Offices	32,409	Yes				
5477	Offices	6,650	Yes				
5626	Offices	4,372	Yes				
5627	Offices	8,415	Yes				
5750	Offices	350	Yes				
5801	Rigger Trailer	520	Yes				
5925	Technology Office/Work Space	2,100	Yes				
5926	Technology Office/Work Space	2,128	Yes				
5928	Offices	2,160	Yes				
5974	Offices	5,781	Yes				
5975	Offices	6,480	Yes				
5976	Computer Support	6,209	Yes				
5977	Offices	6,340	Yes				
5978	Offices	6,480	Yes				
5979	Offices	5,680	Yes				
5980	Offices	5,680	Yes				
5981	Offices	5,744	Yes				
5982	Offices	5,742	Yes				
5983	Offices	5,680	Yes				

TABLE A.2.2–2.—*Overview of All Other Facilities at the Livermore Site (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
5984	Offices	5,680	Yes				
5985	Offices	5,680	Yes				
5999	EPD/ERD Storage Tent	771				Yes	
6127	Offices	1,560	Yes				
6178	Change House	1,040	Yes		Yes		
6179	Offices	2,530	Yes			Yes	
6197	EPD/RHWM Storage Tent	5,148				Yes	
6197B	EPD/RHWM Storage Tent	4,662				Yes	
6198	EPD/RHWM Storage Tent	3,368				Yes	
6199	Equipment Reclamation Tent	10,033				Yes	
6199A	Storage	9,999				Yes	
6199B	Storage	5,468				Yes	
6203	Offices	2,185	Yes		Yes		
6205	Heavy Equipment Yard	404	Yes				
6297	Rigger Tent	1,386				Yes	
6325	Offices	4,320	Yes				
6498	MFE Tent/Corp. Yard	1,500				Yes	
6499	MFE Tent/Corp. Yard	1,500				Yes	
6501	Offices	875	Yes				
6525	Visitor Center Auditorium	960					Yes
6526	Offices	2,513	Yes				
6527	Offices	2,100	Yes				
6575	Offices	1,407	Yes				
6870	Offices	1,325	Yes				
6925	Offices	5,831	Yes				
6926	Offices	2,160	Yes				
6928	Offices	1,886	Yes				
6951	DWTF Service Building	1,440	Yes		Yes		

Source: Original.

BBR = Biology & Biotechnology Research Program; CAM = Containment Atmospheric Monitoring; DNT = Defense and Nuclear Technologies; DO = Directors Office; DOE = U.S. Department of Energy; DWTF = Decontamination and Waste Treatment Facility; EE = Electronics Engineering; EPD/ORAD = Environmental Protection Department/Operations and Regulatory Affairs Division; ERD = Environmental Restoration Division; HC = Hydrocarbon; LCC = Livermore Computing Center; LCW = Low Pressure Cooling Water; LIDAR = Light detection and ranging; LLESA = Livermore Laboratory Employee Services Association; LODTM = Large Optics Diamond Turning Machine; MARS = Military Affiliate Radio System; MFE = Magnetic Fusion Energy; MMED = Manufacturing and Materials Engineering Division; NARAC = National Atmospheric Release Advisory Center; NDE = National Destructive Examination; NIF = National Ignition Facility; PEM&O = Plant Engineering Manufacture and Operations; RHWM = Radioactive and Hazardous Waste Management; SC&CD = Super Computing and Communications Department; UC = University of California; UPS = Uninterruptible Power Supply.

A.2.2.2 *Building 131*

Building 131, the Engineering Facility, is located in the southwest quadrant of the Livermore Site. The 287,192-gross-square-foot facility comprises of an office wing and a high bay. The office wing contains approximately 500 offices and 5 shops and laboratory spaces. The high bay includes 34 industrial shops or laboratories and 13 offices. The high bay is equipped with 20-ton cranes, an environmental test facility, low humidity laboratories, laboratories equipped with high-efficiency particulate air (HEPA)-filtered hoods or gloveboxes for doing work with radioactive and hazardous materials, a conventional machine shop for working nonhazardous and nonradioactive materials, and a materials management vault and other locations for storage of controlled items. Building 131 primarily supports the nuclear weapons program with fabrication, inspection, assembly, testing, storage, and specialized machining functions (LLNL 2000j).

Building 131 also houses laboratories and equipment to support the W80 Life Extension Program. Activities for this program include assembly/disassembly of test units, environmental testing of components and sub-assemblies, and visual/dimensional inspections, among other tasks.

Hazards Assessment

The Building 131 office wing is classified as a general industry facility and the high bay is classified as a low-hazard and radiological facility (LLNL 2000ac). Hazardous materials used in the high bay include hazardous and corrosive chemicals and gases, combustible and toxic metals and metal compounds, sealed radioactive sources, radioactive materials, and very small quantities of specific classes of high explosives. Operations within the high bay involve lithium hydride, beryllium, and depleted uranium as well as flammable and combustible liquids and combustible and toxic metals (LLNL 2001x).

The handling and storage of hazardous and radioactive materials is authorized in the Building 131 High Bay Hazards Analysis Report and are controlled and monitored by a combination of computer-based inventory tracking systems. Quantities of hazardous materials in the immediate work area are limited to the minimum needed for each operation or experiment. The use of a hood or glovebox may be required if the operation could potentially release material into the workplace and result in environmental, safety, or health hazards.

Radiation sources are limited to the high bay area and include a few sealed sources and small neutron radiation generating devices. Small antistatic devices containing sealed sources are also used in the toxic material fabrication laboratories. The health and safety technician monitors radiation levels and checks for radioactive and hazardous material surface contamination.

Other potentially hazardous operations in the Building 131 high bay include the use of lasers and x-ray-generating equipment. Lasers are used for general research activities, alignment work, measurements of component systems, and machining of toxic materials. X-ray sources are used to calibrate diagnostic systems and characterize materials, components, or assemblies. Safety controls are in place to minimize the potential of personnel exposure to x-rays and lasers. These include enclosing x-ray tubes in steel cabinets, and including safety covers or guards on laser devices, and using interlocks and shielding devices for x-ray systems (LLNL 2001x).

Generated Wastes and Effluents

Hazardous wastes and nonhazardous wastes are produced in Building 131, including alkaline and acid solutions; lab-packed and bulk-waste chemicals; lab-packed spent halogenated and nonhalogenated solvent solutions, both organic and inorganic; laser dyes; reactive salts; uncured epoxies; petroleum and mineral-based oils; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituents, machine shop wastes; print shop wastes; photographic wastes such as fix, developer, bleach and flammable liquids; and waste oil, with trace gasoline, diesel, organics, and metals.

Operations in the Building 131 high bay also generate small quantities of low-level radioactive and mixed; i.e., hazardous and radioactive waste. The generation of mixed waste is minimized by the proper segregation of hazardous and radioactive wastes.

Hazardous, low-level radioactive, and mixed waste is identified, labeled, and accumulated at satellite accumulation areas within the facility. When ready for disposal, these wastes are identified, labeled, and packaged by the generator and/or the building Radioactive and Hazardous Waste Management (RHWM) technician then transferred directly to an RHWM facility for proper disposition.

Hoods, gloveboxes, and enclosures used to control dispersible uncontained radioactive or hazardous particulates are ventilated to the outside environment through HEPA filters. Various other exhaust systems are used to intermittently ventilate the paint spray booth, welding hoods, bead blasters, vacuum pump exhausts, laser cavities, and inert gas flush systems directly to the outside of the building. No hazardous or radioactive material is discharged into the sanitary sewer or storm drain systems. These liquid wastes are collected at the point of generation and managed through an RHWM facility.

A.2.2.3 *Building 132N*

Building 132N is located in the southwest quadrant of the Livermore Site. This building comprises approximately 204,559 gross square feet of offices, laboratories, and storage facilities. A number of programs and research activities are underway in the Building 132N laboratories including, but not limited to, general wet chemistry/synthesis, radiochemistry, analytical chemistry, surface science, biological analysis, nanoscale synthesis and characterization, and research with small quantities of energetic materials. The facility also houses the Forensic Science Center, which provides a comprehensive range of analytical expertise on issues related to nonproliferation, counter-terrorism, and domestic law enforcement. There is also a high bay area with common industrial hazards and a machine shop (LLNL 2002ap, LLNL 2000k).

Hazards Assessment

Hazards associated with Building 132N operations include ionizing and non-ionizing radiation, lasers, electrical hazards (high voltages), hazardous and toxic materials, explosives, and up to Risk Group 2 (RG-2) biological materials. RG-2 materials include agents associated with human disease that are rarely serious and for which preventative or therapeutic interventions are often available. Controls for these hazards are specified in integrated worksheets and facility and operational safety plans (LLNL 2002ap, LLNL 2000k).

Biological materials used in Building 132N include infectious agents; tissues, including blood; or other items such as sewage, which may contain biologically hazardous agents and the toxins produced by living organisms. Recombinant deoxyribonucleic acid (DNA) work is also conducted in the facility (LLNL 2000k).

Generated Wastes and Effluents

Wastes that contain Risk Group 1 (RG-1) or RG-2 biological materials are managed as biohazardous wastes as a best management practice. All biological waste is autoclaved (steam sterilized).

The hazardous wastes generated include flammable solids and liquids, organics, biological wastes, radioactive wastes, corrosives, toxic metals, and laser dyes. Small amounts of both radioactive and mixed waste are generated in this facility. Waste materials are collected at satellite accumulation areas and then moved to a designated waste accumulation area. The building also has a laboratory wastewater retention system that is used to collect and retain dilute nonhazardous and nonradioactive rinsewaters from laboratories until analysis determines they can be discharged to the sanitary sewer. Many of the laboratories are equipped with exhaust hoods (LLNL 2002ap, LLNL 2001y).

A.2.2.4 *Building 132S Complex*

The Building 132S Complex is located in the southwest quadrant of the Livermore Site and comprises Buildings 132S, 134, and 135. This 168,715-gross-square-foot complex provides laboratory, office, shop, and storage facilities. Primary activities are biomedical technological research using laser technology and computer simulations, proliferation-detection technology systems, missile and nuclear technology, and mechanical and electronic fabrication shops (LLNL 2002aq).

Operations in the Building 132S Complex include laser experiments, sensor development, spectroscopy, gamma ray imaging, medical physics/biophysics, materials research, distillation and concentration of hydrogen peroxide/satellite fueling, and optical wave guide materials research (LLNL 2002bh, LLNL 2002aq).

Medical physics/biophysics research encompasses the development of advanced biosensors for counter-terrorism applications, participation in LLNL's pathomics project for developing new methods of infectious disease detection, development of advanced biomaterials and shaped memory polymers for use in medical devices, work on artificial organs, and creation of advanced imaging methods for applications in medicine and defense. It is anticipated that BioSafety Level-2 (BSL-2) controls, as specified in the Centers for Disease Control and Prevention *BioSafety in Microbiological and Biomedical Laboratories* guidelines, would be implemented at a future date (LLNL 2002bh).

Hazards Assessment

Hazards associated with Building 132S Complex operations include ionizing and non-ionizing radiation, lasers, electrical hazards (high voltages), hazardous and toxic materials, and RG-1 and RG-2 biological materials. Controls for these hazards are specified in both facility and operational safety plans (LLNL2002bh, LLNL 2002aq).

Hazards associated with medical physics/biophysics research include the handling, use, and storage of RG-1 biological materials. RG-1 materials include live agents or materials commonly used in research, university, college, and hospital settings. RG-2 materials include agents associated with human disease that are rarely serious and for which preventative or therapeutic interventions are often available. Associated laboratory equipment includes incubators, freezers, syringes, and biological safety cabinets. Associated hazards include cuts or needle-sticks from handling sharps, burns from handling hot objects or from ultraviolet light exposure, and laboratory-acquired infections from poor personal practices or poor housekeeping practices (LLNL 2002bh).

Hazards associated with materials research, distillation and concentration of hydrogen peroxide/satellite fueling, and optical wave-guide materials research include lasers, electrical hazards (high voltages), chemical hazards (concentrated hydrogen peroxide), flammables, and biological hazards (LLNL 2002bh, LLNL 2002aq).

Generated Wastes and Effluents

The types of waste produced by the medical physics and biophysics research include nonhazardous biological waste, biohazardous and contaminated sharps (medical) waste, and chemical waste. Biohazardous waste includes waste generated from research with RG-1 and RG-2 agents (LLNL 2002bh). All biohazardous wastes are autoclaved at Building B-361 (BBRP).

Hazardous waste and nonhazardous waste is produced in the Building 132S Complex, including alkaline and acid solutions; lab-packed and bulk-waste chemicals; lab-packed spent halogenated and nonhalogenated solvent solutions, both organic and inorganic; laser dyes; reactive salts; petroleum and mineral-based oils; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituent; machine shop wastes; print shop wastes; photographic wastes such as, fix, developer, and bleach and flammable liquids; and waste oil, with trace gasoline, diesel, organics, and metals (LLNL 2002bh).

A.2.2.5 *Building 141*

Building 141 is located in the southwest quadrant of the Livermore Site. The facility has a total area of 50,927 gross square feet and consists of offices, pulsed-power laboratories, an electromagnetics laboratory, a dielectric research area, machine shop operations, a detonator studies, a crystal growth laboratory, and technician workstations (LLNL 2000b). Planned additional uses of the facility include wet chemistry and biological laboratory operations.

Hazards Assessment

Building 141 is classified as a low-hazard facility. The hazards present in the facility are associated with flammable liquids; reactive, corrosive, carcinogenic, and pyrophoric materials; cryogens; high-voltage electrical systems; ionizing and non-ionizing radiation; toxic materials; lasers; and pulsed-power units (LLNL 2000b, LLNL 2002cs).

Numerous engineering and safety controls are in place. Laboratory practices involve minimizing the use and storage of chemicals as well as labeling and segregation of materials kept onsite. The hood and ventilation system consists of eight exhaust hoods. In the event of ventilation system failure, all work is stopped. Operations that require the use of high-voltage systems or that produce ionizing radiation are equipped with interlock systems to safeguard personnel from electric shock or radiation hazards (LLNL 2001z).

Detonators are stored in approved storage areas only, in a nonpropagating configuration. Detonator use is restricted to approved areas and these areas are electrically interlocked and equipped with physical key lockouts (LLNL 2002cs).

Generated Wastes and Effluents

Hazardous waste and nonhazardous waste is produced in Building 141, including alkaline and acid solutions; lab-packed and bulk-waste chemicals, lab-packed spent halogenated and nonhalogenated solvent solutions, both organic and inorganic; empty containers; laboratory debris, including contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituent; electronic manufacturing wastes; etching wastes; waste oil with trace gasoline, diesel, organics, and metals; discarded capacitors (potentially *Toxic Substance Control Act* [TSCA] wastes), and contaminated equipment such as vacuum pumps, ignition tubes, and other equipment. No radioactive, mixed, or transuranic waste is generated in the facility (LLNL 2001z).

Prior to 2001, Building 141 operated a wastewater retention tank system to support plating operations. The plating operations in Building 141 have been removed and wastewater is no longer discharged to or stored in this system. The system has been closed.

A.2.2.6 *Building 151 Complex*

The Building 151 Complex, located in the southwest quadrant of the Livermore Site, comprises Buildings 151, 152, 154, and 155 and Trailer 1541. The complex has a total area of approximately 120, 218 gross square feet. Buildings 151 and 154 provide office, laboratory, and electronics shop facilities for laboratory operations in a broad range of chemical, radiochemical, and bio-analytical research. Primary activities include research in radiochemical chemical analysis, transport of radionuclides in geomaterials, preparation of radionuclides for experiments, analysis of environmental and waste samples, biological research and analysis, nanoscale synthesis and characterization, and clean room activities. Building 152 is used as a small chemical storage facility as well as an area for accumulating biological waste for transfer to the BBRP. Building 155 contains offices and an auditorium (LLNL 2002ap, LLNL 2000l).

Hazards Assessment

The primary hazards associated with the Building 151 Complex are biological, radiological, and toxicological. Controls for these hazards are specified in integration work sheets and facility and operational safety plans (LLNL 2002ap, LLNL 2000l). Biological materials used in the Building 151 Complex include infectious agents; tissues, including blood; or other items such as sewage and animals, which may contain biologically hazardous agents and the toxins produced by living organisms. Recombinant DNA work is also conducted in the facility.

Generated Wastes and Effluents

The hazardous wastes generated include corrosives, flammable organics, biological wastes, toxic metals, and radioactive and mixed wastes. Waste materials are collected at satellite accumulation areas and then moved to a designated waste accumulation area. Wastes that contain RG-1 biological materials are managed as biohazardous wastes as a best management practice. All waste containing RG-2 biological materials must be autoclaved prior to disposal. Wastewater, potentially contaminated with radionuclides, metals, and acids discharged to sinks or floor drains in chemistry laboratories or shops, is sent to the retention tank system. When full, the retention tanks are sampled. If the wastewater meets the sewer discharge criteria, it is released to the sanitary sewer. If it is unacceptable for release, it is transferred to an RHWM facility for treatment, storage, and/or disposal (LLNL 2002ap). Most laboratories are equipped with exhaust hoods that vent to the atmosphere, and some employ gloveboxes with HEPA filters for radiological work. The types of waste produced by the biological analysis and recombinant DNA research include nonhazardous biological waste, biohazardous and contaminated sharps (medical) waste, and chemical waste. Biohazardous waste includes waste generated from research with RG-1 agents not associated with disease in healthy human adults and RG-2 agents associated with human diseases that are rarely serious and for which preventative or therapeutic interventions are often available. All biological wastes are autoclaved.

Hazardous and nonhazardous wastes are produced in the Building 151 Complex, including alkaline and acid solutions such as lab-packed solutions; lab-packed and bulk-waste chemicals; lab-packed spent halogenated and nonhalogenated solutions, both organic and inorganic; empty containers; laboratory debris, including contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous and or radioactive constituents; cleaning solutions, including solvents; rinsewater; sludge/water; waste oil with trace gasoline, diesel, organics, and metals; print shop wastes; photographic wastes; asbestos; and contaminated equipment such as vacuum pumps and other equipment.

A.2.2.7 *Building 153*

Building 153, the Microfabrication Laboratory, is located in the southwest quadrant of the Livermore Site. This 24,967-gross-square-foot laboratory consists of nine principal laboratory working areas, three dry laboratories, a clean room dressing area, and packaging and machine room areas. The Microfabrication Laboratory is used for micro-electronics fabrication operations, semiconductor opto-electronics, microfluidics electro-mechanical systems, and guided-wave photonics. Additional capabilities include material characterization and device testing capabilities, microscopic inspection, packaging, and electrical and optical testing of devices. Building 153 also houses the Micro-Technology Center's multidisciplinary team, which applies advanced engineering, physics, chemistry, and biology to the development of microfabricated optical, electronics, mechanical, and chemical devices to support LLNL's missions in national security, global ecology, biosciences, and national industrial competitiveness (LLNL 2001a, LLNL 2000m).

Hazards Assessment

Building 153 is classified as a low-hazard facility. The principal hazards are associated with use of various chemicals during the fabrication of silicon and gallium arsenide integrated circuits. Some of these chemicals include acids, bases, solvents, resins, phosphates, fluorides, iodides, and some toxic, pyrophoric, and reactive gases. Testing of microfluidic devices requires the use of small quantities of RG-1 or RG-2 biological agents. Wastes from this process are sterilized prior to disposal. Additional hazards within the facility include common industrial hazards, carcinogens, lasers, radio frequencies (RF), and x-rays (DOE 2001n).

Operations in Building 153 are controlled by the facility and operational safety plans. Operations involving biological materials up to RG-2 or hazardous materials require the use of personal protective equipment. Quantities of hazardous materials in the work area are limited to the minimum needed for each operation. The use of a hood is required if the operation could potentially release material into the workplace. Personnel safety is ensured by toxic materials storage and handling systems. Toxic gases are handled only in gas cabinets, and adequate ventilation and safety valves are provided for added protection (LLNL 2001a, LLNL 2000m).

Safety controls are in place to minimize the potential of personnel exposure to x-rays and lasers. These include enclosing x-ray tubes in steel cabinets, placing safety covers and guards on laser devices, and having interlocks and shielding devices (LLNL 2000m).

Generated Wastes and Effluents

The operations in Building 153 generate hazardous, nonhazardous, and RG-1 and RG-2 biological wastes. Hazardous wastes and nonhazardous wastes are produced in the facility and include alkaline and acid solutions; lab-packed and bulk-waste chemicals; lab-packed spent halogenated and nonhalogenated solvent solutions, both organic and inorganic; laser dyes; petroleum- and mineral-based oils; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituent; machine shop wastes; and flammable liquids.

Waste materials are collected at satellite accumulation areas and then moved to a designated waste accumulation area. Wastes that contain biological materials are managed as biohazardous wastes as a best management practice, which requires appropriate autoclaving before disposal.

Building 153 has an 8,000-gallon wastewater retention system that receives wastewater from the semiconductor operations. When full, the retention tanks are sampled. If the wastewater meets the sewer discharge criteria, it is released to the sanitary sewer. If it is unacceptable for release, it is transferred to an RHWM for treatment, storage, and/or disposal.

Some operations in Building 153 release small quantities of gases and organic vapors to the atmosphere. The gases from fume hoods feed into a 15-meter exhaust stack. Because the quantities of gases used are small, the release of gases under the worst-case condition will not exceed their respective Emergency Response Planning Guideline (ERPG) values (LLNL 2000m).

A.2.2.8 *Building 161*

Building 161 is a 6,119-gross-square-foot building in the west-central portion of the Livermore Site. It houses various research projects involving the development of laser technologies and the development of laser technology applications. The major research activity has been the Advanced Materials Program (AMP) involving the use of high-power tuned lasers to separate isotopes of several materials through the process of selective photo-ionization. The work scope has included generation of laser beams, delivery of the laser beam, preparation of the metallic feedstock, generation of the metallic vapor, separation and collection of the photo-ionized material, recovery of the separated metal, and diagnostic measurements of the laser isotope separator systems (DOE 2002o).

As explained in Section 1.8, the AMP is no longer needed and has been removed from the No Action Alternative. As such, for the foreseeable future, Building 161 would be used for non-AMP research associated with laser technologies and laser technology applications.

Hazards Assessment

Hazards include chemical hazards such as laser dyes, electrical hazards, laser beam and optical radiation hazards, x-rays (from e-beam vaporization), radiological materials, beryllium, vacuum chambers, cryogens, confined spaces and general industrial hazards associated with powered machine tools, solvents, oils, and compressed gases (DOE 2002o).

Generated Wastes and Effluents

Building 161 generates a variety of waste streams. Such wastes may include hazardous, radioactive, and mixed waste. Hazardous constituents may include corrosive liquids, spent solvents, material with concentrations of regulated metals, laser dyes, and waste oils (LLNL 2002o).

A.2.2.9 *Buildings 162, 165, and 166*

Buildings 162, 165, and 166 are located in the northwest quadrant of the Livermore Site. These buildings provide laboratory and office space for various activities related to lasers. The buildings and their operations are summarized in Table A.2.2.9–1 (LLNL 2002ah).

TABLE A.2.2.9–1.—*Summary of Building Operations for Buildings 162, 165, and 166*

Facility	Uses	Square Feet
Building 162	Non-Linear Optics Lab, Crystal Growth Facility, laser materials development, advanced solid state lasers, non-linear optical materials development, x-ray (LAUE) diffraction of crystals, and Inertial Fusion Energy (IFE) Substrate Irradiation	19,840
Building 165	Laser Diode Fabrication Lab, Large Area Tester (LAT), KDP Crystal Optical Load Test System (COLTS), and Phoenix	8,347
Building 166	Pyrochemical Demonstration System, Hi-Brite laser demonstrator, and operation of the Metal Organic Chemical Vapor Deposition (MOCVD) system	10,864

Source: Original.

Hazards Assessment

Hazards within these facilities are associated with high voltages, x-ray radiation, exposure to laser beams, chemical reactions, toxicity to materials, pyrophoric metals, toxic gases, caustic chemicals, acid burns, and fire. Facility safety features are provided to reduce the hazards, providing multilevel protection against accident or injury to operational personnel (LLNL 2002ah).

Generated Wastes and Effluents

There are many different types of hazardous and low-level radioactive wastes generated from this complex of buildings. The wastes include combinations of aluminum, arsenic, phosphorous, antimony, arsine, chlorides, and chlorine. Zinc and silicon may also be present in small amounts.

Wastes are generated from processes using aqueous solutions, acids, bases, halogen salts, gas scrubbers, and organic materials such as solvents and oils. Wastes from these processes are collected in designated containers in the satellite accumulation areas.

A.2.2.10 *Buildings 171, 173, 174, 174 Annex, 176, and 179*

The Building 170 series is located in the northwest quadrant of the Livermore Site. The buildings and their operations are summarized in Table A.2.2.10–1 (LLNL 2002bh).

TABLE A.2.2.10–1.—*Summary of Building 170 Series Operations*

Facility	Uses	Square Feet
Building 171	Dye Laser Development Lab, vacuum test unit, characterization of metal alloys in MINERVA[a] chambers, Dye Lab, Optical Loss Measurement Facility, helium-neon lasers, and waste accumulation area	8,632
Building 173	Machine shop/weld shop	413
Building 174	Laser target research	19,360
Building 174 Annex	Ultra Short Pulse Laser Facility	20,365
Building 176	Light duty machine shop, shipping and receiving	3,958
Building 179	Metrology laboratory, optical measurement tools, electron microscopy and atomic force microscopy; instrument alignment lab	2,720

Source: Original.
[a]A tool for analyzing and planning targeted molecular radiation treatment for cancer patients.

Hazards Assessment

Building 173 has the standard industrial hazards associated with machine shop usage. There are many hazards associated with the Building 174 and Building 174 Annex operations from the use of hazardous and radioactive materials including laser dyes; solvents; flammable liquids; and natural, depleted, or enriched uranium; cryogenic material; and beryllium. Personnel may be exposed to x-rays, high-power laser beams, high voltages, heat and skin burns, eye injuries, and overpressure of vacuum chambers. Laser hazards are mitigated by door interlocks, laser enclosures, and appropriate eyewear. All chemicals and radioisotope inventories are below regulatory threshold levels. General industrial operations in Building 176 are associated with powered machine tools, solvents and oils, and compressed gases. Chemicals found in Building 179 include cleaning compounds, small (<0.5 liter) quantities of ethanol, isopropyl alcohol, and acetone.

Generated Wastes and Effluent

Small amounts of hazardous waste may be generated from the operation of the Building 173 machine shop and would consist of waste commonly produced in industrial facilities, such as oils, cutting fluids, etc.

Building 174 and its annex generate wastes, including various hazardous and radioactive chemicals. Typical hazardous waste streams include spent solvents, waste oils, reactive metals, adhesives and epoxies, and regulated metals. Small amounts of radioactive and mixed waste may be generated from the use of radioactive targets. These wastes are generated in small quantities and are typical of waste generated in experimental laboratories.

Small amounts of hazardous waste may be generated from the operation of the Building 176 machine shop, consisting of waste commonly produced in industrial facilities, such as oils, cutting fluids, etc.

Small amounts of hazardous waste may be generated in Building 179 and would be typical of waste generated in small-scale R&D facilities.

Waste generated at these facilities is temporarily stored at the Building 171 waste accumulation area until transported to RHWM facilities for treatment, storage, and/or disposal.

A.2.2.11 *Building 190*

Building 190, the CAMS Facility, is located in the northwest quadrant of the Livermore Site. This 10,086-gross-square-foot building houses four accelerators ranging in size from 1.0^{-10} megavolts to 10 megavolts. Facility operations include accelerator mass spectrometry for cosmogenic and radiogenic isotopes and a nuclear microprobe for materials characterization. Current research activities emphasize bioscience, such as metabolism, cancer, and protein analysis, and earth and environmental sciences, such as climate change, hydrology, and atmospheric science (LLNL 2000ad).

Hazards Assessment

Hazards within the CAMS facility are typical of accelerator facilities and include ionizing radiation from ion sources, prompt radiation, and residual radiation induced in targets and shielding. Other hazards include high voltage, magnetic fields, and asphyxiants.

Administrative controls and mechanical and electronic safety devices are used to help mitigate these potential hazards. Administrative controls include monitoring for x-rays, radioactivity, and oxygen deficiency and requiring a hazard analysis for any new experimental project in the facility.

Engineering controls associated with operations in the CAMS facility include safety interlocks to limit personnel access to certain areas during operation, radiation shielding, protective equipment or clothing, automatic systems to monitor and limit the production of radiation, and various methods of warning personnel of the operation of experiments with potential hazards. Shielded areas previously used for accelerator research are locked up. Access is controlled by the facilities coordinator and the hazards control technicians assigned to those facilities where there is a potential for contamination (LLNL 2000ad).

Generated Wastes and Effluents

Building 190 generates small quantities of hazardous, radioactive, and mixed waste. Waste produced in the facility would include lab-packed spent organic solvents; empty containers; laboratory debris, such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, and wood and metal parts; and contaminated equipment. These wastes are collected in designated containers in the satellite accumulation areas (LLNL 2000ad).

A.2.2.12 *Building 191*

Building 191, the High Explosives Application Facility (HEAF), is located in the northwest quadrant of the Livermore Site. The building is 120,116 gross square feet and includes 13,000 square feet of office space. R&D activities at HEAF include studying intentional detonations, synthesizing and formulating materials, testing material properties and characterization, studying the physics of initiation, developing diagnostic methods and equipment, and conducting detonator surveillance. This facility was constructed to provide LLNL with a centralized high explosives research facility with modern diagnostic and testing equipment. Building 191 is currently LLNL's center for the study of chemical high explosives and their application to conventional explosive and nuclear device systems (LLNL 2002cp).

Hazards Assessment

Hazardous materials in Building 191 are used in high explosive synthesis and formulation, high explosive properties characterization, shock-loading experiments, detonation experiments, and various support shop operations. Hazard sources associated with HEAF operations include high-voltage power; toxic, reactive, flammable, and corrosive materials; asphyxiants; thermal flux; gravity-mass sources; lasers; ionizing and non-ionizing radiation; cryogenics; and compressed gases (LLNL 2002cp).

The main radiological hazards are associated with the x-ray machine and x-ray-computed tomography used to radiograph components and assemblies. These machines are heavily shielded with concrete to minimize radiation exposure. The other sources of radiation are the flash x-ray generators, which are used as diagnostic tools in some of the firing tanks. Detonation experiments are conducted in firing tanks that provide protection to the facility and personnel. One of the firing tanks was designed to be used for experiments using hazardous materials such as depleted uranium when the associated washdown system is completed and installed (LLNL 2002cp).

Generated Wastes and Effluents

The firing tank debris and high explosives chemistry operations are the two primary sources of potentially hazardous waste. The firing of gun propellants in one of the firing chambers generates water, carbon dioxide, and nitrogen. The wastes generated include high explosives, debris contaminated with high explosives, and high explosive residues. Smaller quantities of carbon monoxide and nitrogen oxides are also produced. Some of the residues may contain mutagenic compounds. Detonations of high explosives produce toxic gases.

Chemistry operations generate small quantities of solid, liquid, and gaseous wastes. The hazardous waste and nonhazardous waste that is produced in the facility includes alkaline and acid solutions, including lab-packed solutions,; lab-packed waste chemicals; spent halogenated and nonhalogenated solutions, both organic and inorganic; empty containers; laboratory debris, such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituents; flammable liquids; cleaning solutions, including solvents; waste oil with trace gasoline, diesel, organics, and metals; photographic wastes; test debris and residues; discarded capacitors (i.e., potentially TSCA wastes); and contaminated equipment such as vacuum pumps, ignition tubes, and other equipment.

Several photographic development laboratories in the HEAF generate spent photographic solution wastes. These wastes are collected in carboys. Rinsewater used in the process is discharged to the LLNL sanitary sewer system because previous samples have shown the concentrations of photographic chemicals are consistently far below acceptable release levels (LLNL 2002cp).

Airborne particulates from the firing tanks are channeled through air filter bags. HEPA filters are installed for the gun tank. Negative pressure hoods are located in all chemistry areas to exhaust effluent gases.

The wastewater retention system consists of two central, aboveground waste retention tanks. The two tanks are surrounded by a berm capable of containing the entire volume of both tanks. All rinsewater is collected in the waste retention system and sampled prior to discharge. This system is considered a nonhazardous system, and the tank's contents are routinely discharged to a sanitary sewer after sampling and analysis.

A.2.2.13 *Building 194*

Building 194, the Electron-Positron Linear Accelerator (LINAC) Facility, is a 42,031-gross square-foot facility located in the northwest quadrant of the Livermore Site. The LINAC Facility consists of a complex of aboveground and underground facilities. The 100-million-electron-volt electron-position linear accelerator, beam lines, and all operational experimental target areas are located underground for enhanced radiation shielding. The aboveground buildings include a modulator building, an office, laboratory, machine shop, and storage facilities. An aboveground neutron silo and an associated time-of-flight experimental area were decommissioned several years ago and are currently unused.

Ongoing research programs in Building 194 include experiments in fundamental nuclear, atomic, solid-state, plasma, and particle physics; fundamental experiments in laser-electron interactions; applied research in materials science; and development of diagnostic and analytical techniques for industrial applications. Building 194 also houses various laser development and experimental activities and the electron beam ion trap (EBIT) experiment. Major equipment in the facility includes two electron accelerators and several high-power, short-pulse lasers (LLNL 2002bh, LLNL 2002cq).

Hazards Assessment

The hazards associated with Building 194 include ionizing and non-ionizing radiation; lasers; hazardous materials such as cryogenic gases, asphyxiants, laser dyes, solvents, high explosives, and lead; vacuum; high-pressure gas; high-voltage; and machine shop-associated hazards.

Three types of radioactive materials are used in Building 194: sealed sources; plutonium samples, housed in a manner similar to a sealed source to prevent plutonium particles from being released; and items activated from accelerator operations. These activated equipment and building components, which are identified by surveying and are controlled accordingly, are not considered contaminated areas.

Administrative controls and mechanical and electronic safety devices are used to help mitigate these potential hazards. Administrative controls include personnel training; maintaining lists of qualified operators; tracking all shipments of hazardous or radioactive materials to ensure that limits are not exceeded; periodic or continuous monitoring for x-rays, radioactivity, toxicity, or oxygen deficiency; and requiring a hazard analysis for any new experimental project. Hazardous materials used and stored in Building 194, including cryogens, are used and stored in accordance with institutional and programmatic controls for minimizing or reducing the potential for exposure, injury, or illness. Controls for the hazards are specified in safety plans.

Engineering controls associated with operations in Building 194 include safety interlocks to limit personnel access to certain areas during operation, radiation shielding, personal protective equipment or clothing, protective storage cabinets or filtered hoods, automatic systems to monitor and limit the release of toxic gases or the production of radiation, and various methods of warning personnel of the operation of experiments with potential hazards. Shielded areas previously used for accelerator and/or nuclear physics research are locked up. Access is controlled by the facilities coordinator and the hazards control technicians assigned to those facilities where there is a potential for contamination (LLNL 2002cq).

Generated Wastes and Effluents

Wastes generated in this facility include hazardous, radioactive, and small amounts of mixed waste. Hazardous waste streams may include solvents, oils, corrosive liquids, regulated metals, and other industrial waste such as epoxies, adhesives, etc. Radioactive waste is generated from research activities using radioactive isotopes and the accelerator. Waste materials, both liquid and solid, are collected in containers at the satellite accumulation areas (LLNL 2002bh, LLNL 2002cq). It is also possible that equipment and parts may be activated due to their proximity to the accelerator.

Building 194 operations generate small amounts of gaseous effluents. These gaseous effluents include radioactive isotopes of oxygen and nitrogen with half-lives of 2 and 10 minutes, respectively, and dust particles. The air emissions are filtered through HEPA filters and discharged to the atmosphere from a 30-meter monitored stack (LLNL 2002cq).

A.2.2.14 *Building 197 Complex*

The Building 197 Complex is located in the northwest quadrant of the Livermore Site and includes Buildings 197, 198, and T1879. These buildings contain semiconductor research laboratories, bench-top electronic assembly areas, plating and etching stations, research laboratories for the development of micro-electronic fabrication processes, and miscellaneous special studies laboratories. The buildings and their operations are summarized in Table A.2.2.14–1 (LLNL 1997f).

TABLE A.2.2.14–1.—*Summary of Building 197 Complex Operations*

Facility	Uses	Square Feet
Building 197	Laser pantography lab, high density plasma lab, gas immersion laser doping (GILD) lab, semiconductor/wafer scale integrated circuits (WSI) hybrid labs, hydrogen peroxide loading of microset crystal growth furnace	10,500
Building 198	Machine and welding shops	966
Building T1879	Electronics fabrication and testing	11,118

Source: Original.

Hazards Assessment

The primary hazards associated with the Building 197 Complex include corrosive, toxic, flammable, and carcinogenic materials; cryogens; ionizing and non-ionizing radiation; lasers; high-voltage electricity; high temperatures; toxic gases; compressed gases; and hydrogen peroxide.

Controls for these hazards are specified in both facility and operational safety plans and integration worksheets. The use of a hood is required if the operation could potentially release material into the workplace. Personnel safety is ensured by toxic materials storage and handling systems. Toxic gases are used in closed systems and handled only in gas cabinets; adequate ventilation and safety valves are provided for added protection.

Generated Wastes and Effluents

Hazardous waste and nonhazardous waste are produced in these facilities and would include acid solutions; both lab-packed and bulk-waste chemicals; lab-packed spent halogenated and nonhalogenated solvent solutions, both organic and inorganic; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituents; electronic manufacturing wastes; etching wastes; waste oil with trace gasoline, diesel, organics, and metals; and contaminated equipment such as vacuum pumps, ignition tubes, and other equipment.

Some operations in Building 197 release small quantities of gases and organic vapors to the atmosphere. The gases from closed systems and fume hoods feed into a 52-foot-high exhaust stack. Because the quantities of gases used are small, the release of gases under the worst-case condition would not exceed the ERPGs (LLNL 1997f).

Liquid wastes from etching and plating operations are recycled at Building 197, and no wastes are discharged or removed from the facility (LLNL 2002ba).

A.2.2.15 *Building 231 Complex*

The Building 231 Complex is located in the southwest quadrant of the Livermore Site. The primary functions of the facilities in this complex are fabrication and testing of parts and assemblies to meet the needs of LLNL programs; storage of hazardous and radioactive material; and inspection, shipping, and storage of controlled materials. The Building 231 Complex includes the buildings listed in Table A.2.2.15–1.

TABLE A.2.2.15–1.—*Summary of Building 231 Complex Areas*

Facility	Name	Square Feet
Building 230	231 Portal	377
Building 231	Development and Assembly	131,454
Building 231V	Building 231 Vault	5,426
Building 232FA	Fenced Area	1,200
Building 233	Materials Management	4,900
Building 234	Materials Management Office	5,261

Source: Original.

Building 230 was constructed for use as a security check portal, but is currently used for storage of plastic sheet stock.

Building 231 consists of a high bay, laboratories, a machine shop, and offices. The high bay runs north/south for the entire length of the building and contains overhead cranes, large ovens, a large hydraulic press, and a rolling mill. A diverse range of R&D activities are conducted in the building, as follows (LLNL 2001b):

- **Machine Shop—**General machining operations include computer numerically controlled machining and turning capabilities. These operations provide primary manufacturing support for activities in Building 231.

- **Plastics and Advanced Composites Group—**Operations include adhesive and solvent bonding, casting, composite fabrication, plastic welding, heat sealing, and form molding. The operations also include a small machine shop for cutting and milling plastics and composites.

- **Vacuum Process Group—**Operations include performing physical vapor deposition and working with vacuum technology. Capabilities include working with high-purity metals, oxides, and ceramics and material characterization using mass spectrometry and residual gas analysis.

- **Mechanics of Materials Group—**Operations include characterizing the mechanical response of materials, components, and assemblies under various conditions of load, deformation, temperature, and environment. Services and capabilities include general test capabilities as well as high-rate and intermediate-rate testing using mechanical and servo-hydraulic test machines; compression, tension, shear, torsion, and bend tests to determine modulus; fracture and fatigue testing; and special tests and capabilities for hardness, surface energy measurements of liquids and solids, and density measurements.

- **Physical Metallurgy and Joining Program Element Capabilities—**Operations include performing fabrication and research that includes metal forming and thermomechanical processing, electron-beam welding, vacuum brazing, tungsten inert gas, gas metal and tube welding, solid-state bonding, and laser welding. Other activities performed include physical vapor deposition by sputtering and evaporation and the fabrication of entire coating systems.

- **Metallography and Scanning Electron Microscopy—**The metallography laboratory characterizes specimens that originate in the Building 231 processing and welding areas. A large range of specimen preparation equipment and characterization tools is present, including optical and scanning electron microscopes and hardness testing equipment.

- **Uranium Casting—**A vacuum induction furnace is used to melt uranium alloy castings in excess of 100 kilograms. Prepared castings are then processed using the capabilities in the thermomechanical area.

- **Heat Treatment—**Several high-vacuum furnaces are operated to heat treat refractory metals.

- **Liquid Metal Embrittlement Studies—**Metallurgical activities include studies of liquid metal embrittlement of structural alloys by elements having low melting points. These elements include thallium, mercury, and bismuth. The studies involve mechanical testing while immersed in the liquid metal and post-test characterization by scanning electron or optical microscopy.

The Building 231 vault is located adjacent to the building and currently functions as an inspection, shipping, and storage facility for controlled materials, which may be hazardous and/or radioactive. The shipping and receiving operations involve only small quantities of radioactive material (LLNL 2000o).

The fenced area is an addition to the north end of Building 232, an inactive laboratory facility. An open passageway separates the fenced area from Building 232. The Building 232 fenced area consists of a steel portal frame structure on a paved asphalt floor, covered with a roof of corrugated transite sheeting, and surrounded by a chain-link fence. A locked sliding gate, located on the west side, controls access. The Building 232 fenced area is used for storage of controlled and nuclear material. Materials are received by materials management personnel and may be inspected to verify contents, proper packaging, and labeling and to verify that proper shipping regulations have been followed. Other operations that may be performed include the repackaging and preparation of "controlled materials" and classified parts for transportation. Operations such as marking, labeling, regrouping of containers, and opening of outer containers is permitted within the facility (LLNL 2000p, LLNL 2001aa).

Building 233 consists of office space and a vault. The Building 233 vault is used for long-term storage of classified and controlled materials, including precious metals, accountable and controlled material, classified parts held for destruction, and components containing mock explosives. The Building 233 vault has a concrete slab floor and reinforced masonry walls (LLNL 2000p).

Building 234 is a single-story facility consisting of 24 offices, 2 restroom facilities, and a janitor's closet. It is used exclusively for administrative and management activities associated with the mission of the Materials Management Section (LLNL 2000p).

Hazards Assessment

Buildings 230 and 234 are considered general industry facilities. No hazardous or radioactive materials are stored, managed, or used within these facilities.

Building 231 is classified as a low-hazard chemical and radiological facility. The potential hazards in this facility are exposure to radiation and radioactive materials; exposure to carcinogenic, corrosive, reactive, and toxic materials; exposure to vapors and high-intensity light from open flame welding; handling and exposure to high explosives, hydrogen gas and other flammable or combustible liquids and gases; handling and operating high-pressure systems, lasers, sealed radioactive sources, and high-voltage equipment; operating and exposure to rotating equipment, other machine tools, cranes; and heavy plates, cylinders, and other objects being lifted; exposure to excessive noise; and exposure to glovebox leakage, implosions, and explosions. Hazardous materials that may be handled in limited quantities include natural and depleted uranium in solid form, natural thorium, rhenium, beryllium, lead, nickel, fibrous carbon materials, toxic resins and epoxies, methylene chloride, chloroform, ethylene dichloride, acetone, other solvents, tungsten hexafluoride, and acids used in chemical etching (LLNL 2001b).

The Building 231 vault is classified as a low-chemical hazard, radiological facility. An inventory report is generated daily to track radionuclides, primarily various sealed sources and depleted uranium, stored in the facility to ensure quantities of radioactive materials stay below the thresholds for a Category 3 Nuclear Facility (DOE 1997d). Hazards associated with the Building 231 vault include the stored legacy material of radionuclides and chemicals. Lithium hydride is also stored in the Building 231 vault. The original packaging is generally leak-tight with a primary container filled with argon atmosphere and a secondary container filled with dry air. Only a small percentage (<1 percent) of the lithium hydride inventory is expected to be in dispersible powder form. Powdered lithium hydride is of concern because of potential fire and explosion hazards when it reacts with moisture. Small quantities of flammable liquids and flammable gases used for cleaning and painting are permitted, but are stored within the flammable materials storage locker (LLNL 2000o, NNSA 2002d).

To ensure their safe conduct, activities in Building 231 and the Building 231 vault are governed by facility safety plans. Any hazardous activity not specifically discussed in facility safety plans requires an individual operating safety plan reviewed by the facility management and others and posted in the work area. These documents detail the processes that must be followed, any needed precautions, the responsible and approved personnel, training requirements, and contingency plans. Various safeguards, including air monitoring and HEPA filtration systems and hydrogen buildup and fire alarms, are provided throughout the building where needed. The work areas within the vault are kept at negative pressure, relative to the outside environment. Outside air is first filtered then passed through the clean area and into the work areas. The exhaust from the rooms and gloveboxes is filtered by two HEPA filters at all times. A backup power system ensures that the negative pressure in the vault can be maintained even in an emergency. If the exhaust system is not working, all work involving radioactive and hazardous materials stops (LLNL 2000o, LLNL 2001b).

The Building 232 fenced area and the Building 233 vault are classified as low-hazard and radiological facilities. Controlled and nuclear materials stored in the facilities include depleted uranium, low enriched uranium, natural uranium, lithium salts, deuterium, thorium, californium, and beryllium. Materials stored in the Building 233 vault are stored in containers and safes. Precious metals and small quantities of depleted uranium may be opened in the Building 233 vault. The storage and management of hazardous and radioactive material are controlled under the facility safety plan. Additionally, the quantities of radioactive and hazardous materials in the facility are controlled and monitored by computer-based inventory tracking systems (LLNL 2000p).

Generated Wastes and Effluents

The hazardous and nonhazardous wastes produced in Building 231 include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; nonhalogenated solutions, both organic and inorganic; halogenated organics; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituents; machine shop wastes; flammable liquids; cleaning solutions, including solvents; waste oil with trace gasoline, diesel, organics, and metals; asbestos; wastewater and residues; discarded batteries; discarded capacitors that are potentially TSCA wastes; and contaminated equipment such as vacuum pumps, ignition tubes, and other equipment. Hazardous, low-level radioactive, and mixed wastes are accumulated at satellite accumulation areas within Building 231. When ready for disposal, the waste generator identifies, labels, and packages waste and then transfers containers directly to RHWM for proper disposal. The RHWM building technician assists the generator in labeling, packaging, and transfer operations. When necessary, the technician also conducts waste sampling and field analysis.

Hoods, gloveboxes, and enclosures used to control radioactive or hazardous particulates are ventilated to the outside environment through HEPA filters in Building 231. Various other exhaust systems are used to intermittently ventilate the paint spray booth, welding hoods, bead blasters, vacuum pump exhausts, laser cavities, and inert gas flush systems directly to the outside of the building.

Wastewater generated by laboratories in Building 231 is discharged into local lift stations. The lift stations pump the wastewater to pipes that gravity drain into two aboveground retention tanks located in a bermed concrete area at the northeast corner of Building 231. Wastewater in these tanks is sampled and, if within acceptable discharge levels, the wastewater is released to the sanitary sewer. If unacceptable for release, it is transferred to RHWM. No hazardous or radioactive material is discharged into the sanitary sewer or storm drain systems.

Radioactive and hazardous wastes in the Building 231 vault are also collected in satellite accumulation areas located in the rooms in which waste is generated and under the control of the generator. Radioactive waste such as contaminated smear tabs, gloves, or other nonhazardous materials, which have been exposed to and contaminated with radioactive material, are disposed of in an appropriately labeled radioactive waste container.

The Building 231 vault, Building 232 fenced area, and Building 234 offices contain no specific processes or activities that would typically generate a waste or effluent. However, personal protective equipment, wipes, empty containers, bags, etc., may be disposed of as hazardous and/or radioactive contaminated waste. Additionally, classified materials sent for destruction and future efforts to reduce inventory could result in materials, once stored for future use, to be determined waste and disposed of through RHWM.

A.2.2.16 *Building 235*

Building 235 is an 88,475-gross-square-foot facility. Building 235 is located in the southwest quadrant of the Livermore Site. The Building 235 Complex consists of research laboratories and offices and provides facilities for experimental research in chemistry and materials science and for performing materials analysis. The building houses a 4-million-electron-volt accelerator and an ion implanter. Typical activities include material fabrication and characterization, x-ray spectroscopy, metallography, actinide and biological materials research, biomedical research, biodegradation, fuel cell development and testing, a nanoscale synthesis and characterization lab, specialized target fabrication, and other specialized research projects (LLNL 2002ap, LLNL 2001ag, LLNL 2001ah).

Hazards Assessment

The primary hazards associated with Building 235 include corrosive, toxic, reactive, flammable, pyrophoric, and carcinogenic materials, beryllium, pathogens, allergens, irritants, explosives, cryogens, ionizing and non-ionizing radiation, lasers, high-voltage electricity, high temperatures, and compressed gases. Biological research may be conducted in the facility, with operations potentially up to and including RG-2. RG-1 agents are not associated with disease in healthy human adults and RG-2 agents are associated with human diseases, which are rarely serious and for which preventative or therapeutic interventions are often available. Wastes that contain RG-1 or RG-2 biological materials are managed as biohazardous wastes as a best management practice. Controls for these hazards are specified in facility and operational safety plans (LLNL 2002ap, LLNL 2001ag, LLNL 2001ah).

Generated Wastes and Effluents

The hazardous and nonhazardous wastes that are produced in Building 235 include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; nonhalogenated solutions, both organic and inorganic; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous and radioactive constituents; cleaning solutions, including solvents; waste oil with trace gasoline, diesel, organics, and metals; discarded batteries; and contaminated equipment such as vacuum pumps, ignition tubes, and other equipment. Small amounts of both radioactive and mixed waste; e.g., laboratory chemical solutions and scintillation vials, are also generated. Waste materials are collected at satellite accumulation areas and then moved to a designated waste accumulation area.

The types of waste produced by the biological research include nonhazardous biological waste, biohazardous and contaminated sharps (medical) waste, and chemical waste. Biohazardous waste includes waste generated from research with RG-1 and RG-2 agents.

Building 235 also has a laboratory wastewater retention system that is used to collect and retain diluted nonhazardous and nonradioactive rinsewaters from laboratories until analysis determines they can be discharged to the sanitary sewer. Most laboratories are equipped with exhaust hoods that vent through HEPA filters to the atmosphere (LLNL 2002ap, LLNL 2001ah).

A.2.2.17 *Building 239*

Building 239, Radiography Facility, is a 12,517-gross-square-foot facility that contains nondestructive evaluation facilities (LLNL 2002bq). Facility operations involving radiography are carried out in the basement of the building. The basement consists of two large high bays that house linatrons, x-ray equipment machines and sealed sources (LLNL 2002dc). Facility operations consist of material property evaluations and determination of composition, density, uniformity, and cell or particle size and of assembly structural integrity (LLNL 2002ac).

Hazards Assessment

The range of hazards present in Building 239 include compressed gases, high-voltage electricity, reactive materials, explosives, hazardous and carcinogenic chemicals such as cleaning solvents, and ionizing and non-ionizing radiation.

Fissile materials in solid, nondispersible form are limited to 25 kilograms of HEU and 6 kilograms of fuel-grade equivalent plutonium. These materials are not dispersed or changed in form in the facility, and they are not stored in the building. Plutonium is not allowed to be in the same area as explosives (LLNL 2002dc). Sealed sources are also used in the facility. Transitory transuranic waste drums may be brought into the facility for radiography and held for a short time within the facility. The total resident quantity of material is maintained below Hazard Category 3 levels.

Chemical inventories typically consist of laboratory chemicals, cleaners, oils, etc. Lithium hydride and beryllium oxide are handled on a transitory basis, but are always in an approved container and are never handled uncontained in the building (LLNL 2002ac).

Generated Wastes and Effluents

Only solid radioactive waste is generated in Building 239. Solid radioactive waste may result from handling items potentially contaminated with radioactive material, including smear tabs, gloves, and other nonhazardous materials that may have been exposed to a radioactively contaminated item. A small amount of lead waste is generated primarily from expended lead screens used in film radiography cassettes. Other hazardous waste consists primarily of rags and paper towels used to apply cleaning solvent to various pieces of hardware.

No liquid radioactive waste is generated in the building. Liquid hazardous waste is generated during normal operation of the film-processing equipment. Liquid waste is accumulated and removed by RHWM (LLNL 2002ac).

A.2.2.18 *Building 241 Complex*

The Building 241 Complex is located in the southwest quadrant of the Livermore Site. It consists of a two-story building and several trailers. The complex includes laboratories, offices, and machining and storage facilities. Also included is a large high-low bay area. The ground floorspace is approximately 53,935 gross square feet and the mezzanine floor is about 7,910 gross square feet (LLNL 2002ap, LLNL 2001f).

Building 241 provides facilities for laboratory operations in materials development, measurement, and testing. Operations conducted in Building 241 include research in ceramics, surface science, electrochemical processes, high-pressure processes, biomedical sensors, recombinant DNA, chemistry, corrosion, processing of hazardous waste surrogates, nanoscale synthesis and characterization, and handling toxic and atmospherically sensitive materials. Building 241 also has offices, laboratories, a high bay area, storage space, a machine shop, and an electronics shop (LLNL 2002ap, LLNL 2001f, LLNL 2001ah).

Hazards Assessment

The primary hazards associated with Building 241 include corrosive, toxic, reactive, flammable, and carcinogenic materials, pathogens, allergens, irritants, cryogens, lasers, ionizing and non-ionizing radiation, high- and very-high-voltage electrical equipment, multiple heat sources, and compressed gases. Biohazards include infectious agents; tissues, including blood; and other items that may contain biohazardous agents. Controls for these hazards are specified in both facility and operational safety plans (LLNL 2002ap, LLNL 2001f, LLNL 2001ah).

Generated Wastes and Effluents

The hazardous wastes and nonhazardous wastes that are produced in the facility include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; nonhalogenated solutions, both organic and inorganic; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous and radioactive constituents; cleaning solutions, including solvents; waste oil with trace gasoline, diesel, organics, and metals; discarded batteries; and contaminated equipment such as vacuum pumps, ignition tubes, and other equipment. Small amounts of both radioactive and mixed waste; e.g., laboratory chemical solutions and scintillation vials, are also generated. Waste materials are collected at satellite accumulation areas and then moved to a designated waste accumulation area.

The types of waste produced by biological research include nonhazardous biological waste, biohazardous and contaminated sharps (medical) waste, and chemical waste. Biohazardous waste includes waste generated from research with RG-1 and RG-2 agents. Wastes that contain RG-1 or RG-2 biological materials are managed as biohazardous wastes as a best management practice.

The building also has a laboratory wastewater retention system, which is used to collect and retain dilute nonhazardous and nonradioactive rinsewaters from laboratories until analysis determines it can be discharged to the sanitary sewer. Many laboratories are equipped with exhaust hoods, some of which vent through HEPA filters into the atmosphere (LLNL 2002ap, LLNL 2001ah).

A.2.2.19 *Building 243*

Building 243, the Energy and Environment Research Facility, is located in the southwest quadrant of the Livermore Site. This 17,884-gross-square-foot facility houses high-pressure equipment and laboratories used for the testing and analysis of rocks and other materials. Other activities performed in this facility include x-ray microanalysis; bioremediation experiments; rock cutting, crushing, and polishing; laser-assisted, high-pressure spectroscopic measurements; and machine shop activities.

The research in Building 243 is conducted in support of basic energy sciences, the Yucca Mountain Project, other LLNL-directed R&D, and defense programs (LLNL 2000q).

Hazards Assessment

The principle hazards associated with Building 243 are pressure vessels, high-pressure fluid systems, electrical, toxic materials, flammable liquid, cryogens, hazardous gases, x-rays, radioactive materials, lasers, and routine industrial hazards associated with machine shop activities.

Small quantities of common-use laboratory and shop chemicals are used for specimen preparation and analysis and small-parts cleaning. Hazardous chemicals stored and used in the facility include carbon tetrachloride, red fuming nitric acid, hydrofluoric acid, vinylidene chloride, methyl butyl ether, and 2-propanol. Various carcinogens are also stored and used in facility operations. These include ethylene dichloride, lead, arsenic, cadmium, chromium, and nickel compounds.

Ionizing radiation hazards are present as a result of the use of analytical x-ray machines and sealed radioactive sources. Laser hazards in the facility result from the operation of Class 3b and Class 4 laser systems.

Bioremediation characterization of LLNL groundwater can also be performed in this facility. These activities involve the use of naturally occurring BioSafety RG-1 microorganisms. Standard BSL-1 work practices and controls are followed during these activities (LLNL 2000q).

Generated Wastes and Effluents

The operations in this building generate small amounts of solid and liquid hazardous and radioactive waste. Hazardous and mixed wastes generated in Building 243 workplaces are collected in satellite accumulation areas.

Many sinks and floor drains in Building 243 are connected to the LLNL sanitary sewer system and are not intended for the discharge of hazardous wastes. Additionally, the building does not have a retention tank system (LLNL 2000q).

A.2.2.20 *Building 251*

Building 251 is located in the western portion of the Livermore Site. The operations in this 31,809-gross-square-foot facility have varied over its lifetime, but include preparing radioactive tracers used in underground testing and conducting a heavy element research program. These operations involved using multicurie quantities of transuranic radioisotopes and SNM. Building 251 is now in storage mode, awaiting possible commencement of the decontamination and decommissioning (D&D) process. In this mode, the building inventory of radioactive material is stored primarily in underground storage vaults. However, some material remains in two Mosler safes and in containers stored in the hot cells (LLNL 2001aj). There has been a continuing effort to reduce inventories of radioactive material and to clean up all gloveboxes, other enclosures, and laboratory spaces since the facility moved to program standby in 1995. LLNL began a Building 251 risk reduction program (RRP) in 2001 that is designed to bring the facility down to radiological status by April 2005. When the RRP is completed, most radioactive material, waste, and contaminated hardware would be removed, leaving mostly embedded spills in the building. Nearly all room-filtered exhaust systems would remain to provide protection for the public and the environment when a decision is made to D&D or reuse the building. The RRP consists of three well-defined projects:

- The Inventory Reduction Project to reduce inventory of stored radioactive materials
- The Glovebox Removal Project to remove unneeded gloveboxes
- The Glovebox Ventilation System Removal Project to evaluate glovebox ventilation systems and deactivate and remove those systems not necessary for future activities

Hazards Assessment

Building 251 hazardous material inventories were reduced during 1996 and 1997. The chemicals remaining in the facility include small quantities of acetone, ethyl alcohol, ethylene dichloride, hydrochloric acid, methyl isobutyl ketone, and sodium hydroxide. Other chemicals include adhesives, cleaners, fluxes, greases, lubricants, and sealants. Approximately 18 tons of lead, primarily in the form of bricks, is stored in the building.

In addition to these inventories, hazards to personnel also consist of exposure to ionizing radiation; cryogens; compressed gases; electrical shocks; high noise; asphyxiation, due to confined space hazards; and standard industrial hazards associated with D&D activities.

Building 251 contains numerous small-mass, legacy, transactinide isotopes, which include fissionable materials subject to criticality control. The criticality safety program in Building 251 maintains the entire inventory of fissionable materials to less than a minimum critical mass in order to ensure that a criticality accident is not credible (LLNL 2001aj). Implementation of the RRP is expected to result in hazard reclassification to a radiological facility.

The Glovebox Removal Project would necessitate the use of a variety of additional chemicals in the facility in order to clean the gloveboxes and equipment contained in them for packaging and disposal.

Generated Wastes and Effluents

The hazardous wastes and nonhazardous wastes that are produced in the facility would include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; nonhalogenated solutions, both organic and inorganic; empty containers; laboratory debris, including contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous and radioactive constituents; cleaning solutions, including solvents; waste oil with trace gasoline, diesel, organics, and metals; discarded batteries; and contaminated equipment such as vacuum pumps, ignition tubes, and other equipment. Small amounts of both radioactive and mixed waste, such as laboratory chemical solutions and scintillation vials, are also generated. Radioisotopes of uranium, americium, curium, and plutonium are the principal radiological contaminants. The Glovebox Removal Project would increase the transuranic waste and low-level waste generated by the facility. The additional chemicals include various solutions to wash the inside surfaces of the gloveboxes to remove contamination; e.g., radiac wash, cerium nitrate, electrolytic stripping, etc., strippable coatings, and fixative coatings. Generated liquid waste would be stabilized before shipment. In addition, if a glovebox cannot be decontaminated to low-level waste levels, it would be size-reduced to fit into transuranic waste drums. This activity would be done in enclosures in the facility that are designed to contain contamination.

Each workspace, excluding offices, within Building 251 may be used as a satellite accumulation area. Waste is characterized, packaged, and prepared for transfer in accordance with RHWM guidelines.

Radioactive waste is also generated through building cleanup, repackaging, removal of equipment, storage, maintenance, and surveillance activities. Low-level waste and transuranic waste may also be generated during hot-cell or glovebox operations related to these activities. Radioactive liquid waste can be solidified within the building in small quantities in a glovebox. Other potential low-level radioactive liquids are placed in polyethylene waste carboys and sent to RHWM for disposition.

Liquids from laboratory sinks, eye washes connected to facility plumbing, the decontamination shower, and the floor drains are connected and diverted to the area retention sump and then pumped to one of the two 1,000-gallon retention tanks. Liquid in the tanks is sampled and held until laboratory analysis of radiological constituents indicates that the contents can be discharged into the sanitary sewer system. If sample results indicate concentrations in excess of discharge limits, it is transferred by tank truck to RHWM.

Air effluents from facility areas and processes are released though the facility ventilation system. This system consists of the glovebox exhaust system, the fume hood exhaust system, the room exhaust system, and the facility heating, ventilation, and air conditioning (HVAC) system. All systems are processed through HEPA filtration units. Each exhaust point from areas with contaminated enclosures or dispersible radioactive material is equipped with an isokinetic stack-sampling system. Filter papers are removed and evaluated by Hazards Control to determine the type and quantity, if any, of radioactive effluent (LLNL 2001aj).

A.2.2.21 *Building 253*

Building 253 is located in the central portion of the Livermore Site. This 32,276-gross-square-foot facility is LLNL's primary analytical laboratory for hazards control samples. LLNL operations include aliquoting, precipitating, acid digesting, and distilling samples; preparing calibration standards; and analyzing gross alpha and beta. The analytical laboratory has the following capabilities (LLNL 2001ak):

- **Flame Atomic Absorption Spectrometer—**Used for environmental lead analysis; provides backup capability for inductively coupled plasma
- **Flame Atomic Absorption Spectrometer with Graphite Furnace—**Used to analyze mercury and low-concentration metals
- **Inductively Coupled Plasma/Mass Spectrometer—**Used for uranium bioassay analysis and scan of metals in low concentrations
- **Inductively Coupled Plasma/Optima Emissions Spectrometer—**Used to analyze metal, including industrial hygiene metals and pump metals
- **Gas Chromatograph—**Used to analyze organic solvent
- **Gas Chromatograph/Mass Spectrometer—**Used to identify and measure organic solvents
- **Ion Chromatograph—**Used to analyze anions
- **High-Pressure Liquid Chromatograph—**Used to analyze high molecular weight solvents, formaldehyde, toluene, diisocyanate, MDI, etc.

Building 253 also houses the Whole-Body Counting Facility, which provides services for the in vivo analysis of radioactivity in the whole body and specific organs and provides gamma and alpha spectroscopy services for the analysis of in vitro and special samples. The Whole-Body Counting Facility consists of the control room and the counting room. The control room houses the computer system, the wound-counting system, the uninterruptible power supply, and other associated electronic and safety equipment. The counting room houses the whole-body-organ-and thyroid-counting systems. Most of the procedures for in vivo measurements require shielding to reduce the natural background radiation associated with building material, soil, air, and cosmic rays. The ceiling, walls, and floor of the counting room are shielded. Air entering the counting room passes through two HEPA filters in series to control airborne radioactivity (LLNL 2001ak).

Hazards Assessment

Hazards associated with Building 253 operations include toxic and corrosive chemicals, solvents, resins, and radiation associated with the small quantities of radionuclides contained in samples. Operations are controlled by a facility safety plan. Quantities of hazardous materials in the work area are limited to the minimum needed for each operation. The use of a hood is required if the operation could potentially release material into the workplace.

Generated Wastes and Effluents

The waste stream generated at Building 253 contains both hazardous and nonhazardous wastes that include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; nonhalogenated solutions, both organic and inorganic; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous and radioactive constituents; cleaning solutions, including solvents; waste oil with trace gasoline, diesel, organics, and metals; discarded batteries; and contaminated equipment such as vacuum pumps, ignition tubes, and other equipment. Small amounts of radioactive and mixed waste; e.g., laboratory chemical solutions, resins, and solvent wipe cleaning materials, are also generated (LLNL 2002as). This material is collected in satellite accumulation areas and then moved to the Building 253 waste accumulation area and segregated. From there, the waste is transferred to the appropriate treatment/disposal facility by RHWM.

A.2.2.22 *Building 254*

Building 254, the Bioassay Laboratory, is located in the central portion of the Livermore Site. This 2,465-gross-square-foot facility is a wet chemistry laboratory that prepares urine and fecal samples for bioassay. Sample preparation operations include sample aliquoting, precipitation, ion exchange separation, and electrodeposition. The prepared samples are transferred to Building 253 for bioassay analyses (LLNL 2003af).

Hazards Assessment

Hazards associated with Building 254 operations include the use of acids such as hydrochloric, nitric, and sulfuric; ammonium hydroxide; solvents; and ion exchange resins and potential exposure to the small quantities of radionuclides contained in bioassay samples. Operations are controlled by a facility safety plan. Quantities of hazardous materials in the work area are limited to the minimum needed for each operation. The use of a hood is required if the operation could potentially release material into the workplace (LLNL 2003af).

Generated Wastes and Effluents

The waste stream generated at Building 254 contains both hazardous and nonhazardous wastes that include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; resins; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous and radioactive constituents: waste oil with trace gasoline, diesel, organics, and metals; cleaning solutions including solvents; and contaminated equipment such as vacuum pumps, ignition tubes, and other equipment. Small amounts of radioactive and mixed waste; e.g., laboratory chemical solutions, resins, and solvent wipe cleaning materials, are also generated. Multiple waste steams are segregated and collected in various satellite accumulation areas, then moved to a waste accumulation area at Building 253 where the wastes are segregated from other noncompatible waste streams.

A.2.2.23 *Building 255*

Building 255 Calibration Facility is located in the central portion of the Livermore Site. This 21,813-gross-square-foot facility is divided into two sections, each housing independent operations. The eastern portion of the building houses the calibration and standards laboratory while the western portion contains the laboratory for development of diagnostic techniques (LLNL 2003m).

Radiation dosimetry calibrations are conducted in the eastern portion of Building 255 using both sealed and unsealed sources and radiation-generating equipment. This part of the facility is equipped with shielded irradiation cells housing radiation sources, support laboratories, and offices. Radiation sources used for calibration generate beta, gamma, x-rays, neutrons, and tritium. Several sealed sources are stored in this portion of the building (LLNL 2003m).

The western portion of Building 255 comprises offices, laboratories, and respirator services. Analytical chemistry, aerosol science, air cleaning performance, personal protective equipment performance, instrument development, and the industrial hygiene instrument laboratory are evaluated/housed in this portion of the building (LLNL 2003m). Respirator testing and cleaning are also performed in this area.

Hazards Assessment

The hazards present at this facility are those associated with handling fissile material and intense x-ray and gamma-ray sources. The eastern portion of Building 255's x-ray operations could produce an exposure rate of approximately 65,000 rem per hour, approximately 3 feet from the x-ray head. Sealed sources of radiation in this portion of the building could produce high radiation exposure from cobalt-60, californium-252, and cesium-137. The maximum rates of exposure from these sources are 8 rem per hour at approximately 3 feet from a gamma source such as cesium-137 and cobalt-60 and 5 rem per hour at approximately 3 feet from a neutron source such as californium-252 (LLNL 2003m).

Storage and use of the radioactive standards, including tritium, and tracers do not exceed 120 microcuries each in the western portion of Building 255. The small amounts in use do not represent an external hazard from the x-ray and gamma radiation emitted from these materials.

Similarly, the alpha and beta radiation from a majority of the isotopes does not represent a problem with internal deposition at these low levels. The estimated unshielded exposure rate from gamma radiation is not expected to exceed 1 millirem per hour at 0.4 inch while personnel are handling these materials (LLNL 2003m).

Maintenance and calibration gases, including carbon dioxide, carbon monoxide, hydrogen, methane, various refrigerants, and hydrogen sulfide, are used in the calibration of instruments in the eastern portion of Building 255. Carbon monoxide and hydrogen sulfide are toxic and overexposure to these gases may result in serious health effects. Therefore, mixtures at or below five times the Occupational Safety and Health Administration permissible limit or threshold limit value of the toxic gas are used. A mercury vapor source is also present for calibrating mercury meters. Exposure may result in serious health effects. The laboratory ventilation system helps reduce risk to exposure of these materials (LLNL 2003m).

The rooms and storage cells in the eastern portion of the building that contain radioactive sources are equipped with safety interlocks and warning lights to prevent entry during operations. A remote area monitoring system provides a readout at the control console and initiates both an audible and a visual alarm if radiation is present in the cell and the cell door is open. The cell used for the storage of radioactive sources is further equipped with a continuous air monitor (LLNL 2003m).

There are no special access controls associated with the western portion of the building. Only authorized personnel are permitted access to these laboratories, which remain locked when not in use (LLNL 2003m).

Generated Wastes and Effluents

The waste stream generated at Building 255 contains both hazardous and nonhazardous wastes that include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; nonhalogenated solutions, both organic and inorganic; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous and radioactive constituents; cleaning solutions, including solvents; waste oil with trace gasoline, diesel, organics, and metals; discarded batteries; and contaminated equipment such as vacuum pumps, ignition tubes, and other equipment. Small amounts of radioactive and mixed waste such as laboratory chemical solutions and scintillation vials are also generated. This material is collected in satellite accumulation areas, then moved to a waste accumulation area at Building 253 and segregated. From there, the waste is transferred to the appropriate treatment/disposal facility by RHWM (LLNL 2003m).

A.2.2.24 *Building 261/262*

Building 261/262 is located in the northwest quadrant of the Livermore Site. This 53,197-gross square-foot facility houses NAI program personnel and the Safeguards and Security Department CAIN Maintenance Group. The eastern portion of Building 261 consists primarily of office space, but also houses computing equipment and a vault-type security area. The western portion contains laboratory and office space. Building 262, a large containment structure, is attached to the south side of Building 261 (LLNL 2002k).

The Building 262 dome is divided into two equal compartments. Currently, the west dome is used for NAI/B-division experiments and the east dome is used as a storage facility. Future plans include the use of both compartments for experimental activities. The experiments conducted in Building 262 are designed to investigate the feasibility of developing a safe, portable, nondestructive, neutron-based apparatus and technique for in situ identification and qualification of various elements in closed containers. The experiments employ various types of portable neutron generators, radiation detectors, test samples, and radiation-shielding materials (LLNL 2002k).

Hazards Assessment

The hazards associated with Building 261/262 include operation of the neutron generators and handling small quantities of hazardous materials involved in research activities. Hazardous materials used at this facility include solvents; pyrophoric materials; e.g., mock explosives; combustible and toxic metals; sealed radioactive sources; and other radioactive material in solid form (LLNL 2002k).

The handling and storage of hazardous materials is controlled under the applicable operational safety procedures. Quantities of hazardous materials in the work area are limited to the minimum needed. In addition, Building 262 is equipped to provide fully automated remote operation capability, including a portable control room located just outside the dome, which houses the controls and electronic equipment for neutron generator operation. Total remote controlled operation, access interlocks, and 5-foot-thick concrete shield walls mitigate the radiation exposure hazards (LLNL 2002k).

Generated Wastes and Effluents

The principal liquid waste stream within Building 261 contains photolab developer and fixer. Solvents, oils, and organic liquids are held to an absolute minimum. Liquid hazardous waste is typically less than 100 gallons per year. Solid hazardous waste is anticipated in relatively small quantities and is expected to be primarily composed of lab trash; e.g., contaminated wipes and rags from the printing press operation. Generation of radioactive waste is not planned. However, small quantities could be generated if solid metal uranium and thorium parts were found to have surface oxidation. Mixed waste may be generated if a hazardous material, such as a solvent, comes in contact with a radioactive material, such as solid uranium, and a residual waste is generated. Wastes generated from this facility include small quantities of hazardous wastes and low-level radioactive wastes contaminated primarily with depleted uranium, natural uranium, and thorium (LLNL 2002k). Hazardous and mixed wastes generated in Building 261 workplaces; e.g., laboratory, shop, etc., are collected in satellite accumulation areas.

A.2.2.25 *Building 272*

Building 272, the Electro-optic Development Laboratory, is a two-story, 9,978-gross-square-foot facility located in the northwest quadrant of the Livermore Site. The facility consists of office, laboratory, and shop space. The building's use is currently in transition, having been used previously for etching circuit boards and interferometer detection systems. The building's second floor is currently being used by the Information Science and Technology Program.

Hazards Assessment

The primary hazards associated with Building 272 are limited to solvents, lubricants, cleaners, compressed gases, and limited paint. Although cryogenics have been used periodically in the facility, no cryogenics are stored in the building (LLNL 2000ab). However, a 600 gallon liquid nitrogen tank and associated equipment is currently being installed in the building.

Generated Wastes and Effluents

Small quantities of hazardous wastes are generated.

A.2.2.26 *Building 281*

Building 281, the Health and Ecological Assessment Laboratory, is located in the northwest quadrant of the Livermore Site. This 18,549-gross-square-foot facility comprises laboratory, shop, office, and refrigerated storage space. A number of programs and research activities are underway in the Building 281 laboratories including, but not limited to, general wet chemistry, radiochemistry, analytical chemistry, surface science, and biological analysis. Operations in Building 281 include radioactivity migration studies, dissolution studies, flow studies, and tracer solution preparation.

Hazards Assessment

The primary hazards associated with Building 281 operations include low-level radioactive tracer solutions and sealed sources, ionizing radiation; beryllium; concentrated acids and bases; toxic, flammable, and carcinogenic materials; RG-1 and RG-2 biological materials; lasers; cryogens; high-voltage electricity; and high temperatures and pressures. Controls for these hazards are specified in both facility and operational safety plans. The use of a hood is required if the operation could potentially release material into the workplace.

Generated Wastes and Effluents

The operations in Building 281 generate small amounts of solid and liquid hazardous, nonhazardous, and biological wastes. The hazardous and nonhazardous wastes produced in the facility include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; nonhalogenated solutions, both organic and inorganic; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous and radioactive constituents; flammable liquids; cleaning solutions, including solvents; and contaminated equipment. Small quantities of radioactive and mixed waste may also be generated. Waste materials, both liquid and solid, are collected in containers at workplace accumulation areas in or near the laboratories where the waste is generated. The waste is segregated until collected by RHWM. Wastes that contain biological materials could be managed in several different ways, from nonhazardous to biohazardous, depending on their characteristics. As a best management practice, all nonhazardous and nonradioactive wastes containing biological materials are sterilized prior to disposal. Some operations in Building 281 release small quantities of organic vapors to the atmosphere. These vapors will not exceed their respective ERPG values even under the worst-case conditions.

A.2.2.27 *Building 298*

Building 298, the Fusion Target Fabrication Facility, is located in the northwest quadrant of the Livermore Site. This 47,780-gross-square-foot facility consists of various laboratories, a machine shop, and office areas. The facility supports the ICF Program, the Laser Science and Technology Program, and the NIF Program. Supporting activities involve developing and analyzing cryogenic deuterium-tritium fusion targets, producing fusion targets, and developing state-of-the-art optics associated with the NIF Program. Operations within the building include laser cutting; 2,000-pound-per-square-inch D2 pumping system; specialty gas equipment and gas mixing activities; sol-gel optical coating process R&D laboratory; capsules and organic materials development; cryogenic target studies; target development, fabrication, and characterization; excimer laser ablation of polystyrene; diffractive optics development labs; diffractive optics fabrication; cryogenic hohlraum development; and cryogenic target studies (LLNL 2002ai).

Hazards Assessment

Building 298 is classified as a radiological/general industry facility. The primary hazards within the building include fire, the operation of chemical and physical laboratories, exposure to laser beams and x-rays, the use of vacuum and gas pressure systems, and leakage of cryogenic fluids. The facility is equipped with an automatic sprinkler system; access to lasers is controlled by warning signs, lights, signals, intercom systems, and door interlocks; the vacuum and pressure systems use engineering and operational safeguards; and the cryogenic fluid systems have been designed in accordance with LLNL safety standards (LLNL 2002ai).

Other operational and safety controls include radiation protection monitors, alarms, and controls; HEPA-filtered air flow hoods for depleted uranium in the sputtering assembly area; and radiation shielding for the radiographic machines.

Over 4,300 chemicals have been identified as being stored and/or used in facility operations. Of these 4,300 chemicals, seven exceeded the reportable quantity listed in 40 CFR §302.4. These included benzene, carbon tetrachloride, chloroform, lead, beryllium, n-butyl phthalate, and chlorine. Primary radionuclides of concern are tritium and depleted uranium (LLNL 2002ai).

Generated Wastes and Effluents

Wastes generated from this facility include hazardous wastes and low-level radioactive wastes contaminated primarily with depleted uranium, tritium, and thorium. Wastes are collected in designated containers in the satellite accumulation areas. A retention tank system is located north of Building 298. The system is designed and managed to routinely accept nonhazardous and nonradioactive wastewater that enters the system via specially designated sinks in the building (LLNL 2002ai).

A.2.2.28 *Building 321 Complex*

The Building 321 Complex, the Engineering Technology Complex, is located in the southwest quadrant of the Livermore Site. The primary function of these facilities is the fabrication of parts and assemblies to meet the needs of LLNL programs. This complex includes the buildings listed in Table A.2.2.28–1.

TABLE A.2.2.28–1.—*Building 321 Complex*

Facility	Name	Square Feet
Building 321	Materials Fabrication	149,489
Building 322	Plating Shop	5,822
Building 322A	Metal Finishing Facility Annex	340
Building 329	Laser Weld Shop	5,214
Building T3203	Materials Fabrication	632
Building T3204	Materials Fabrication	647

Source: Original.

Building 321 consists of several wings. Building 321A contains a large high-bay machine shop. There are numerous machine tools in this bay, and they vary in size from large computer numerical control mills and lathes to small conventional machines. Building 321A contains shops and offices, including the Optics Facility. The Heat Treat Facility and Spin/Press Forming Shop have large pieces of equipment used for their respective operations as well as furnaces heated by electric elements. Building 321A also includes an electronics circuit board fabrication process (LLNL 2001aw).

Building 321B contains electronics fabrication, powder coating, and silk screening operations. Building 321C contains offices, shops, and storage areas. The Numerical Control Shop is equipped with computer numerical control mills and lathes and has electrical discharge machining capabilities. The water jet cutting machine uses high-pressure water and garnet to cut a variety of nontoxic materials including metals, ceramics, and plastics. A vault is also included in Building 321C where classified hardware and accountable materials are stored (LLNL 2001al).

Building 321D holds the circuit board fabrication and wave-soldering machine. Building 321E is the main mechanical equipment room for the Building 321 Complex. Building 322 is a plating shop used to finish metal surfaces with a wide variety of protective and functional surface coatings. It contains a large number of tanks of chemical solutions and rinsewater for processing parts.

Building 322A is used for glass bead blasting and nonhazardous storage (LLNL 2001e). Building 329 houses laser processing, including cutting, drilling, etching, and welding, of various materials such as plastics, ceramics, and metals, including beryllium and depleted uranium. Trailer 3203 houses a limited machine shop and a chemical storage area. Trailer 3204 provides a conference room, office space, and a change room for the metal finishing buildings.

Hazards Assessment

Buildings 321A and 321C are classified as low-hazard, radiological facilities. Building 322 and Trailer 3203 are classified as low-hazard facilities. Buildings 321B, D, and E; 322A; and 329 and Trailer 3204 are classified as general industry. The primary hazards within the complex include chemicals, acids, rotating machinery, hazardous and radioactive material operations, high temperatures, cryogenic materials, pressure, lasers, high voltage, and x-rays (LLNL 2001aw).

In Building 321A, the Heat Treat Facility and Spin/Press Forming Shop are permitted to form and heat treat fissionable materials such as uranium-238 (depleted uranium) and low-level radioactive material such as natural and depleted uranium and thorium. The Heat Treat Facility may also process toxic materials, such as beryllium. These areas are controlled, monitored, and routinely surveyed for airborne contaminants.

In Buildings 321A and 321C, material fabrication includes machining and forming operations of various metals and hazardous and radioactive materials that may include compounds of uranium, thorium, cobalt, beryllium, and lithium hydride. Lithium hydride solid, uranium, and powdered beryllium have established maximum inventory limits. A HEPA filter replacement requirement and a periodic cleanout of the cyclone separator catch basins have been established (LLNL 2001al).

Operations in Building 322 use, store, and dispose of chemicals used in the electroplating industry, including cyanide, arsenic, nitric acid, hydrochloric acid, sodium hydroxide, ammonium sulfate, acetone, and perchloroethylene. Concentrated liquid plating waste solutions are collected and transferred to a holding tank (LLNL 2001e). Building 329 houses laser processing of materials including beryllium, fluorine, and depleted uranium.

The Building 321 Complex is equipped with contamination control areas for processing toxic and radioactive materials such as arsenic, beryllium, uranium, thorium, lithium hydride, and mercury compounds. Enclosures and close-capture systems, such as hoods and gloveboxes, are provided when working with radioactive and toxic material. The machine tools are provided with ventilation systems that aspirate the fine particulates and mists and capture them in HEPA filters.

In recent years, no uranium-235 parts or assemblies have been processed that could become critical; however, the complex is capable of handling such parts if required. Two rooms of the Materials Fabrication Shop are equipped with nuclear accident dosimeters and criticality alarms. Special criticality evaluations and safety procedures are required for such work.

Generated Wastes and Effluents

The hazardous and nonhazardous wastes that are produced in the facility includes alkaline and acid solutions, including lab-packed solutions; bulk and lab-packed waste chemicals; nonhalogenated solutions, organic and inorganic; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituents; wastewater; residues; cleaning solutions, including solvents; waste oil with trace gasoline, diesel, organics, and metals; discarded batteries; and contaminated equipment such as vacuum pumps, ignition tubes, and other equipment. Mixed wastes such as coolants, laboratory debris, contaminated equipment, and metals are and also generated.

A.2.2.29 *Building 327*

Building 327, the Nondestructive Evaluation Facility, has a floorspace of 19,052 gross square feet and is located in the south-central portion of the Livermore Site. The activities and operations include the receipt and handling of hazardous materials; maintenance and operation of radiation-generating devices (RGDs), such as x-ray machines and sealed sources; film-processing equipment; ultrasonic and acoustic test equipment; infrared imaging equipment; dye penetrant and magnetic particle equipment; eddy current equipment; visual inspection equipment; and various support equipment and systems (LLNL 2000d).

Hazards Assessment

Building 327 is classified as a radiological facility. The primary hazards within the building include common industrial hazards, hazardous and radioactive material operations, high temperatures, cryogenic materials, lasers, high voltage, and x-rays. Minor amounts of chemicals are kept in the building, including cleaning solvents and photographic chemicals. Lithium hydride is contained within components. Beryllium is handled in the facility, but only in solid parts that are nondestructively examined. Because of the amount and nature of the chemical and toxic materials, the facility may be considered a general industry facility (LLNL 2000d, LLNL 2000r).

Nondestructive evaluation is conducted on radioactive materials, solid (nondispersible) uranium or thorium materials, biological clinical specimens, and samples of encapsulated or unencapsulated explosives in specific rooms. Use and handling of biological clinical samples are potentially hazardous. Work with these materials can be conducted safely if proper procedures and facilities are used.

The total quantity of fissionable material present in Building 327, including sealed sources, may not exceed specified limits and criteria (LLNL 2000r). Materials that require the facility to be rated as a radiological facility may be reduced in the future to levels that would result in reclassification to a general industry facility.

Generated Wastes and Effluents

The operations in Building 327 generate solid and liquid wastes; e.g., acid solutions and solvent-contaminated debris, and solid low-level radioactive waste. The potential for generating mixed waste is small and is minimized by the proper segregation of hazardous and radioactive waste. Hazardous and mixed waste generated in the workplace are collected in satellite accumulation areas. Spent fixer and developer from film processing are disposed of pursuant to Environmental, Safety, and Health (ES&H) Manual requirements. Low-level radioactive waste is also collected in satellite accumulation areas.

The facility water retention tank system is located on the west side of the building and consists of a 5,000-gallon fiberglass in-ground tank designed and managed to accept nonhazardous waste from the ultrasonic tank. Retention tank wastewater is released to the sanitary sewer after characterization and when within release limits. Sinks and floor drains are connected to the sanitary sewer system and are intended for the discharge of nonhazardous waste only (LLNL 2000r).

A.2.2.30 *Building 328 Complex*

Buildings 328, 328A, and 328B, the Hazards Control Fire Test Facility, are located in the south-central portion of the Livermore Site. Building 328 is a 372-gross-square-foot steel building where LLNL conducts burn tests, located in the south-central portion of the Livermore Site. Burn tests can be for LLNL projects or work for others. Diagnostic instrumentation and signals are fed to Building 328B, a smaller corrugated aluminum building of 288 gross square feet that contains diagnostic instrumentation and HEPA filters for cleansing the exhaust fumes prior to release. Building 328A is also corrugated aluminum and is used as a storage area. This 720-gross-square-foot building was scheduled to be demolished in 2002, but is still standing.

Hazards Assessment

Hazards associated with this facility include high temperature, off-gases, smoke, and open flames. No hazardous materials are currently used or stored in any of the complex buildings.

Generated Wastes and Effluents

Generated solid wastes may consist of unburned project material or the ash remains of burned material. Solid wastes will also include HEPA filters containing some particulates. Generated solid waste is containerized as appropriate for treatment or disposal by RHWM. Effluents to the atmosphere may include carbon monoxide, nitrogen oxides, hydrocarbons, and particulates.

A.2.2.31 *Building 331*

Building 331, the Tritium Facility, is part of the Superblock, a protected area located in the southwest quadrant of the Livermore Site. The 28,493-gross-square-foot building contains laboratories, offices, and a machine shop. The access-controlled area of Building 331 consists of two connected wings. The first wing was constructed in 1958 and houses primarily the actinide chemistry laboratories. The second wing was constructed in 1964 and houses primarily the tritium area. However, actinide and tritium work can occur in either wing.

Current activities in the facility include both tritium and nontritium operations. Tritium operations include tritium-related research, tritium recycling, decontamination and renovation activities, legacy waste processing, and tritium systems design; e.g., the Tritium Facility Modernization Project, and operational support. Nontritium processes include assaying plutonium; handling small amounts of explosives, such as squib valves, and other transuranic isotope specimens in small quantities; computed tomography; elemental characterization; and carbon dioxide cleaning (LLNL 2002w).

The tritium area laboratories are used primarily for experimental work with the isotopes of hydrogen gas, metal hydrides in contained beds, and small amounts of experimental metal hydrides and tritium-labeled compounds.

Tritium operations similar to those currently being performed would continue and expand. Programmatic work would include support of high-energy density target development especially for cryogenic targets and test readiness. Efforts for the recovery and recycling of tritium would also expand. Several projects supporting Defense Programs mission objectives and involving tritium and SNM may be performed as well. Facility initiatives to support expanded tritium operations include increasing the material at risk to 30 grams of tritium and conducting the Tritium Facility Modernization Project, which would renovate and modify approximately 4,000 square feet of laboratory space for installation and operation of a modern hydrogen isotope research capability (LLNL 2002w).

Nontritium operations include (LLNL 2002w):

- Carbon dioxide cleaning system for decontaminating parts
- Computed tomography for determining the internal structure of mock weapons materials
- High-sensitivity neutron instrument for surveying waste containers generated in the Plutonium Facility (Building 332)
- Surface characterization laboratory for analyzing the elemental and chemical composition of the surface of solid actinide samples using a variety of techniques such as x-ray photoelectron spectrometer (XPS), scanning auger microprobe (SAM), scanning electron microscope, x-ray diffractometer, and x-ray fluorescence
- Elemental and isotopic analysis laboratory for analyzing the elemental and isotopic composition of liquid and solid actinide samples using spectrometers, such as an Inductively Coupled Plasma/Mass Spectrometer and an Inductively Coupled Plasma/Optima Emissions Spectrometer
- Glow discharge mass spectroscopy laboratory for analyzing the elemental and isotopic composition of solid actinide samples by sputtering the surface and measuring the ionized species with an instrument such as a mass spectrometer

Nontritium operations similar to those currently being performed would also continue and expand. Use of the carbon dioxide cleaning system would increase, and new actinide chemistry operations would be added to allow for disposition. Programmatic work would include characterization of HEPA filters from the NMTP facilities and repackaging and storing low-level waste and transuranic waste containers. Preparing SNM targets for the NIF experiments and post-shot recovery and disposition operations would also take place in Building 331 (see Appendix M).

Hazards Assessment

The primary radiological hazard in Building 331 is associated with the handling and storage of tritium, SNM, and other radioactive isotopes. Other hazards include high-pressure gases, x-ray, lasers, hazardous and toxic materials; e.g., beryllium, mercury, and asbestos from D&D

activities, high magnetic fields, cryogenic liquids, and small quantities of high explosives such as squib valves.

The bulk of the tritium inventory is in elemental form or metal hydrides capable of being turned into elemental form by heating. A small amount of tritium is used in the labeling of compounds or in the synthesis of lithium hydride. Some tritiated water is formed in the facility's tritium cleanup systems.

Building 331 is divided physically and operationally into zones of relative potential hazard. All experimental laboratories and work with radioactive materials is limited to the radioactive materials area (RMA). The RMA is separated by double doors from the offices and shop area.

Building 331 has an engineered ventilation system to protect workers and to control the release of radioactive material to the environment. Within the RMA, pressure gradients are maintained so that air always flows from clean areas toward areas of increasing contamination potential; i.e., from the RMA hall, to the lab, to the hood. The system is designed to quickly dilute and exhaust tritium through two 100-foot-high continuously monitored stacks.

In the actinide chemistry laboratories, material is handled in forms or enclosures to prevent its release to the worker's breathing zone and control exposure to airborne radioactive material within the facility. All exhaust from active gloveboxes in the actinide laboratory areas is filtered through multiple stages of HEPA filters; this exhaust is continuously sampled and monitored for radioactive contamination prior to release from the facility. Any contamination within a glovebox is confined to its ventilation zone.

In addition to the engineered controls supplied to keep radioactive materials out of the worker's breathing zone, workers are further protected by using continuous air monitors that continually monitor the breathing zone air for tritium and other radioactive materials and sound an alarm to warn the workers if the activity exceeds a preset level. Gaseous effluents from the facility are also monitored in this fashion. To provide a lower limit of detection than is possible with the continuous air monitors, passive air sampling, which does not have alarming capability, is also conducted in work areas before gases are exhausted from the facility.

The air monitoring equipment is electrically connected to the uninterruptible power supply and emergency power system. If power is lost, the uninterruptible power supply will provide power for the time it takes the standby diesel generator, shared with Building 334, to start and assume the load (LLNL 2002cu).

Generated Wastes and Effluents

The hazardous and nonhazardous wastes that are produced in the facility include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; nonhalogenated solutions, organic; empty containers; debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituents; cleaning solutions, including solvents; and waste oil with trace gasoline, diesel, organics, and metals. Radioactive and mixed wastes; e.g. laboratory debris, contaminated equipment, and metals, contaminated with tritium and other radioactive material are also generated. D&D activities may result in laboratory equipment and gloveboxes potentially contaminated with low-level waste components.

Air potentially containing tritium at low concentrations is exhausted from the rooms and hoods, within the RMA and is discharged through two 100-foot-high continuously monitored stacks. Tritium is removed from glovebox atmospheres by tritium air scrubbing systems. Air discharged from the actinide chemistry laboratories may contain small quantities of organic vapor. These discharges are within permitted limits for the glovebox exhaust systems (LLNL 2002cu).

A.2.2.32 *Building 332 Plutonium Facility*

The Building 332 Plutonium Facility is part of the Superblock, a protected area located in the southwest quadrant of the Livermore Site. This building has a total area of 104,687 gross square feet, including radioactive materials laboratories, mechanical shops, change rooms, storage vaults, a fan loft, basement, equipment rooms, and offices. There are currently 24 laboratories in which radioactive materials can be handled within the RMAs of the facility (LLNL 2002br, LLNL 2002r).

The mission of Building 332 includes R&D in the physical, chemical, and metallurgical properties of plutonium and uranium isotopes, compounds and alloys, and certain actinide elements. This basic mission and these research capabilities support DOE's Defense Programs and the Stockpile Stewardship and Management Plan. The major activities in Building 332 include testing plutonium-bearing and uranium-bearing engineering assemblies; fundamental and applied research in the metallurgy and chemistry of actinide elements, compounds, and alloys; development and demonstration of pyrochemical processing methods; development of plutonium coatings and fabrication; enhanced surveillance and pit surveillance; pit assembly and disassembly; and pit reuse. These main activities are supported by metallography, chemical, and radiographic, including x-ray, analyses.

Operations within Building 332 include melting, casting, welding, and machining; developing alloys and heat treating: testing torsion, tensile, and compression; measuring density and heat capacity; machining, inspecting, and testing components; using chemical processes to purify, separate, or convert actinide materials; pressure testing and gas filling operations; and assembling components. Chemical analyses can also be conducted on gram-sized samples in support of these activities.

The Materials Management Division is responsible for all shipments of radioactive and other controlled materials to and from Building 332, as well as movement within the building. This division also controls storage of these materials in the building vaults. The vaults are equipped to safely store fissile, radioactive, and certain other SNM required for programmatic operations. Criticality safety controls for the vaults include specially designed storage racks and containers to control the spacing of stored fissile materials and mass limits for each storage location or rack cell within a storage vault. LLNL criticality safety controls also specify mass limits for each workstation. The basic LLNL administrative workstation plutonium limit is 220 grams. A larger quantity can be authorized by management in an operational safety plan (LLNL 2002r).

Operations similar to those currently being performed in Building 332 would continue and expand. Facility initiatives to support expanded Plutonium Facility operations include increasing the material limit for two rooms and the Building 332 ductwork replacement project, which replaces an old glovebox exhaust system (LLNL 2003cj). Other facility initiatives include rebuilding the downdraft system to eliminate contaminated ducting and wooden box HEPA filters in the loft; installing a drum repacking area; installing a modern analytical chemistry room; installing a radiography cave; replacing an autoclave; and various room cleanouts, equipment replacements, and D&D of older equipment.

Programmatic enhancements and facility initiatives in existing laboratories are ongoing activities in Building 332 and are part of its R&D mission in support of DOE's programmatic requirements. Some examples of near-term programmatic enhancements include weapon-type welding and nonnuclear development work, which includes installing a new laser welding system in an existing laboratory; developing and demonstrating engineering demonstration units for different weapon types; and demonstrating a modular system for the modern pit facility foundry, the Livermore Casting and Shaping Technology System, which includes installing a set of modular gloveboxes in an existing laboratory, all tied together with an enclosed transport system designed to minimize worker exposure and reduce potential environmental, health, and safety impacts. Major components of the system glovebox line include size reduction, feed casting and blending, breakout and storage boxes, shape casting, heat treatment, density measurements, and mold and crucible preparation. Another near-term programmatic enhancement project includes demonstration of a modular system for the low-exposure actinide processing, which includes mechanically disassembling pits using pit bisectors or lathes, retrofitting and automating the hydriding and chlorination systems, decontaminating HEU using electrolytic or carbon dioxide pellet blasting, sanitizing and declassifying non-SNM parts, and using an evaporative purification system using a cold wall furnace.

Hazards Assessment

The primary potential hazard in this facility is exposure to airborne radioactive material. Plutonium and enriched uranium are the materials of primary concern. Plutonium and enriched uranium are fissile materials and quantities will be present that must be properly controlled to prevent assembly of a critical mass. Plutonium and enriched uranium are also reactive metals and alpha emitters. Fine powders, oxide, or metal involved in a fire have the potential for dispersal. Personnel handling dispersible forms are at risk for internal contamination and must be properly protected.

Other hazards in Building 332 include ionizing and non-ionizing radiation, x-ray, lasers, compressed gases, corrosives, asphyxiants, solvents, halogenated organics, hazardous and toxic materials; e.g., lead, beryllium, mercury, and asbestos from D&D activities, high temperature equipment, hydrogen, combustible and flammable materials, vacuum chambers, and cryogenic liquids.

The facility is divided physically and operationally into zones of relative potential hazard. Storage and work with radioactive materials is limited to the RMA. Handling material in forms or enclosures that prevent its release to the worker's breathing zone controls exposure to airborne radioactive material within the facility. Handling the material in the RMA, which has an engineered ventilation system, controls release of radioactive material to the environment. Within the RMA, pressure gradients are maintained so that air always flows from clean areas toward areas of increasing contamination potential. In addition, entry into the radioactive materials area is through air locks that maintain the pressure gradient. All exhaust from the gloveboxes and laboratory areas is filtered through multiple stages of HEPA filters; this exhaust is continuously sampled and monitored for radioactive contamination prior to release from the facility. Processing in gloveboxes is usually done under an inert gas atmosphere (nitrogen or argon), since finely divided plutonium may spontaneously ignite in moist air. Any contamination within a glovebox is confined to its ventilation zone. Only in the case of a spill would decontamination of a room or the building become necessary.

Two diesel generators provide emergency power for safety system structures and components. These generators can assume full load within minutes. Battery power is supplied to selected equipment to avoid interruption in supplied power. Battery power is provided, for example, to the fire alarm and criticality alarm systems.

In addition to the engineered controls supplied to keep radioactive materials out of the worker's breathing zone, workers are further protected by the use of continuous air monitors that continuously monitor the breathing zone air for radioactivity and sound an alarm if the activity exceeds a preset level. Exhaust streams from facility rooms, hoods, and gloveboxes are also monitored in this fashion after passing through their final stage of HEPA filtration. To provide a lower limit of detection than is possible with the continuous air monitors, passive air sampling, which does not have alarming capability, is also conducted in work areas and before exhaust streams are discharged from the facility (LLNL 2002r).

The proposed near-term programmatic enhancements and D&D projects would be similar to ongoing activities in the building, and their potential environmental, safety, and health impacts would be mitigated to minimal levels. Some of these projects would be designed to further minimize the impacts to workers; e.g., the enclosed transport system for Livermore Casting and Shaping Technology System would reduce potential for worker exposure to radioactive materials.

Generated Wastes and Effluents

There are five specific categories of waste that may be generated in Building 332: transuranic waste (waste with radioactive material contamination levels greater than 100 nanocuries per gram); low-level waste (all waste with radioactive materials contamination levels less than 100 nanocuries per gram); mixed waste (hazardous waste contaminated with radioactive waste); hazardous waste (hazardous waste sampled and shown to be free of radionuclides); and uncontaminated solid waste (nonhazardous, nonradioactive waste disposed of via the municipal landfill). Wastes in all of these categories are evaluated for radionuclide content before transportation to RHWM facilities.

Legacy and new transuranic waste is temporarily stored in the basement, and the individual waste drums are scanned by a segmented gamma scanner to verify radionuclide and curie content. The drums are then sent to RHWM. Plutonium-contaminated liquids are also generated by Building 332 operations and consist of cleaning or lubricating fluids and contaminated oil and aqueous solutions used in analytical and metallurgical operations. All plutonium-contaminated liquid wastes, typically in liter quantities, are either solidified prior to disposal as solid waste or retained in approved containers prior to pickup by RHWM for proper treatment, storage, and/or disposal.

Building 332's ongoing activities and near-term programmatic enhancements would increase the transuranic waste generation amounts, but the waste amounts would be well within the capacities and capabilities of the RHWM facilities. Appendix B describes how transuranic waste is managed and stored at LLNL and identifies the upcoming activities for certification and transport of this waste type to the Waste Isolation Pilot Plant (WIPP).

Two 750-gallon tanks are used to collect nonradioactive aqueous laboratory wastes. The aqueous wastes may contain a small amount of acid waste such as sulfuric acid, chromic acid, phosphoric acid, fluoroboric acid, and nitric acid, and/or metal salts such as nickel, beryllium, copper, and silver. When a tank becomes full, the contents are analyzed for radioactive and hazardous contaminants. If the waste meets the criteria of the Livermore Water Reclamation Plant, it is discharged to the sanitary sewer system.

Other Building 332 waste streams include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; halogenated and nonhalogenated organic solutions; empty containers; debris such as contaminated paper and rags, protective clothing, glassware, plastic ware, tubing and fittings, wood and metal parts, and HEPA filters with hazardous constituents; wastewater; residues; asbestos; cleaning solutions, including solvents; waste oil with trace gasoline, diesel, organics, and metals; and contaminated equipment. All waste streams are properly managed based on radioactive and hazardous material content.

A.2.2.33 *Building 334*

Building 334, the Hardened Engineering Test Building, is part of the Superblock, a protected area located in the southwest quadrant of the Livermore Site. Building 334 has a total area of 8,600 gross square feet and is used for three main activities (LLNL 2002bs, LLNL 2002s):

- Conducting intrinsic radiation measurements. Nonexplosive, plutonium-bearing assemblies are used in these experiments, using gamma and neutron generators in some cases to determine the occupational radiation exposure to personnel during transportation, storage, and handling of nuclear components.

- Conducting physical testing of components to various combinations of vibration, acceleration, mechanical, and thermal shock. These tests simulate the harsh conditions to which the components may be subjected over their lifetime in storage, transportation, and use.

- Performing low-level radiography of specific components.

The building has two three-story high bays used for performing tests, two control rooms, an entry and signal amplifier room, a mechanical equipment room, and supporting utilities. In one test bay, low level counting based on intrinsic radiation and radiography are performed. The second test bay, houses the physical test equipment. Each bay is equipped with a HEPA ventilation system. The separation of bays and the independent ventilation systems ensure that events in one bay do not affect the other.

Work performed in Building 334 consists of thermal and mechanical testing, low-level x-ray radiography, and intrinsic radiation measurements using a gamma or neutron generator on occasions. Work could involve items being brought into the facility containing an array of potentially hazardous materials (LLNL 2002s).

Hazards Assessment

The hazards for Building 334 are associated with reactive materials, cryogenic materials, heat sources, high-voltage electrical systems, compressed gases, radiation-generating devices, ionizing radiation, toxic materials, and industrial hazards due to sample testing techniques. These hazards are associated with thermal and mechanical shocks and radiation measurement activities.

The release of radioactive material from the Hardened Engineering Test Building is prevented by multiple confinement barriers, including metal barriers around the radioactive source material in the intrinsic radiation bay and the engineering test bay (confinement) as well as walls and equipment enclosures (physical barriers).

When operations are ongoing in a bay, continuous air monitors are used to provide immediate warning if airborne radioactive contamination exists. If radiation levels exceed a preset level, continuous air monitors in each room sound an audible local alarm to warn bay occupants and send a signal to the alarm panels in the control rooms.

A standby generator, shared with Building 331, provides power in the event of an outage. Standby power is provided for air monitoring systems, fire and security alarms, and the lighting of the two bays (LLNL 2002s).

Generated Wastes and Effluents

This facility is used for measurement and testing only. No radioactive, hazardous, or mixed wastes are generated during normal operations in Building 334.

A.2.2.34 *Building 341*

The Building 341 Physics and Advanced Technology Facility is located in the southwest quadrant of the Livermore Site. This 44,322-gross-square-foot building contains a variety of isolated, interlocked, and remotely controlled major experimental facilities for high-energy operations. The experimental studies within the facility include the use of high-energy electrical systems and explosives, high-velocity experiments using gun systems, and development and testing of optics, laser systems, flash x-ray generators, and hydro-diagnostics equipment (LLNL 2002bh).

The experimental facilities in Building 341, where required, are designed with hardened construction, soundproofing, special ventilation, fire protection, safety interlocks, run-safe switches, and warning devices to minimize hazardous conditions to personnel (LLNL 2002bh).

Depleted uranium in metal form is used in Building 341 for a number of scientific applications other than fuel for nuclear reactors. These applications include projectiles, armor-piercing ammunition, and target materials.

Hazards Assessment

The primary hazards within this building are from work involving high-velocity projectiles, high-energy electrical storage systems, high-pressure operations, laser operations, use of toxic and radioactive materials, x-ray producing equipment, flammable gases and liquids, detonators, explosives, and high-speed rotating cameras (LLNL 2002bh).

Some of the operational and safety controls include warning light systems for hazardous operations, safety interlock systems for personnel entry, use of protective clothing and equipment, use of hazardous materials only in designated areas with equipment approved for the type of operation, remote operation of the high-speed rotor cameras, insulation and shielding of high-voltage systems, and high ventilation rates for enclosed spaces and vaults (LLNL 2002bh). Remote key-controlled firing, safety interlocks, and strict adherence to operational controls are required to prevent injuries and damage to property.

Propellant and detonators are stored in approved storage areas only, in a nonpropagating configuration. Detonator use is restricted to approved areas and these areas are electrically interlocked and equipped with physical key lockouts (LLNL 2002bh).

Operations involving radioactive material are performed in areas designed to minimize both personnel exposure and the probability of releasing radioactivity into uncontrolled areas.

There may be funding in the future for advanced armor studies. Associated hazards could include explosion, shrapnel, x-ray exposure, high-voltage shock, smoke inhalation, and loose radioactive particles. Some of the controls include interlocked doors and equipment, remote operations, containment box ventilated through HEPA filters, air monitoring, x-ray safety boxes, and electrical isolation of explosives (LLNL 2002bh).

Generated Wastes and Effluents

Hazardous wastes such as photographic materials, waste oils, gunshot, and contaminated clothing are produced in this facility as a result of gas gun operations. Explosives wastes and radioactive fragments are also produced. All wastes are handled by RHWM for proper treatment, storage, and disposal (LLNL 2002bh).

A.2.2.35 *Building 343*

Building 343, the High-Pressure Laboratory, is located in the southwest quadrant of the Livermore Site. This 25,590-gross-square-foot facility has four reinforced concrete cells used for tests and experiments with high-pressure systems up to 75,000 pounds per square inch. The high-pressure systems inside these cells can be operated remotely for burst, leak, or certification testing with liquids and inert or flammable gases. Systems tested in Building 343 include vessels and components manufactured from radioactive (depleted uranium) and toxic (beryllium) materials. Facility operations also include engineering design and fabrication of high-pressure systems (LLNL 2003n).

Hazards Assessment

Hazards that are associated with the high-pressure systems include rupture of pressurized equipment, contamination by toxic or radioactive material, or ignition of flammable gases. Facility safety procedures have been established that restrict the quantity, containment, physical state, type, and energy potential of the hazardous materials (LLNL 2003n).

Generated Wastes and Effluents

Wastes generated from this facility include hazardous waste and low-level radioactive waste contaminated with depleted uranium. Wastes are collected in designated containers in satellite accumulation areas (LLNL 2003n)

A.2.2.36 *Building 360 Complex*

The Building 360 Biological Research Complex is located in the center of the Livermore Site. The buildings in the Building 360 Complex are used in fulfilling the mission of the BBRP, which conducts basic and applied research in health and life sciences in support of national needs to understand causes and mechanisms of ill health, to develop biodefense capabilities for national and homeland security, and to improve disease prevention and lower health care costs. Activities in these facilities include general chemistry and biology research up to BSL-2, which includes work with biological agents of moderate potential hazard, such as *E. coli* K12; mouse tissues; untransformed normal human cell lines; and fixed samples of human tissue, and work with experimental animals (mice). BSL-2 includes human tumor cells and potentially infectious cells and secretions. The BSL-3 facility would handle infectious microorganisms. The Building 360 Complex building sizes and operations are summarized in Table A.2.2.36–1 (LLNL 2002an).

TABLE A.2.2.36–1.—*Summary of Building 360 Complex Operations*

Facility	Uses	Square Feet
Building 361	Biological research, recombinant DNA, sterilization of all LLNL medical waste	67,672
Building 362	Biological research	3,749
Building 363	Food toxicology	1,584
Building 364	Animal care and research	10,951
Building 365	Pathogenic microbe research, primary treatment of BSL-2 waste	8,871
Building 366	Mouse genomics research	2,620
Building 368	Animal handling, pathogen research up to BSL-3	1,500
Building 376	Machine shop	1,560
Building 377	Structural biology research, x-ray diffraction crystallography, Class 3 laser	4,333

Source: Original.
BSL = BioSafety Level; DNA = deoxyribonucleic acid; LLNL = Lawrence Livermore National Laboratory.

Hazards Assessment

The hazards associated with work in the biological research laboratories include radiological, chemical, berryllium and biological hazards. Radiological concerns include a cesium-137 irradiation facility at Building 364, with a 3,500-curie cesium-137 source, and the use in various laboratories of tritium, carbon-14, phosphorus-32, and sulfur-35. Chemical hazards include the usual laboratory chemicals and a number of toxic and carcinogenic materials. These include benzene, toluene, xylene, and phosgene, among others. Biological work includes experiments with materials up to BSL-2 (LLNL 2002an).

The planned BSL-3 laboratory would contain organisms of types, forms, and quantities that require BSL-3 controls and precautions. This would include up to 1 liter of any organism in growth media and a total of 25,000 samples of various pathogens. The facility would not contain radioactive materials, and hazardous chemical inventories would not exceed general industry criteria (LLNL 2002an).

Generated Wastes and Effluents

The Building 360 Complex generates hazardous waste; low-level radioactive waste, mostly from isotopes such as phosphorous-32, carbon-14, and sulfur-35; and mixed waste. The hazardous wastes generated include halogenated and nonhalogenated solvents, including lab-packed solutions; lab-packed waste chemicals; organics; corrosives; reactive salts; laser dyes; empty containers; debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing, and fittings. Waste materials are collected at satellite accumulation areas and then moved to a designated waste accumulation area.

The types of waste produced by the biological analysis and recombinant DNA research include nonhazardous biological waste, biohazardous and contaminated sharps (medical) waste, and chemical waste. Biohazardous wastes include waste generated from research with RG-1 agents (i.e. agents not associated with disease in healthy human adults), RG-2 agents (i.e. agents associated with human disease that are not transmissible by aerosols including hepatitis and human immune deficiency virus [HIV]), and from research in the planned BSL-3 laboratory with RG-3 agents (i.e. agents associated with serious or lethal human disease that can be transmitted by aerosols and for which preventative or therapeutic interventions may be available). The complex sterilizes medical waste prior to disposal as landfill waste and biohazardous sharps waste prior to incineration offsite.

Hazardous packaged waste is bagged, labeled, and transferred to the waste accumulation area. Carcinogens are packaged and transferred directly to toxic waste control. Animal carcasses are double bagged and kept in freezers until they are picked up by RHWM for disposal.

The complex also has two laboratory wastewater retention systems that are used to collect and retain dilute nonhazardous and nonradioactive rinsewaters from laboratories until analysis determines they can be discharged to the sanitary sewer. The Building 364 water retention tank receives animal cage rinsewater that may be contaminated with radioactive or hazardous materials. The Building 365 water retention tank collects water from sinks and floor drains in the seven laboratories in that building, as well as from Building 368. The retention tank effluent is sanitized before being discharged to the sanitary sewer.

A.2.2.37 *Building 378*

Building 378, the Environmental Radioactivity Analysis Laboratory, is located in the central portion of the Livermore Site. This 3,840-gross-square-foot facility comprises two wet chemistry laboratories; an instrumentation room containing alpha, beta, and gamma spectrometers; and supporting office and storage spaces.

Building 378 conducts alpha, beta, and gamma spectrometric studies on environmental samples such as plant and animal tissues. Support operations include dissection of animals, birds, and fish and sample preparation using acid or microwave digestion, ion exchange separation, electro-deposition, spontaneous deposition, or chemical precipitation.

Low-level radioactive chemical yield tracers are used in radiochemical analyses to trace and quantify analyses of interest. These may include the gamma tracers cesium-134 and strontium-85. Alpha tracers may include polonium-209, plutonium-242, and americium-243. Encapsulated beta- and gamma-emitting sources may also be used for calibration and instrument performance testing. Various radiochemical procedures are developed or modified by Environmental Radioactivity Analysis Laboratory staff as dictated by programmatic needs (LLNL 1997g).

Hazards Assessment

The primary hazards associated with Building 378 include low-level radioactive tracer solutions and sealed sources (ionizing radiation); concentrated acids and bases; toxic, flammable, and carcinogenic materials; cryogens; high-voltage electricity; and high temperatures and pressures. Controls for these hazards are specified in both facility and operational safety plans. The use of a hood is required if the operation could potentially release material into the workplace. Personnel safety is ensured by toxic materials storage and handling systems (LLNL 1997g).

Generated Wastes and Effluents

Wastes generated by Building 378 consist of small amounts of solid and liquid wastes. The hazardous and nonhazardous wastes that are produced in the facility include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; nonhalogenated solutions, both organic and inorganic; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous and radioactive constituents; flammable liquids; cleaning solutions, including solvents; and contaminated equipment. Small quantities of radioactive and mixed waste may also be generated. Waste materials, both liquid and solid, are collected in containers at workplace accumulation areas in or near the laboratories where the waste is generated. The waste is segregated until collected by RHWM.

Some operations in Building 378 release small quantities of organic vapors to the atmosphere. Because the quantities of organic vapors released are small, the release of organic vapors under the worst-case condition will not exceed the ERPG value (LLNL 1997g).

A.2.2.38 *Building 379*

Building 379, the Gamma Spectrometry Facility, is a 1,500-gross-square-foot facility located in the central portion of the Livermore Site. The facility is divided into a gamma spectrometry room, containing 22 detector systems with liquid nitrogen cooling; a sample receiving bay/workshop; and a data reduction/computer room (LLNL 1997g).

Hazards Assessment

The primary hazards within Building 379 are associated with the use of electronic equipment and cryogens. Controls for these hazards are specified in both facility and operational safety plans. No radioactive unencapsulated samples or calibration standards enter the facility (LLNL 1997g).

Generated Wastes and Effluents

Waste streams generated in Building 379 consist of small amounts of solid and liquid hazardous and radioactive wastes. The hazardous wastes and nonhazardous wastes produced in the facility include laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous and radioactive constituents; cleaning solutions, including solvents; and contaminated equipment. Small quantities of radioactive and mixed waste may also be generated. Waste materials, both liquid and solid, are collected in containers at workplace accumulation areas in or near the laboratories where the waste is generated. The waste is segregated until collected by RHWM.

Some operations in Building 379 release small quantities of organic vapors to the atmosphere. Because the quantities of organic vapors released are small, the release of organic vapors under the worst-case condition will not exceed the ERPGs (LLNL 1997g).

A.2.2.39 *Building 381*

Building 381, the Laser Facility, is located in the north-central section of the Livermore Site. This 101,598-gross-square-foot facility consists of a two-story, three-wing office area, laser research laboratories, and a mechanical equipment area. The facility supports the ICF Program, the LS&T Program, and the NIF Project. Supporting activities involve laser R&D, x-ray calibration of ICF/NIF diagnostics, and the NIF amplifier assembly. Operations within the facility include low-energy x-ray calibration of ICF/NIF diagnostics, optical science laser facility operations, NIF front-end oscillator development; NIF preamplifier development; mercury laser; advanced laser drilling; neutron generator and advanced diagnostic development; the NIF master oscillator; preamplifier beam transport system risk mitigation testing; and Building 381 frame assembly (LLNL 2002aj).

Hazards Assessment

The primary hazards within the building include fire, electrical, exposure to laser beams and x-rays, the use of vacuum and gas pressure systems, and exposure to large and custom handling equipment. The facility is equipped with an automatic sprinkler system. Laser access is controlled by warning signs, lights, signals, intercom system, and door locks. Electrical equipment is designed with shielded cables and connectors and interlocked housing to prevent inadvertent electrical shock. Operational safety plans are followed for each experiment, and appropriate signs are posted on equipment and across doors.

The facility's radionuclide inventory is derived from sealed sources and a physical inventory of tritium targets. The current tritium inventory is about 8.5 curies, including the installed target, which is well below the storage limit of 20 curies.

Based solely on building inventory quantities, only lead and mercury exceed the reportable quantities for classification as a general industry facility. The ERPGs for lead mercury would not be exceeded in the event of a spill or fire (LLNL 2002aj).

Generated Wastes and Effluents

Wastes generated from this facility include hazardous waste and low-level radioactive waste contaminated primarily with tritium. Wastes are collected in designated containers in the satellite accumulation areas (LLNL 2002aj).

A.2.2.40 *Building 391*

Building 391, The Inertial Confinement Fusion Laser Facility, is located in the north-central section of the Livermore Site. This 186,594-gross-square-foot building provides laboratories, mechanical utility rooms, and office space for various R&D activities related to lasers. The building houses a variety of support activities for the NIF as well as the stored NOVA components; NOVA operations in Building 391 were terminated in April 1999.

The facility has 20 Sea Land containers located to the north of Building 391. There are five groups of four containers stacked two high. The containers are mainly used for storage of parts and equipment. Only one container is used for flammable and corrosive storage. A fenced laydown area on the ground level is between the five groups of containers

A number of aboveground tanks are also associated with Building 391 operations. A water purification system is located adjacent to the northwest corner and a standby power generator is located to the north of the facility on the western end. A 500-gallon, double-walled diesel tank supplies the generator. On the northeastern side of the building is a 28,000-gallon liquid nitrogen tank that supplies Building 391 and Building 381 with nitrogen gas.

Major research areas in the facility include beam control and laser diagnostics; laser peening technology; testing and development of cleaning, coating, and diagnostic techniques for large optics; development of fast-streak cameras; operation and testing of flash lamps; testing and assembly of amplifiers; fabrication of submicron-period diffraction gratings for x-rays; use of analytical x-rays; beryllium coating; and performance and reliability of the NIF power conditioning modules (LLNL 2002au).

Hazards Assessment

The primary hazards in Building 391 include fire, hazardous materials, exposure to laser beams and x-rays, high voltage, explosion of components, cryogenic systems, and vacuum and pressure systems.

Because of the many hazards present, Building 391 has several extensive operational and safety controls. These controls include an automatic sprinkler system; electrical equipment designed with shielded cables, connectors, and interlocked housings to prevent inadvertent electrical shock; access to lasers controlled by warning signs, lights, signals, and operational safeguards; engineering and operational safeguards on the vacuum and pressure systems. Operational safety plans are followed for each experiment, and appropriate signs are posted on equipment and access doors (LLNL 2002au).

Generated Wastes and Effluents

Wastes generated from this facility are hazardous wastes and are collected in designated containers in the satellite accumulation areas.

A.2.2.41 *Building 392*

Building 392, an optics laboratory, is located in the north-central portion of the Livermore Site. This 8,401-gross-square-foot facility supports the NIF Laser and Target Area Building (LTAB). Activities in Building 392 include a sol-gel coating process and photometer operations. A number of capacitors containing di(2-ethylhexyl)phthalate (DEHP) and ignitron switches containing mercury are stored in the Building 392 corporate yard (LLNL 2002ak).

Hazards Assessment

Building 392 is classified as a general industry facility. The primary hazards in this facility include high-voltage electrical systems; lasers; compressed gases; hazardous materials; e.g., flammable liquids, hydrofluoric acid, ammonia, epoxies, solvents; and industrial safety hazards. Safety documentation; e.g., integration work sheets, peer reviews, operational safety plans, and the facility safety plan, is used to help ensure personnel safety (LLNL 2002ak).

A number of large ignitron switches, which have about 3.4 pounds of mercury sealed within each, are stored in the Building 392 corporate yard. In the past 30 years of LLNL operations using ignitrons, the large ignitrons have never failed or leaked. Capacitors that contain DEHP are also stored in the corporate yard. DEHP is considered to be a very weak suspected carcinogen with low acute toxicity. Small amounts are contained in the welded, sealed case of each capacitor, with little possibility of leakage (LLNL 2002ak).

Generated Wastes and Effluents

Small quantities of liquid and solid hazardous wastes are generated from this facility. Wastes are collected in designated containers in the satellite accumulation areas.

A.2.2.42 *Building 431*

Building 431, the Accelerator Research Facility, is a 150,366-gross-square-foot, multi-use facility located in the southwest quadrant of the Livermore Site. Building 431 comprises office, shop, and laboratory space. The facility houses the experimental test accelerator (ETA)-II and the compact and underground radiography experiments. Building 431 also has a high bay that is used for preparing, modifying, and testing the NIF hardware, components, and beam enclosures (LLNL 2002bh, LLNL 2002al).

Hazards Assessment

Hazards associated with Building 431 include high-voltage/high-energy electrical systems; ionizing radiation; lasers; hazardous materials such as toxic gases, asphyxiants, solvents, and lead; magnetic fields; and industrial safety hazards. Of the hazardous materials used and stored in Building 431, all are used and stored in accordance with institutional and programmatic controls for minimizing or reducing the potential for exposure, injury, or illness.

Generated Wastes and Effluents

Small amounts of hazardous wastes are generated in this facility including solvents, spent oils, and waste streams with high concentrations of regulated metals and other industrial waste; i.e., epoxies, adhesives, etc. Waste materials, both liquid and solid, are collected in containers at the satellite accumulation areas (LLNL 2002bh, LLNL 2001am).

A.2.2.43 *Building 432*

Building 432, a mechanical shop for the NIF, is located in the south-central portion of the Livermore Site. This 34,747-gross-square-foot facility comprises laboratory, shop, and office space. Building 432 houses several laboratories for the NIF Programs Directorate. A high bay is used for developing the final optics assembly, line replacement units, loading systems, flash lamp, and slab canisters. A clean room is used to test first article equipment using a variety of mechanical manipulator systems. Other rooms conduct software development and controls hardware interfacing; fabrication, assembly, and testing with first article hardware; assembly and testing of subassemblies for line replaceable units, canisters, and skids; and assembly and testing of a variety of optical steering hardware and mechanical manipulators (LLNL 2002av). In the past, Building 432 also housed a biological safety and security laboratory that used RG-1 or nonselect RG-2 biological materials. Activities in this facility included general chemistry and biology research up to BSL-2, which included work with biological agents of moderate potential hazard such as *E. coli* K12 (DOE 2003f).

Hazards Assessment

Typical operations include the use of welding equipment, power tools, forklifts, cranes, compressed gases, and vacuum ovens. The hazards associated with work in Building 432 include chemical and biological hazards. Controls for these hazards are specified in both facility and operational safety plans.

Generated Wastes and Effluents

The operations in Building 432 generate hazardous, nonhazardous, and RG-1 and RG-2 biological wastes. Hazardous wastes and nonhazardous wastes produced in the facility include alkaline and acid solutions; both lab-packed and bulk-waste chemicals; lab-packed spent halogenated and nonhalogenated solvent solutions, both organic and inorganic; laser dyes; petroleum and mineral-based oils; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituents; machine shop wastes; and flammable liquids. Small quantities of radioactive and mixed wastes are also generated in this facility.

Waste materials are collected at satellite accumulation areas and then moved to a designated waste accumulation area. All wastes that contain biological materials are managed as biohazardous and sterilized prior to disposal as a best management practice.

A.2.2.44 *Buildings 435 and 446*

Building 435, the corrosion research and the NIF support facility, and Building 446, the former Yucca Mountain Program experiment facility, are located in the south-central section of the Livermore Site. Building 435 is a 54,768-gross-square-foot facility that houses wet chemistry and corrosion research laboratories (LLNL 2003f) and contains equipment to perform corrosion testing and electrochemistry, including a laser interferometer, Thompson scattering equipment, and autoclaves for sterilization (LLNL 2002bc). Building 435 houses two magnetic fusion energy experiments: the Sustained Spheromak Physics Experiment, operated by the Physics and Advanced Technology Directorate, and the Davis Diverted Tokamak, operated by the University of California, Davis, Department of Applied Science. Experiments are conducted in these facilities on the confinement and heating of plasmas as part of the U.S. Fusion Energy Program. Plasmas are formed in large vacuum vessels and studied using diagnostics including a laser interferometer and laser Thompson scattering. Building 446 is a 1,730-gross-square-foot facility that consists of a high bay, a utility room, and a microbiology/biochemistry wet laboratory. An equipment pad is located adjacent to the western side of the building (LLNL 2003f).

These facilities are used to perform material testing to determine the impact of microorganisms on engineered barriers. Operations include culture analyses of microbial communities found in environmental samples, biological corrosion testing of metal alloys, and measurement of microbiological community gas generation rates. Building 446 also houses a 5-liter, 10-liter, 20-liter and a 1,500-liter bioreactor, which could be used for cultivating microorganisms. Microbial community characterization activities include extracting total community DNA from environmental samples and using polymerase chain reaction assays to perform DNA sequence analyses that may also include the use of radionuclides for labeling experiments. Corrosion test activities involve the use of 1-liter bioreactors, in which metal alloy samples are subjected to simulated groundwater with the addition of micro-organisms. All work is currently performed at BSL-1, but the facility will be upgraded to perform at BSL-2 or below with nonselect micro-organisms (DOE 2001i).

Hazards Assessment

The primary hazards associated with Buildings 435 and 446 include ionizing and non-ionizing radiation; hazardous materials such as flammable liquids, flammable gases, toxic materials, carcinogens, reproductive toxins, corrosives, and oxidizers; compressed gases; high temperatures; and up to RG-2 nonselect microorganisms. Controls for these hazards are specified in both facility and operational safety plans (DOE 2001i, LLNL 2003f). The primary hazards for the magnetic fusion energy experiments in Building 435 are high voltage, ionizing and non-ionizing radiation, magnetic fields, compressed gases, high temperatures, and confined spaces.

Generated Wastes and Effluents

These buildings generate a small amount of solid and liquid hazardous, radioactive, and mixed waste; the magnetic fusion energy work generates small amounts of hydrocarbon-contaminated tissues for surface cleaning. Flammable or combustible wastes are stored in appropriate containers. All hazardous, radioactive, or other regulated wastes are collected in appropriate containers, labeled, and temporarily stored at a satellite accumulation area prior to treatment or disposal by RHWM (LLNL 2003f).

No biohazardous waste is generated at these buildings. Nonpathogenic concentrated isolates of naturally occurring bacteria and fungi are considered nonbiohazardous. As a best management practice, all nonhazardous and nonradioactive wastes that contain biological materials are sterilized prior to disposal (LLNL 2003f).

A.2.2.45 *Building 453*

Building 453, the Terascale Simulation Facility, is a new facility that is currently under construction in the central area of the Livermore Site. The 253,000-gross-square-foot facility will consist of two computer clean rooms and a four-story office complex. The Terascale Simulation Facility design accommodates parallel processing computer systems of increasing computational power within the same footprint and building space. As computer systems change, old equipment would be removed and replaced with current, state-of-the-art equipment. The basic building structure, components, utilities, and exterior support facilities are designed to support the maximum planned computer load through 2014.

The Terascale Simulation Facility would be capable of housing the 100-TeraOps-class (trillion operations per second) computers and networks and the data and visualization capabilities necessary to perform the simulations essential to ensuring the safety and reliability of the U.S. nuclear stockpile. Using data from past test and surrogate experiments, computer scientists would conduct three-dimensional simulations of nuclear weapon performance. Space would be available to support a weapons code development team to integrate experimental, physical, material, and computer sciences for support of stockpile stewardship requirements (DOE 1999b, LLNL 2003cj).

Hazards Assessment

Once built, the Terascale Simulation Facility will be a general industry facility. As such, the only hazardous materials present would be industrial cleaning agents, equipment lubricating oils, and maintenance solvents and chemicals used for maintaining the cooling system such as biocide, corrosion inhibitor, and chlorine (LLNL 2002ax). During construction, hazards will include those generally associated with typical construction activities.

Generated Wastes and Effluents

The Terascale Simulation Facility comprises offices and computing facilities only. No radioactive, hazardous, or mixed wastes will be generated during normal operations.

A.2.2.46 *Building 511*

Building 511, the Craft Shop, is located in the southeast quadrant of the Livermore Site. This 76,552-gross-square-foot facility is used as a crafts shop for electrical and mechanical equipment assembly, disassembly, and repairs.

This facility supports the Livermore Site field operations, including routine electrical equipment inspections; repair and installation in electrical/communication vaults, manholes, and trenches; repairing refrigerant tubing; disassembly, repair, and maintenance of vacuum pumps; and visual inspections, maintenance, and electrical installations in manholes and underground vaults (LLNL 2002t).

Hazards Assessment

Hazards associated with operations in this facility include potential flammable atmospheres, oxygen-deficiency atmospheres, asbestos, or polychlorinated biphenyl (PCB) oils; compressed gases; zinc or cadmium present as a plating material causing toxic fumes when exposed to flames; the use of fluorocarbon refrigerants, which when heated, break down chemically into hydrofluoric acid, hydrochloric acid, phosgene, and other toxic vapors; vacuum pumps that are contaminated with beryllium, mercury, radioactive materials, heavy metals, and toxic compounds; and electrical shock (LLNL 2002t, LLNL 2001an).

Strict operational and safety controls are followed to avoid the many hazards associated with field operations. Some of the controls include proper ventilation of manholes and vaults during work activities; cleanup of asbestos and PCB oils is performed under proper guidance from Hazards Control; personnel will not enter any confined space where tests show any flammable atmosphere or reduction of normal oxygen; refrigerants are removed from the tubing being repaired to avoid exposure to heat; safety eye protection and gloves are required; the vacuum pumps are decontaminated before being sent to Building 511 for maintenance and repairs; and the decontaminated vacuum pumps are repaired in a ventilated enclosure equipped with a catch tray or edge curbs to contain spilled oils (LLNL 2002t).

Generated Wastes and Effluents

Specific waste streams that are produced in the facility include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; nonhalogenated organic solutions; empty containers; debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituents; wastewater; residues; metals; asbestos; print shop wastes; photographic wastes; flammable liquids; cleaning solution, including solvents; waste oil with trace gasoline, diesel, organics, and metals; discarded capacitors that are potentially TSCA wastes; and contaminated equipment. All contaminated wastes are handled by RHWM for proper treatment and disposal (LLNL 2002t).

A.2.2.47 *Buildings 518 and 518A*

Buildings 518 and 518A are located in the southeast quadrant of the Livermore Site. These general industry facilities are dedicated to receiving and temporarily holding U.S. Department of Transportation (DOT)-packaged containers and processing paperwork for materials that are commonly used by the public (LLNL 2000s).

Building 518, the 3,270-gross-square-foot gas cylinder dock, serves as a receiving, storage, and distribution area for compressed gas cylinders, cryogenic dewars, and bottled water. Compressed gas cylinders are generally distributed throughout LLNL within 24 hours of receipt, although the facility does have provisions for storing cylinders containing oxidizing, flammable, inert, or nonflammable gases in the Building 518 yard. Toxic gases, however, are received and distributed to the requestor on the same day; no toxic gas is held overnight. No gases are used at this facility (LLNL 2002cv, LLNL 2000s).

Building 518A, the Chem Track Facility, is 195 gross square feet and serves as a chemical receiving and barcoding area. Inbound chemicals are received in closed containers and are processed and distributed throughout LLNL within 24 hours of receipt. No radioactive, pathogenic, or explosive material is received at Building 518A. No chemicals are used or stored at this facility (LLNL 2000s).

Hazards Assessment

The hazards at Buildings 518 and 518A are primarily associated with handling compressed gas cylinders and receipt and delivery of hazardous and toxic chemicals (LLNL 2002cv, LLNL 2000s).

Generated Wastes and Effluents

These facilities are used primarily as loading, receiving, and storage areas. There is a small amount of hazardous waste generated from the cleanup of spilled chemicals. The waste is properly disposed of by RHWM (LLNL 2002cv).

A.2.2.48 *Building 519*

Building 519, the Heavy Equipment Shop, is located in the southeast quadrant of the Livermore Site. This facility is used for vehicle and equipment maintenance and repair. The total area for the building is 10,206 gross square feet (LLNL 2002cw).

Hazards Assessment

Operations at the Heavy Equipment Shop encounter common industrial hazards including using compressed gases; hazardous chemicals such as brake cleaner and other degreasing compounds; and welding, metal machining, and sandblasting (LLNL 2002cw).

Generated Wastes and Effluents

Wastes generated from routine activities at this facility include industrial oils, antifreeze, equipment cleaning chemicals, and rags. All contaminated wastes are handled and disposed of by RHWM (LLNL 2002cw).

A.2.2.49 *Building 520*

Building 520, the Pesticide Handling and Storage Building, is 400 gross square feet, located in the southeastern portion of the Livermore Site. This building is used for the storage of herbicides, insecticides, and rodenticides in varying quantities. This is a general industry facility containing materials and products that are common to the public. All chemicals are stored in a bermed area within Building 520. At any one time, about 80 percent of the materials are stored in steel cabinets. The remaining bulk materials are stored on pallets. The building is constructed of galvanized sheeting over steel framing (LLNL 2002cx, LLNL 2002cy).

Licensed personnel mix and dilute pesticides in a work area next to Building 520. All mixed pesticides are used at the Livermore Site in accordance with labeled instructions. Empty spray tanks are rinsed, and the rinsewater is sprayed out on other target areas (LLNL 2002cx, LLNL 2002cy).

Hazards Assessment

The primary hazards associated with Building 520 are herbicides, insecticides, and rodenticides. Controls for these hazards are specified in both facility and operational safety plans (LLNL 2002cy).

Generated Wastes and Effluents

All wastes generated within this facility are a result of rinsing equipment, accidental spills, and discarding outdated products. All empty pesticide containers are rinsed three times and the triple-rinsed containers are taken to the Pleasanton Refuse Transfer Station, where they are inspected by the Alameda County Agricultural Department prior to disposal. The rinsate from these containers and any equipment rinsing is either used as make-up water for future mixing and application or stored in 55-gallon containers in an adjacent waste accumulation area until picked up by RHWM. Similarly, spills are absorbed using a water-soluble absorbent and the absorbed material is used for future mixing and application or stored in an adjacent waste accumulation area until picked up by RHWM. Outdated pesticides are tagged and sent to RHWM for proper disposal (LLNL 2002cx, LLNL 2002cy).

A.2.2.50 *Building 531*

Building 531, the Custodians and Gardeners Shop, is a 12,589-gross-square-foot facility located in the southeast quadrant of the Livermore Site. This is a general industry facility containing materials and products that are common to the public. Products used by custodians and gardeners may contain hazardous materials listed in the reportable quantities, threshold planning quantities, or threshold quantities lists, but the products themselves are not listed and are available to the public (LLNL 2002ao).

Hazards Assessment

Hazards consist of chemicals, waste from unused products, and gasoline and diesel fuels. All flammable liquids are located in flammable storage lockers, outside, in a fenced and covered area adjacent to the building. The maintenance, repair, and usage of power equipment represent cut- and pinch-type hazards, which are common for this type of activity (LLNL 2002ao).

Generated Wastes and Effluents

All wastes generated within this facility are a result of accidental spills, discarding unwanted custodial or office supplies, and equipment maintenance. All wastes are handled by RHWM (LLNL 2002ao).

A.2.2.51 *Building 581*

Building 581, the NIF LTAB, is located in the northern quadrant of the Livermore Site. The LTAB is the main experimental building of the NIF and is where laser-driven experiments are conducted. This 677,757-gross-square-foot facility consists of two laser bays, two optical switchyards, a target bay, a target diagnostics areas, capacitor bays, mechanical equipment areas, control rooms, and operational support areas. Operations within the facility would include the NIF master oscillator; preamplifier maintenance; installation of line-replaceable units; activation and operation of a plasma electrode pockels cell; flash lamp firing; beam path and roving mirror diagnostics; transport spatial filter, argon operation, and cavity spatial filter initial vacuum operation; injection laser system commissioning; and alignment of the precision diagnostic system 3-omega tank and optical tables (LLNL 2002g).

Hazards Assessment

Building 581 is classified as a low-hazard radiological facility. The primary hazards during equipment installation are associated with a general industrial facility; during routine full facility operations hazards would include radiation and neutron-activated material generated during yield shots, tritium handling, lasers, high voltages, small quantities of hazardous materials, and oxygen-deficient atmospheres. Controls and mitigation features would be in place to minimize these hazards and would include concrete shielding, interlocks, personal protective equipment, and access controls (LLNL 2002g).

Generated Wastes and Effluents

Wastes generated from this facility would include hazardous waste and low-level radioactive and mixed waste, contaminated primarily with tritium. Wastes are collected in designated containers in the satellite accumulation areas. This waste would be handled and disposed of by RHWM.

A.2.2.52 *Building 621*

Building 621, the Compressed Natural Gas Station, is located in the southeast quadrant of the Livermore Site. The station is used for refueling LLNL's fleet of natural gas fueled vehicles. The pumping station has a gross area of 824 square feet. The station has two natural gas compressors designed for a working pressure of up to 4,000 pounds per square inch (LLNL 2002cg).

Hazards Assessment

The primary hazards associated with the compressed natural gas station are noise and hazardous (flammable) gas (LLNL 2002cg).

Generated Wastes and Effluents

The compressed natural gas station generates approximately 3 gallons of compressor oil annually. This waste is handled and disposed of by RHWM (LLNL 2002cg).

A.2.2.53 *Building 681*

Building 681, the Optics Assembly Building, is located in the northern quadrant of the Livermore Site. This 46,885-gross-square-foot facility supports the NIF LTAB by assembling and aligning optics in a clean environment for installation into the NIF laser system. The Optics Assembly Building has four separate rooms designated as gross mechanical cleaning, precision mechanical cleaning, optics transfer, and assembly and alignment (LLNL 2002am).

Hazards Assessment

Building 681 is classified as a general industry facility. The primary hazards during routine facility operations include lasers, electrical and mechanical equipment, small quantities of hazardous chemicals, and oxygen-deficient atmospheres. Controls and mitigation features are in place to minimize these hazards and include interlocks, personal protective equipment, and access controls (LLNL 2002am).

Generated Wastes and Effluents

Hazardous and nonhazardous wastes are generated from this facility. Hazardous wastes are collected in designated containers in the satellite accumulation areas. This waste is handled and disposed of by RHWM.

A.2.2.54 *Building T1527*

Building T1527, the Bioagent Sensing and Testing Laboratory, is located in the southwest quadrant of the Livermore Site. Operations in this 3,841-gross-square-foot facility use RG-1 or nonselect RG-2 biological materials (DOE 2003f).

Hazards Assessment

The hazards associated with work in Building T1527 include chemical and biological hazards. Controls for these hazards are specified in both facility and operational safety plans.

Generated Wastes and Effluents

The operations in Building T1527 generate hazardous, nonhazardous, and RG-1 and RG-2 biological wastes. Hazardous wastes and nonhazardous wastes produced in the facility include alkaline and acid solutions; lab-packed and bulk-waste chemicals; lab-packed spent halogenated and nonhalogenated solvent solutions, both organic and inorganic; laser dyes; petroleum and mineral-based oils; empty containers; laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with hazardous constituent; and flammable liquids.

Waste materials are collected at satellite accumulation areas and then moved to a designated waste accumulation area. All wastes that contain biological materials are managed as biohazardous and are sterilized prior to disposal as a best management practice.

A.2.2.55 *Building T6675*

Building T6675, the Edward Teller Education Center, is a 3,200-gross-square-foot modular classroom located adjacent to the northeast quadrant of the Livermore Site at the UC Davis Department of Applied Sciences. The education center provides educational opportunities for teachers and students. The center contains a computer room/classroom, a multipurpose wet laboratory, a server room, storage areas, and other associated rooms.

The wet laboratory is used for demonstrations typical of high school chemistry and biology courses and features mostly microscale techniques. The laboratory is equipped with a fume hood, appropriate chemical storage cabinets, and other necessary equipment (DOE 2001m).

Hazards Assessment

The primary hazards are associated with the materials used in the wet laboratory. These materials include small quantities of organic solvents, acids, bases, inorganic salts, metals, organic solids, dyes, and indicators. No heavy metals or radioactive materials are used (DOE 2001m).

Generated Wastes and Effluents

The facility generates small quantities of hazardous and nonhazardous waste. The wastes include alkaline and acid solutions, waste chemicals, spent solvent solutions, empty containers, and laboratory debris such as contaminated paper and rags, protective clothing, glassware, plasticware, and tubing and fittings. Wastes are handled and disposed of in accordance with RHWM requirements.

A.2.2.56 *Waste Management Facilities*

The RHWM facilities at the Livermore Site are discussed below. For further details, including sections on hazards assessment, see Appendix B.

Building 233 Container Storage Unit

The Building 233 Container Storage Unit (CSU) is a 1,350-gross-square-foot covered waste storage facility located next to Building 233 in the southwest quadrant of the Livermore Site. The unit is used to store radioactive, hazardous, and mixed wastes in containers (LLNL 1999g).

Building 280 Dome

The Building 280 Dome is located in the northwest quadrant of the Livermore Site. The facility was proposed and permitted to store wastes types to include solid transuranic wastes, mixed transuranic wastes, low-level wastes, and hazardous wastes. The proposal was to store up to 672 cubic yards of waste and to accept containers up to 250 cubic feet in volume. However, RHWM may not use this facility for storage purposes if the waste types can be stored in other RHWM facilities (LLNL 1999a, LLNL 1999e).

Building 513

Building 513 is located in the southeast quadrant of Livermore Site at the south end of the Building 514 area. The facility comprises approximately 5,638 gross square feet and is used to sample, treat, and store hazardous and mixed waste. Building 513 houses a solidification unit that includes a self-contained process optimization and treatability laboratory used to support ongoing process optimization for the waste management facilities. Solidification agents used are cementaceous materials such as portland cement, gypsum cement, pozzalonic flyash, aluminum and magnesium silicate clays, and resinous materials such as polystyrene, epoxides, and resorcinol formaldehyde.

Building 513 also houses a container storage unit that covers approximately 2,800 square feet of the building's total square footage. The Building 513 CSU is used for storage of liquid and/or solid hazardous, radioactive, and mixed waste (LLNL 2000t).

Building 514 Area

The Building 514 area liquid waste storage and disposal facilities are located in the southeast quadrant of the Livermore Site. This area is comprised of Building 514, the 514-1 CSU and treatment unit, the 514-2 and 514-3 CSUs, a wastewater treatment tank farm consisting of six 1,850-gallon treatment tanks, and a storage and treatment facility consisting of four 4,600-gallon storage tanks (LLNL 2000t).

Building 514 is a 2,500-gross-square-foot facility built in 1943 that houses the wastewater filtration unit and the equipment for the wastewater treatment tank farm processes. The wastewater filtration unit comprises a filter basin with rotating vacuum drum filter, filtrate and precipitate transfer pumps, a vacuum pump, a precoat system with a precoat tank and pump, and a cooling water system. The unit removes solids such as precipitates, suspended solids, or particulates from liquid hazardous and mixed wastes (LLNL 2000t). When the new Decontamination and Waste Treatment Facility (DWTF) becomes operational, RHWM plans to vacate Building 514 and return it to the institution for D&D.

The wastewater treatment tank farm is used to store and treat liquid and solid hazardous and/or mixed wastes. The types of treatment performed in this unit include neutralization/pH adjustment, oxidation/reduction, cyanide destruction, precipitation, chelation/flocculation, ion exchange, adsorption, separation, and sizing/blending. Treated waste may be shipped offsite or discharged to the city of Livermore Water Reclamation Plant via the sanitary sewer, in accordance with established discharge limits (LLNL 2000t).

The Building 514 area storage and treatment quadruple tank unit is used to store hazardous and mixed wastewaters contaminated with low concentrations of metals, oils, and solvents. Two tanks are used to manage liquid waste not regulated by the California Department of Toxic Substance Control. The remaining two tanks are used to manage mixed waste. Operations conducted in this unit include transferring, pumping, bulking, and sampling.

The Building 514-1 CSU is located in the center of the Building 514 area facility and treats aqueous hazardous and mixed wastes generated at the Livermore Site and Site 300. The Building 514-1 area CSU can store up to 7,260 gallons of liquid waste and 250 cubic feet of solid waste. The treatment units consist of a tank blending unit, portable blending unit, centrifugation unit, carbon adsorption unit, and cold vapor evaporation unit. The overall weight reduction of the waste in the treatment units is approximately 95 percent. The destruction of cyanides and cyanates and the reduction of reactives, corrosives, and oxidizers are 100 percent (LLNL 2000t).

The Building 514-2 CSU is located in the center of the Building 514 area and stores solid and liquid hazardous and mixed wastes. Waste handling operations conducted in this unit include bulking, overpacking, sampling, and transferring. Overpressurized containers are repackaged after consulting with Hazards Control. Containers are segregated according to their compatibility based on ignitability, reactivity, toxicity, and corrosivity and stored within the structure. The container storage design capacity of this unit is 10,400 gallons, and it can accommodate liquid containers of 330 gallons or solids stored in containers of 250 cubic feet (LLNL 2000t).

The Building 514-3 CSU is located in the northeast corner of the Building 514 area and stores hazardous and mixed wastes. Waste handling operations conducted in this unit include bulking, overpacking, sampling, and transferring. Overpressurized containers are repackaged after consulting with Hazards Control. The storage capacity of this unit is 22,050 gallons. The largest containers are 1,100 gallons for liquids and 250 cubic feet for solids (LLNL 2000t).

Building 612 Area

Area 612 facilities are located in the southeast quadrant of the Livermore Site and receive waste from LLNL generators. Area 612 consists of Building 612; the Area 612 portable tank storage unit, the Area 612 tank trailer storage unit; the 612-1, 612-2, 612-3, and 612-5 CSUs; the Area 612 consolidation waste accumulation area; Building 614 east and west cells CSUs; and Building 625 (LLNL 2000t).

Building 612 is located in the southwest portion of Area 612 and is 11,308 square feet. The building houses a lab packing/packaging container storage area, drum/container crushing unit, size reduction unit, and container storage unit. Operations in Building 612 include decontaminating, sampling, bulking, transferring, overpacking, lab packing, and repacking solid, liquid, and gaseous hazardous, radioactive, and mixed wastes. Ignitable, reactive, toxic, and corrosive wastes are grouped by compatibility and are segregated appropriately. These wastes are then stored for a maximum of 90 days pending onsite treatment or shipment to a permitted offsite facility for treatment, storage, or disposal. These wastes may also be sent to onsite permitted areas such as Building 612, Room 100, for up to one year (LLNL 2000t).

The Area 612 tank trailer storage unit is located in the north portion of Area 612. The unit is approximately 698 square feet and is used to store hazardous and mixed liquid wastes. The unit was designed to store tank trailers as well as portable tanks on flatbed trailers. The unit was also designed as a secondary containment for transportable treatment units used intermittently when waste is not stored at the unit. Staging, sampling, pH adjusting, bulking, and transferring are conducted at this storage facility (LLNL 2000t).

The Area 612 portable tank storage unit, located in the east portion of Area 612, is used to store liquid and solid hazardous and mixed wastes in containers, such as portable tanks. This unit is an uncovered 1,200-gross-square-foot pad that is divided into two cells by a concrete curb. The total storage capacity of the unit is 10,000 gallons; 6,000 gallons in one cell and 4,000 gallons in the other cell. Ignitable, toxic, reactive, and corrosive wastes are grouped by compatibility and are segregated appropriately within this unit (LLNL 2000t).

The 612-1 CSU is located in the northwest portion of Area 612. This unit is used to store solid hazardous and mixed wastes. No wastes containing free liquids are allowed in this unit. The 612-1 CSU comprises approximately 9,600 square feet of surface area and was designed to store a maximum of 1,422 cubic yards of waste. Approximately two-thirds of the facility is covered by tents and the remainder is open (LLNL 2000t).

The 612-2 CSU is located in the east portion of Area 612. This unit is used to store hazardous, mixed, and biohazardous wastes. The 612-2 CSU comprises approximately 1,400 square feet of surface area. Waste handling operations conducted in this storage area include staging, sampling, pH adjusting, lab packing, overpacking, bulking, and transferring (LLNL 2000t).

The Building 612 consolidation waste accumulation area is located in the southwest corner of Area 612 and is used to store waste for a maximum of 90 days. This unit is used to store liquid and solid hazardous and mixed wastes in containers, such as portable tanks. This unit is a covered 4,000-gross-square-foot pad. Ignitable, toxic, reactive, and corrosive wastes are grouped by compatibility and are segregated appropriately within this unit. The storage capacity of this unit is 47,520 gallons of waste (LLNL 2000t).

The Building 612-5 CSU is located in the southeast corner of Area 612 and is used to store solid hazardous and mixed wastes. No wastes containing free liquids are allowed in this unit. The 8,300-gross-square-foot partially covered facility is used to store ignitable, toxic, reactive, and corrosive wastes after they are grouped by compatibility and segregated. The unit has a container storage capacity of 995 cubic yards of solid mixed wastes (LLNL 2000t).

Building 614

The Building 614 CSU occupies the eastern half of Building 614 and is located in the southeast portion of Area 612. Building 614 has a surface area of approximately 1,188 square feet. The east cell unit is used to store liquid, solid, and gaseous hazardous and mixed wastes and has a storage capacity of approximately 3,520 gallons of waste material. Additional operations include sampling, bulking, repackaging, transferring, overpacking, pH adjusting, and lab packing of small quantities of compatible wastes. The west cell is used to store hazardous, radioactive, and mixed wastes. This unit can be used to store liquid, solid, or gaseous wastes. The unit also performs lab packing, sampling, bulking, transferring, overpacking, and pH adjusting. The storage capacity of the west cell unit is 672 gallons of waste. Both east and west cell units group ignitable, toxic, reactive, and corrosive wastes by compatibility and are appropriately segregated (LLNL 2000t).

Building 625

Building 625 is approximately 4,800 gross square feet and is located in the north portion of the 612 Area. The building is divided into east and west areas and is used to store hazardous wastes, radioactive wastes, mixed wastes, TSCA regulated wastes, California-only regulated wastes, transuranic wastes, and mixed transuranic wastes. This building can be used to store liquid and solid hazardous wastes. Toxic, reactive, and corrosive wastes are segregated by compatibility and stored within this unit. The facility has a total storage capacity of 42,416 gallons (210 cubic yards) (LLNL 2000t).

The Decontamination and Waste Treatment Facility

The DWTF is located in the northeast corner of the Livermore Site. The DWTF comprises Buildings 693, 693 Annex, 695, 696, and 696R.

Buildings 693 and 693 Annex comprise approximately 9,600 gross square feet and are used for hazardous waste storage (LLNL 1996c). Building 693 was constructed to replace the Area 612-3 drum/container storage unit. The unit is used to store *Resource Conservation and Recovery Act of 1976* (RCRA) and Department of Toxic Substances Control-regulated hazardous and mixed wastes as well as TSCA-regulated waste and transuranic waste. The unit stores liquid, solid, and gaseous wastes and has a storage capacity of approximately 84,470 gallons of waste material. Additional operations include sampling, bulking, repackaging, transferring, overpacking, pH adjusting, and lab packing of small quantities of compatible wastes (LLNL 2000t). The Building 693 Annex houses materials such as corrosives, highly toxic materials, and irritants that are health hazards. A roll-off pad and freezer pad are west of the Building 693 Annex.

Building 695 consists of approximately 33,000 gross square feet of floorspace used for office space, the liquid waste process area, and the reactive materials area. The liquid waste process area stores and treats radioactive, mixed, and hazardous waste that includes materials such as corrosives, highly toxic materials, and irritants. The liquid waste process area houses a tank farm for storing and treating wastewater, evaporators, a wastewater filtration module, a bulking station, a carbon adsorption unit, and a waste blending station. The reactive materials area includes the reactive waste processing room and the reactive materials cell. The building also houses analytical equipment including a gas chromatograph/mass spectrometer, x-ray fluorescence spectrometer, and dry electrolytic conductivity detector for real-time radiological, metals, and volatile organic compounds analyses to aid in treating mixed and radioactive wastes and developing improved treatment processes. The facility has a filtered ventilation system to reduce emissions. The facility includes a firewall between the operations.

Building 696 consists of 21,381 gross square feet and houses the solid waste processing area, approximately 10,000 square feet, and the radioactive waste storage area (Building 696R). The facility is divided into three areas: a receiving/classification room, a solid waste processing room, and an airlock. The processing room contains a transuranic repackaging unit and a size reduction unit (LLNL 1996d).

Building 696R is formerly the radioactive waste storage area portion of Building 696, is approximately 9,600 square feet, and is used for the storage of transuranic waste and California-only mixed waste until it can be shipped offsite. Operations include loading, unloading, staging, storing, banding, possible overpacking, and periodically visually inspecting. Containers are not opened in this facility (LLNL 2002da).

A.2.2.57 *Security, Medical, and Emergency Response Facilities*

Building 271 Security Facility

The Security Facility, Building 271, is located in the central portion of the Livermore Site. This 17,278-gross-square-foot facility houses routine security and emergency response services. The Safeguards and Security Program is designed to establish an effective system of safeguards and security measures, to maintain employee security awareness and training, and to monitor system procedures and plans to keep consistent with NNSA regulations.

Routine security services include access controls, fixed access, surveillance points, random vehicle and foot patrols, response elements, and response team elements. Emergency response services provide contingency plans for work stoppages, bomb threats, natural disasters, site-wide evacuations, callout procedures, satellite command center activation procedures, executive protection, SNM alarm response procedures, non-SNM response procedures, and civil disorders.

Building 663 Medical Facility

The Medical Facility, Building 663, is located in the eastern portion of the Livermore Site. This 24,784-gross-square-foot building houses a comprehensive occupational health program designed to provide optimal clinical and preventive medical support for the employees at LLNL. Services provided include treatment for occupational and minor nonoccupational illnesses and injuries; emergency care, stabilization, and transfer; return-to-work assistance; multidisciplinary work-site inspections regarding health hazards and environmental conditions; medical surveillance, qualification, and fitness-for-duty examinations; educational programs; health promotion services; physical therapy; decontamination and treatment for chemical or radiological exposures; and employee assistance services.

The Health Services Department provides services in compliance with all applicable state and Federal laws and accepted standards of medical and nursing practice. Injuries and illnesses are reported to the Health Services Department during working hours. The LLNL Fire Department provides ambulance services 24 hours a day, 7 days a week.

Biological wastes generated from this facility are defined as medical waste and include needles, syringes, gauze, gloves, and other materials that could be contaminated with infectious agents. These wastes are transported to BBRP at Building 361 for autoclaving. All wastes are handled by RHWM for proper disposal.

Buildings 313 and 323 Emergency Response Facilities

The emergency response facilities include the LLNL Fire Department Emergency Dispatch Center in Building 313; the Fire Station, Building 323; and an emergency operations command center and a number of operation support centers located throughout LLNL. In case of an emergency, telephone communications link the command center with the operation support centers. There are additional radio communications as backup for the redundant phone communications. (Refer to Appendix I for details on the emergency planning and response procedures.) Buildings 313 and 323 are located in the southwest quadrant of the Livermore Site; the sizes of these facilities are 4,444 square feet and 18,555 square feet, respectively (LLNL 1999f). The LLNL Public Affairs Office, in agreement with the Alameda County Office of Emergency Services, may activate a joint information center at the offsite emergency services offices in Dublin, California. The center, operated by LLNL public affairs office, provides emergency response agencies with a central location for release of emergency public information in the event of an LLNL emergency with potential for offsite consequences.

A.2.2.58 *Offsite Leased Properties*

LLNL conducts limited activities at various offsite properties. The nearby offsite properties are shown in Figure A–3. LLNL-related operations contribute little, if any, environmental effects at these sites. The facilities are briefly described below.

- The Arroyo Mocho Pump Station, located about 6 miles south of the Livermore Site, is the Livermore Site's primary source of water. The pumping station lifts water from the city of San Francisco's Hetch Hetchy Aqueduct to the surface. This water then flows by gravity to the Livermore Site via storage tanks located at SNL/CA.

- Patterson Pass Road site in Livermore, California, is a warehouse and staging area for the NIF Program. The total leased space is approximately 52,000 square feet.

- The Almond Avenue Site in Livermore, California, is a childcare facility. The total leased space is approximately 9,200 square feet.

- The Graham Court site in Livermore, California, is a storage warehouse used by DNT and NAI. The total leased space is approximately 14,300 square feet.

A.2.3 No Action Alternative, Livermore Site

The No Action Alternative would include approved interim actions; facility construction; facility expansion or modification; and facility decontamination, decommissioning, and demolition, for which environmental analysis and documentation already exist. Projects and programs associated with the No Action Alternative at the Livermore Site are described in Sections A.2.3.1 through A.2.3.25. Operational modifications to existing programs and projects involving new facilities or maintenance are summarized in Table A.2.3–1, and Figure A.2.3–1 shows the locations of these projects. A list of all deactivation and D&D projects at the Livermore Site is provided in Table A.2.3–2. Projects at Site 300 are described in Section A.3.

A.2.3.1 *National Ignition Facility*

The NIF conventional facilities construction is complete. Completion of the systems leading to full operation in fiscal year (FY) 2008 is in progress. In operation, the NIF would perform fusion ignition, high energy density, and radiation effects experiments in support of stewardship of the Nation's stockpile of nuclear weapons and fusion energy and applied sciences objectives. The LTAB, Building 581, the main experimental building of the NIF, is where laser-driven experiments would be conducted. The LTAB consists of two laser bays, two optical switchyards, a target bay, target diagnostics areas, capacitor bays, mechanical equipment areas, control rooms, and operational support areas. The LTAB would provide an optically stable and clean environment and provide sufficient shielding against prompt radiation and residual radioactivity. A 192-beam, neodymium glass laser would be housed in the LTAB. The laser would deliver laser light to small fusion targets mounted in a vacuum chamber. The NIF is also described in Section A.2.2.51.

A.2.3.2 *BioSafety Level-3 Facility*

The BSL-3 Facility, Building 368, would be a 1,500-gross-square-foot laboratory and office complex located in the Building 360 Complex area. The facility is designed to accommodate work on detection and counter-terrorism technologies, and would be used for environmentally safe and physically secure manipulation and storage of infectious microorganisms. The facility would have the unique capability within NNSA to perform aerosol studies to include infectious agents or biologically derived toxins. The facility would more effectively use and capitalize on LLNL's existing onsite facilities, expertise, and capabilities and would also ensure the necessary quality, integrity, and security of microbiological work (NNSA 2002a). The facility is also described in Section A.2.2.36.

TABLE A.2.3–1.—*Livermore Site Program Projections*

Project Name	Square Feet	Map Location
No Action Alternative		
National Ignition Facility	570,000	N1
BioSafety Level-3 Facility	1,500	N3
Terascale Simulation Facility	253,000	N2
Superblock Stockpile Stewardship Program operations	N/A	N18
Container Security Testing Facility	54,000	N9
East Avenue Security Upgrade	N/A	N10
Central Cafeteria replacement	16,300	N17
International Security Research Facility	64,000	N8
Waste Isolation Pilot Plant Mobile Vendor	N/A	b
Engineering Technology Complex upgrade	N/A	N7
Tritium Facility Modernization	7,000	N12
BioSafety Laboratories	N/A	b
Reclassify Building 446 as BSL-2 Facility	1,730	N15
Remove and replace offices	d	N14
Westgate drive improvements	N/A	N5
Extend Fifth Street	N/A	N4
Superblock security upgrade	N/A	N18
Site utilities upgrade	N/A	b
Protection of real property (roofs)	N/A	b
Building 298 roof replacement	47,000	N16
Plutonium Facility ductwork replacement	N/A	N11
SNM tests with Optical Science Laser	N/A	N13
Deactivation and D&D Projects	234,443	c
Proposed Action includes all the projects under No Action Alternative and the following additional projects		
Use of Proposed Materials on the National Ignition Facility	N/A	P1
Increased administrative limits for plutonium in the Superblock	N/A	P7
Increased material-at-risk limits for Superblock	N/A	P7
Increase of Tritium Facility material limits	N/A	P6
High Explosives Development Center Project	N/A	e
NIF neutron spectrometer	N/A	P1
Material Science Modernization Project	60,000	P5
Chemical and Biological Nonproliferation Program expansion	N/A	P4
Petawatt Laser Prototype	N/A	P1
Consolidated Security Facility	50,000	P2
Waste management	N/A	P9
Building 625 waste storage	N/A	P10
Direct Shipment of transuranic wastes from the Plutonium Facility	N/A	P3
Berkeley waste drums	N/A	a
Building utilities upgrade	N/A	b
Building seismic upgrades	N/A	b
Building 696R Mixed Waste Permit	N/A	P8
Deactivation and D&D Projects	456,456	c
Increased Administrative Limit for Highly Enriched Uranium for Building 239	N/A	P11

TABLE A.2.3–1.—*Livermore Site Program Projections (continued)*

Project Name	Square Feet	Map Location
Reduced Operation Alternative would involve the following program reductions and projects		
NIF Operations Reduction	N/A	R1
Reduce Number of EDUs	N/A	R3
Reduce Pit Surveillance Efforts	N/A	R3
Reduce Number of Sub-Critical Assemblies	N/A	R3
Terascale Simulation Facility Operations Reduction	N/A	R2

Source: Original.
[a] Not available.
[b] Several site-wide locations.
[c] See Table A.2.3–2 for Livermore Site Decontamination and Decommissioning projects.
[d] 20,000 square feet per year.
[e] Site 300.
D&D = decontamination and decommissioning; EDU = Engineering Demonstration Unit; N/A = not applicable; NIF = National Ignition Facility; SNM = special nuclear material.

TABLE A.2.3–2.—*Livermore Site Deactivation, Decommissioning, and Demolition Projects*

Facility Number	Facility Name	Square Feet	Waste Generation (LLW, MLLW, transuranic, solid sanitary waste, etc.)[j] (ton)
No Action Alternative			
222C	Chemistry Laboratory	22,000	NA[i]
222N	Chemistry Laboratory	22,000	NA[i]
232	Vacant	2,030	1.015
280	RHWM Waste TSDF	5,343	2.6715 [d]
328A	Vacant	720	NA[i]
412	Vacant	28,607	14.3035 [a]
431	Accelerator Research Center	100,000	50
513	RHWM Liquid Waste TSDF	3,500	1.75 [b]
514	RHWM Liquid Waste TSDF	2,484	1.242 [c]
1477	Offices	10,749	5.3745
1478	Vacant	9,929	NA[i]
2626	Offices	1,591	NA[i]
2629	Offices	6,377	NA[i]
2633	Offices	1,595	0.7975
3903	Optical Glass Storage	2,130	NA[i]
3904	E Tech. Support	2,130	1.065
3905	Test Lab/Drafting	2,130	1.065
4181	Offices	3,692	1.846
4440	Offices	5,276	2.638
5928	Offices	2,160	1.08
Proposed Action includes all the projects under No Action Alternative and the following additional projects			
162	Research/Crystal Growth	19,398	9.699 [e]
165	Optics/Development Lab	9,712	4.856
166	Development Lab	14,628	7.314
169	Vacant	903	0.4515
171	Development Lab	8,632	4.316
182	Neutrino Mass Experiment	1,958	0.979
173	Welding Shop	413	0.2065
175	North Section	11,452	5.726
194	Line of Flight Tube	5,000	2.5
195	EPD/ORAD Shop	400	0.2
196	EPD/ORAD SVRC Monitor Station	853	0.4265
196A	EPD/ORAD Storage	112	0.056
198	Physics	966	0.483
212	Physics Lab/Vacant	1,800	0.9 [f]
221	Computation	1,764	0.882

TABLE A.2.3–2.—*Livermore Site Deactivation, Decommissioning, and Demolition Projects (continued)*

Facility Number	Facility Name	Square Feet	Waste Generation (LLW, MLLW, transuranic, solid sanitary waste, etc.) [j] (ton)
230	231 Portal	377	0.1885
251	Heavy Element Facility	31,809	15.9045 [g]
251 2nd	Heavy Element Facility year	359	0.1795
325U	LCW Control	3,500	1.75
328B	Duct and Filter Storage	288	0.144
328	Hazards Control Fire Test	372	0.186
336	South Security Portal	792	0.396
382	Tech Support	292	0.146
419	RHWM Indtrl	7,687	3.8435 [h]
436	Energy Research	9,693	4.8465
442	RHWM Shop/Corp	4,098	2.049
443	Storage	8,981	4.4905
444	Tel. Equip. Storage	805	0.4025
639	Storage	448	0.224
651	Visitor Center	2,390	1.195
652	Telescope Building	253	0.1265
1253	Vacant	1,080	0.54
1401	Offices	5,113	2.5565
1402	Offices	5,113	2.5565
1403	Offices	5,113	2.5565
1404	Offices	5,226	2.613
1405	Offices	5,113	2.5565
1406	Office/Computer Areas	5,200	2.6
1407	Restroom Trailer	520	0.26
1408	Vending Machine Trailer	184	0.092
1413	Offices	1,040	0.52
1456	Offices	4,914	2.457
1481	Electronics Engineering	5,275	2.6375
1526	Offices	1,380	0.69
1601	Offices	2,228	1.114
1602	Vacant	2,217	1.1085
1631	Vacant	1,490	0.745
1714	Restroom/Shower Trailer	270	0.135
1730	Offices	2,100	1.05
1826	Document Archival Storage	3,590	1.795
1830	Offices	6,470	3.235
1877	Vacant	5,770	NA [i]
1925	Offices	2,176	1.088
1927	Offices	2,160	1.08

TABLE A.2.3–2.—*Livermore Site Deactivation, Decommissioning, and Demolition Projects (continued)*

Facility Number	Facility Name	Square Feet	Waste Generation (LLW, MLLW, transuranic, solid sanitary waste, etc.) [j] (ton)
2425	Offices	2,704	1.352
2428	Offices	4,179	2.0895
2512	Offices	359	0.1795
2526	Offices	1,549	0.7745
2529	Offices	1,040	0.52
2530	Offices	1,595	0.7975
2684	Offices	5,284	2.642
2685	Offices	4,320	2.16
2687	Offices	2,100	1.05
2701	Shower Trailer	720	0.36
2775	Offices	9,831	4.9155
2787	Exercise Trailer	2,160	1.08
2801	Vacant	2,130	1.065
2802	Vacant	2,130	1.065
2804	Offices	720	0.36
2807	Offices	600	0.3
2808	Restroom Facility	238	0.119
2825	Offices	5,922	2.961
3175	Offices	1,612	0.806
3203	Materials Fabrication	632	0.316
3204	Offices	647	0.3235
3340	Offices	2,160	1.08
3502	Offices	684	0.342
3550	Offices	684	0.342
3629	Offices	2,160	1.08
3703	Offices	10,068	5.034
3751	Offices	2,240	1.12
3775	Offices	1,386	0.693
3777	Offices	6,390	3.195
3907	E Tech. Support	1,855	0.9275
3982	Offices	1,920	0.96
4104	Restroom Facility	291	0.1455
4107	Science & Tech. Education	382	0.191
4128	Offices	960	0.48
4161	Computation	1,229	0.6145
4177	Offices	1,577	0.7885
4180	Offices	3,120	1.56
4182	Offices	2,799	0

TABLE A.2.3–2.—*Livermore Site Deactivation, Decommissioning, and Demolition Projects (continued)*

Facility Number	Facility Name	Square Feet	Waste Generation (LLW, MLLW, transuranic, solid sanitary waste, etc.)[j] (ton)
4184	Offices	3,799	1.8995
4302	Offices	5022	2.511
4316	Offices	299	0.1495
4325	Offices	2,130	1.065
4377	Offices/Computer Space	4,920	2.46
4378	Offices	5,180	2.59
4383	Offices/Computer Space	5,003	2.5015
4384	Offices	1,577	0.7885
4385	Offices	3,744	1.872
4387	Offices	3,658	1.829
4388	Restroom Facility	320	0.16
4406	Control Room	1,560	0.78
4442	Offices	5,760	2.88
4905	Offices	322	0.161
4906	Offices	322	0.161
4926	Offices	1,638	0.819
5104	Industrial Gas Facility	624	0.312
5105	Lunchroom	510	0.255
5125	Office Areas	2,912	1.456
5207	Freon Storage	320	0.16
5225	Offices	1,960	0.98
5226	Offices	2,548	1.274
5627	Offices	8,415	4.2075
5801	Vacant		0
5925	Tech. Office/Work Space	2,100	1.05
5926	Tech. Office/Work Space	2,128	1.064
5975	Offices	6,480	3.24
5976	Computer Support	6,209	3.1045
5977	Offices	6,340	3.17
5978	Offices	6,480	3.24
5979	Offices	5,680	2.84
5980	Offices	5,680	2.84
5981	Offices	5,744	2.872
5982	Offices	5,742	2.871
5983	Offices	5,680	2.84
5984	Offices	5,680	2.84
5985	Offices	5,680	2.84
6203	Offices	2,181	1.0905
6501	Offices	875	0.4375

TABLE A.2.3–2.—*Livermore Site Deactivation, Decommissioning, and Demolition Projects (continued)*

Facility Number	Facility Name	Square Feet	Waste Generation (LLW, MLLW, transuranic, solid sanitary waste, etc.) [j] (ton)
6525	Visitor Center Auditorium	960	0.48
6526	Offices	2,513	1.2565
6527	Offices	2,100	1.05
6575	Offices	1,407	0.7035

Source: LLNL 2003cj.
[a] Building 412 D&D generated wastes includes 8 tons LLW, 2 tons hazardous waste, and 4.5 tons industrial waste.
[b] Building 513 D&D generated wastes includes 0.75 ton LLW, 0.5 ton hazardous waste, and 1.5 tons industrial waste.
[c] Building 514 D&D generated waste includes 0.5 ton LLW, 0.5 ton hazardous waste, and 1.5 tons industrial waste.
[d] Building 280 D&D generated waste includes 2 tons LLW, 0.25 ton hazardous waste, and 0.42 ton industrial waste.
[e] Building 162 D&D generated waste includes 1 ton LLW, 1 ton hazardous waste, and 8 tons industrial waste.
[f] Building 212 D&D generated waste includes 2 tons LLW, 2 tons hazardous waste, and 5 tons industrial waste.
[g] Building 251 D&D generated waste includes 10 tons LLW, 2 tons transuranic, 2 tons hazardous waste, and 1 ton industrial waste.
[h] Building 419 D&D generated waste includes 1 ton LLW, 1 ton hazardous waste, and 2 tons industrial waste.
[i] Not available. Data will be in separate NEPA documentation for the Facility
[j] In addition to Facility, D&D projects, routine deactivation of laboratories and equipment would generate 5 tons/year solid hazardous waste, 2 tons/year mixed waste and 10 tons/year of LLW.
D&D = decontamination and decommissioning; EPD = Environmental Protection Department; LLW = low-level waste; MLLW = mixed low-level waste; NEPA = *National Environmental Policy Act*; ORAD = Operations and Regulatory Affairs Division; RHWM = radioactive and hazardous waste management; TSDF = treatment, storage, and disposal facility.

A.2.3.3 *Terascale Simulation Facility*

This project provides for the design, engineering, and construction of the Terascale Simulation Facility, Building 453. The new facility will be capable of housing future computers required to meet the Advanced Simulation Computing Program. From its inception, the Terascale Simulation Facility has been designed to enable very-large-scale computing simulations essential to ensuring the safety and reliability of U.S. nuclear stockpile. The Terascale Simulation Facility will house the computers, networks, data, and visualization capabilities necessary to store and understand the data generated by the most powerful computing systems in the world. The facility will house the 100-Teraflops (trillion operations per second)-class computers and networks. The facility will be approximately 253,000 square feet and comprise a multistory office tower with an adjacent computer center (DOE 1999b, LLNL 2003cj). The facility is also described in Section A.2.2.45.

A.2.3.4 *Superblock Stockpile Stewardship Program Operations*

Several Stockpile Stewardship Programs will be conducted in the LLNL Superblock. These include Pit Surveillance, Shelf Life, Enhanced Surveillance, W80 Canned Sub-Assembly, Emergency Responses, W88 Stockpile-to-Target Sequence Testing, and disassembly and feed preparation demonstrations. Full implementation of these projects, will become constrained in the future by the existing administrative limit of 700 kilograms of plutonium unless a disposition pathway becomes available. NNSA is working on a long-term comprehensive solution for disposal of excess plutonium. These operations would have to be modified or curtailed if a disposition pathway is not established for plutonium.

A.2.3.5 *Container Security Testing Facility*

The Container Security Testing Facility (CSTF) is a planned facility that would be located south of Building 531 in the southeast quadrant of the Livermore Site or other suitable onsite location. The CSTF would develop methods to detect WMDs of various types in maritime cargo containers. The CSTF would occupy a ground footprint of approximately 54,000 gross square feet, with two simple warehouse-type buildings totaling approximately 9,200 square feet (LLNL 2002ar, LLNL 2002dh). A track passing through the facility would allow the CSTF to test detection capabilities against a moving target. The CSTF would include vaults for storing materials, neutron generators, and standard industrial radiation sources used for radiography. The CSTF would also house cargo moving equipment, radiation shielding material, cargo containers, and shipping materials used in testing (DOE 2003a). The facility is also described in Section A.2.2.51.

Radiological hazards would exist at the CSTF either from installed equipment or from the material provided for testing. Equipment sources would meet testing requirements established by the American National Standards Institute. Material provided for testing may include natural and depleted uranium, uranium-235, and plutonium-239. Only quantities less than the DOE Category 3 nuclear facility inventory thresholds would be allowed in other than qualified forms and sealed sources or certified DOT Type B shipping containers. All material would be handled in accordance with LLNL's ES&H safety procedures (DOE 2003a).

Chemicals used at the facility would be used in small (laboratory quantity) amounts or would represent materials encountered by the general public. Accordingly, releases due to fire would not present a hazard in excess of that routinely encountered in office, warehouse, and home fires. Potential exceptions would be limited to quantities of hazardous substances such as ammonium fluoride, ammonium chloride, arsenic, and various nuclear shielding materials; i.e., lead and cadmium. None of these would be handled in a manner conducive to significant release absent of a large fire. Additional stored materials would include ammonium dihydrogen phosphate, ammonium sulfate, sulfur (commercial fertilizer grade), ammonium sulfite, sodium chloride, hypophosphorous acid, sulfuric acid, sulfurous acid, and hydrochloric acid. Mock explosives used would present no fire hazards.

Wastes would primarily consist of small amounts of laboratory waste containing paper, laboratory wipes, gloves, glassware, and plasticware that would be contained in laboratory packs for offsite disposal (DOE 2003a).

A.2.3.6 *East Avenue Security Upgrade*

The East Avenue security upgrade project was initiated to administratively control a portion of East Avenue between South Vasco and Greenville Roads. The project includes controlling access to the approximately 1 mile of roadway by installing security posts and vehicle barriers at both ends of the roadway. The controls restrict public access to the roadway on either a temporary or permanent basis to improve security at the Livermore Site and SNL/CA. A visitor kiosk at the west end of East Avenue, at Vasco Road, and a shared shipping and receiving truck inspection facility to serve both LLNL and SNL/CA at the east end of East Avenue, at Greenville Road, will also be constructed (DOE 2002i).

A.2.3.7 *Central Cafeteria Replacement*

The replacement for the central cafeteria is located north of the Drainage Retention Basin and southeast of the existing E-7 parking lot. The 16,300-gross-square-foot facility accommodates food preparation and dining and can be used for meeting rooms. This facility serves 1,400 meals per day with a seating capacity of 600 (DOE 2002a).

A.2.3.8 *International Security Research Facility*

Building 140, the International Security Research Facility (ISRF), is a new 64,000-gross-square-foot, two-story building on the west side of the Livermore Site, adjacent to and north of Building 132. The ISRF provides enhancements in information management, optical-fiber networking, storage and retrieval, and real-time communications with NNSA and the intelligence community. The ISRF contains sensitive compartmented information facilities (DOE 2000a).

A.2.3.9 *Waste Isolation Pilot Plant Mobile Vendor*

In an effort to expedite the removal of transuranic waste from the Livermore Site, a Waste Isolation Pilot Plant (WIPP)-qualified "mobile" contractor has packaged and shipped approximately 700 drums of transuranic and mixed transuranic waste to WIPP. This work was initiated in FY2004 and was completed in FY2005. DOE determined that this facility was categorically excluded from further NEPA review (DOE 2003g).

A.2.3.10 *Engineering Technology Complex Upgrade*

The Engineering Technology Complex upgrade project will revitalize and enhance capabilities of facilities and equipment and consolidate existing research, prototype fabrication, and metrology activities in the Building 321 complex. The scope of this project includes facility upgrades to correct code compliance issues, consolidation and reorganization of laboratories and shops, and replacement of outdated equipment. When completed, the Engineering Technology Complex upgrade will consolidate manufacturing functions into one contiguous complex, which will improve operation efficiency and production quality, enhance scientific research, and reduce operating costs (DOE 2002c, LLNL 2003cj).

A.2.3.11 *Tritium Facility Modernization*

The Tritium Facility modernization project will renovate and modify approximately 7,000 square feet of Building 331 laboratory and laboratory support floorspace to install and operate a modern hydrogen isotope research capability. Adding this capability supports the Stockpile Stewardship Program by providing necessary infrastructure for high-energy density physics weapons effects and tritium/materials R&D. This capability is necessary to enable LLNL programs to meet mission objectives in stockpile stewardship and energy research. Tritium throughput would gradually increase, over a 9-year phase-in period, from about 3.5 grams per year to 25 grams per year, with a corresponding increase in operational emissions from 30 curies per year to approximately 210 curies per year (DOE 2003j). The increase in emissions would be far below the historical releases described in the 1992 LLNL EIS/EIR (LLNL 1992a).

This project includes cleanup, decontamination, and removal of tritium-contaminated equipment and remodeling activities; e.g., painting and tile removal, in various rooms in the northern end of the building. This project may include the construction of a 6,000-gross-square-foot staging, storage, and maintenance facility on the east side of Building 331 (DOE 2003j).

A.2.3.12 *Advanced Materials Program*

As explained in Section 1.8, the Advanced Materials Program has been removed from the No Action Alternative.

A.2.3.13 *BioSafety Laboratories*

This project consists of siting, constructing, modifying, and operating microbiological or biomedical R&D facilities at the Livermore Site. These BioSafety laboratories will explore the detection, response to, and avoidance of biological effects to humans, agriculture, facilities, or the environment from pathogens. Two types of experimental facilities are planned under this project. The first would use RG-1 or nonselect RG-2 biological materials, but would exclude activities with the potential for aerosol production. The second type of experimental facility would use RG-1 and RG-2 biological materials or toxins of biological origin (or synthetic versions). The second type of experimental facility would include certain levels of activity with the potential for aerosol production, but would exclude outdoor aerosol testing and uncontrolled indoor release of materials or toxins of biological origin. Aerosolization experiments involving RG-2 materials, which are also select agents, would be limited to biomaterials that are attenuated or nonvirulent. Initial locations for the BioSafety Laboratories and planned activities are identified in Table A.2.3.13–1.

All biological agents would be managed in accordance with the *Center for Disease Control* [CDC] *and Prevention BioSafety in Microbiological and Biomedical Laboratories Guidelines*. The project would not include any activities involving production quantities or concentrations of biological materials. Project activities would be conducted at BSL-1 and BSL-2. No work above BSL-2 would be performed in these facilities (DOE 2003f, DOE 2003i).

A.2.3.14 *Reclassify Building 446 as a BioSafety Level-2 Facility*

Building 446 is located in the south-central portion of the Livermore Site, just south of the Cryogen Farm. Building 446 is a 1,730-gross-square-foot facility, containing 1,627 square feet of laboratory space. It contains a bioreactor that has not been used in 4 years, two large autoclaves, a biosafety cabinet, and two fume hoods (LLNL 2003ao). Building 446 is currently classified as a BSL-1 facility. This project would reclassify Building 446 as a BSL-2 facility in order to use the bioreactor in biochemical research using RG-1 and RG-2 biological materials. Activities in Building 446 would include general chemistry and biology research up to BSL-2, which would include work with biological agents of moderate potential hazard such as *E. coli* K12. BSL-2 work would exclude human tumor cells and potentially infectious cells and secretions and any work with potential for aerosolization of RG-2 materials.

TABLE A.2.3.13–1.—*Summary of BioSafety Laboratory Locations and Activities*

Facility	Experiments with No Possibility of Aerosol Production	Experiments with Possibility of Aerosol Production
Building 132N	Yes	Yes
Building 132S	Yes	Yes
Building 151	Yes	Yes
Building 153	Yes	Yes
Building 154	Yes	Yes
Building 190	Yes	
Building 235	Yes	Yes
Building 241	Yes	Yes
Building 281	Yes	Yes
Building 432	Yes	
Building 435	Yes	Yes
Building 446	Yes	
Building 8545	Yes	Yes
Building T1527	Yes	Yes
Building T4352	Yes	Yes

Source: Original.

A.2.3.15 *Remove and Replace Offices*

This project consists of removing, relocating, and replacing of temporary facilities. These facilities consist of trailers and modular units that house temporary offices. This action would affect office space for approximately 150 persons per year (approximately 20,000 square feet per year) for the foreseeable future and would include buildings at both the Livermore Site and Site 300. The facilities would be replaced by modular or permanent structures in previously developed areas and would include site preparation and construction of new parking areas or improvement to existing parking areas.

A.2.3.16 *Westgate Drive Improvements*

Currently, during peak traffic periods, there is a backup of vehicles turning from Vasco Road onto Westgate Drive. This project consists of widening Westgate Drive to relieve traffic congestion on Vasco Road. The roadwork would include a LLNL standard street section. This includes a sidewalk on one side, storm drainage, and street lighting.

A.2.3.17 *Extend Fifth Street*

This project included road repairs along Fifth Street as well as extended Fifth Street west to West Perimeter Drive and east to Inner Loop Road. The roadwork included a LLNL standard street section with sidewalks, storm drainage, and street lighting. The security kiosk currently located on Avenue B, north of Fifth Street, was relocated south along Avenue B to a new location on the north side of Third Street. The related fence and security access/alarm issues necessary to relocate the kiosk were also included in the scope of this project. The project improved the condition of the existing roadway, improved traffic circulation on the west side of the Livermore Site, and enhanced future building sites in the vicinity of the Fifth Street extension (LLNL 2003cj).

A.2.3.18 *Superblock Security Upgrade*

The Superblock security upgrade consists of a series of projects to add physical barriers to protect the integrity of the NMTP facilities; e.g., Buildings 239, 331, 332, 334, and 335. The Safeguards and Security Department staff are continuously evaluating Superblock to provide greater security to the facilities, workers, and the public. No physical building additions or new buildings are considered as part of the planned security upgrades.

A.2.3.19 *Site Utilities Upgrade*

Significant replacements and life-extension improvements, over and above normal repair by replacement, are required for LLNL's utility systems at the Livermore Site and Site 300. The scope of the project includes various upgrades to mechanical utilities, including equipment and systems replacement at both low-conductivity water stations; upgrades to the compressed air plant; and upgrades to the potable water system and a transmission line looping system at Site 300. The site utilities upgrade also includes a subproject to convert approximately 7,700 circuit feet of overhead 13.8-kilovolt electrical distribution lines at the Livermore Site to underground, replace 16 overhead distribution transformers with pad-mounted units, and install 13.8-kilovolt feeders and a duct bank to allow looping of feeders to other load grid switchgear (area substations) (LLNL 2003cj).

A.2.3.20 *Protection of Real Property*

This project protects the maintenance and integrity of many critical facilities at LLNL to ensure that programmatic work can proceed without risk of serious damage to either the buildings themselves or the work effort. This project includes Buildings 111, 113, 121, 141, 194, 231, 241, 251, 321, 332, and the reroofing package for Building 281 (LLNL 2003cj).

A.2.3.21 *Building 298 Roof Replacement*

Building 298 is a 20-year-old radiological laboratory/diagnostic facility housing the NIF target physics activities and is vitally important to the NIF project and experiments in the laser facility. This project consists of removing the existing 47,000-gross-square-foot roof; seismically bracing and repairing the roof and subroof as necessary, installing of new roof members, platforms, and flashing for all roof-mounted mechanical and HVAC equipment; abating lead and asbestos on the roof; and replacing skylight covers and outdated ducting (LLNL 2003cj).

A.2.3.22 *Plutonium Facility Ductwork Replacement*

The Building 332 Plutonium Facility ductwork replacement project replaces an existing 40-year-old glovebox exhaust system that serves 18 laboratories (LLNL 2003cj).

A.2.3.23 *Special Nuclear Material Tests with Optical Science Laser*

This DNT project would use the Optical Science Laser Laboratory in Building 381 for an ongoing material study. The study uses encapsulated SNM for stockpile stewardship evaluations.

A.2.3.24 *Building 292 Cleanup*

Building 292 is a 23-year-old permanent building used as an environmental laboratory housing the Expedited Technology Demonstration Project. This 15,828-gross-square-foot facility consists of offices, laboratories, and service shops. The cleanup involves cleaning up tritium-contaminated targets and the machining rooms for future use.

A.2.3.25 *Deactivation, Decommissioning, and Demolition Projects*

This project will D&D 20 excess facilities at the Livermore Site, encompassing 234,443 gross square feet.

Facility deactivation may include disposition of stored or surplus materials that may be potentially contaminated. These materials and equipment are designated as legacy items, meaning there is no identified sponsor or program. Most legacy materials are materials that were placed in storage or set aside for a future need that never materialized.

Deactivation support activities may include material abatement, characterization, spot decontamination, material containment, spill cleanup, waste packaging, and disposal. Buildings that are obsolete and too expensive to rehabilitate will undergo demolition. The demolition effort would include electrical and mechanical isolation from the LLNL utility grid, sampling for contamination, characterization and proper disposal of all subsystems and components, and dismantling and disposal of the structures. Where feasible, building materials that could be recovered may be segregated and transported offsite for recycling.

The list of excess facilities, including gross square footage and estimated waste generation, is provided in Table A.2.3–2.

Decontamination and Decommissioning

D&D may include deactivation, decontamination, decommissioning, or demolition. Deactivation is the process of placing a facility in a stable and known condition, including the removal of readily removable hazardous and radioactive materials, to ensure adequate protection of the worker, public health and safety, and the environment. Decommissioning takes place after deactivation and includes surveillance and maintenance, decontamination, and/or dismantlement. Decontamination is the removal or reduction of residual radioactive and hazardous material. Demolition is the destruction and removal of facilities or systems from the construction site.

A.2.4 Proposed Action, Livermore Site

The Proposed Action at the Livermore Site would include all the projects and programs described under the No Action Alternative (Section A.2.3) and the additional projects and programs described in Sections A.2.4.1 through A.2.4.19. Proposed Action projects and programs are listed in Table A.2.3–1. Figure A.2.3–1 shows the locations of these projects.

A.2.4.1 *Use of Proposed Materials on the National Ignition Facility*

In 1996, the programmatic impacts of conducting DOE/NNSA's Stockpile Stewardship and Management Program at all NNSA sites were evaluated in the *Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (SSM PEIS). The SSM PEIS Record of Decision (ROD) documented the decision to construct and operate the National Ignition Facility at LLNL. In 1997, the Natural Resources Defense Council (NRDC) and 39 other organizations brought suit against DOE in *NRDC v. Peña*, Civ. No. 97-936(SS) (D.D.C.), challenging the adequacy of the SSM PEIS, partially on the basis that DOE should have analyzed conducting experiments on the NIF using plutonium, other fissile materials, fissionable materials, and lithium hydride. DOE maintained that the use of these materials were not reasonably foreseeable at that time. In August 1998, the judge in the lawsuit issued a Memorandum Opinion and Order (USDCDC 1998) that dismissed the plaintiffs' case. The Memorandum Opinion and Order provided in Paragraph 6 that:

> No later than January 1, 2004, DOE shall (1) determine whether any or all experiments using plutonium, other fissile materials, fissionable materials other than depleted uranium (as discussed in the Supplement Analysis for the Use of Hazardous Materials at the NIF Experiments, A.R. doc. VIIA-12), lithium hydride, or a Neutron Multiplying Assembly (NEUMA), such as that described in the document entitled Nuclear Weapons Effects Test Facilitization of the National Ignition Facility (A.R. doc VII.A-4) shall be conducted at the NIF; or (2) prepare a Supplemental SSM PEIS, in accordance with DOE NEPA regulation 10 C.F.R.1021.314, analyzing the reasonably foreseeable environmental impact of such experiments. If DOE undertakes the action described in subpart (2) of this paragraph, DOE shall complete and issue the Supplemental SSM PEIS and the Record of Decision based thereon within eighteen (18) months after issuing a notice of intent to prepare the Supplemental SSM PEIS.

In November 2002, the NNSA Deputy Administrator for Defense Programs approved proposing experiments on the NIF using plutonium, other fissile materials, fissionable materials, and lithium hydride (Crandall 2002). NNSA has chosen to use the LLNL SW/SPEIS as the mechanism for complying with the court's instruction to prepare a supplemental SSM PEIS. The inclusion of this supplemental SSM PEIS in the LLNL SW/SPEIS ensures timely analysis of these proposed experiments within the environmental impacts being evaluated for the continued operation of LLNL. In any ROD to be issued, NNSA will address decisions on the use of any or all of these materials in NIF experiments within the context of continuing LLNL operations.

A.2.4.2 *Increased Administrative Limits for Plutonium in the Superblock*

In the 1992 LLNL EIS/EIR, a primary goal of LLNL was to reduce the plutonium inventory to 200 kilograms through offsite disposition of significant portions of the inventory. This goal was partially achieved by relocating approximately half of the excess material offsite; however, DOE facilities were unable to accept all materials identified to be shipped. In 1999, DOE prepared a supplement analysis that reexamined future program requirements at LLNL and identified the need to modify certain radioactive material limits established in the 1992 LLNL EIS/EIR. The

1999 supplement analysis confirmed the need for an administrative limit of 700 kilograms of plutonium to provide for continued LLNL support of the Stockpile Stewardship Program.

NNSA continues to rely on LLNL to meet its Stockpile Stewardship Program mission objectives. These objectives include campaigns relating to pit manufacturing and certification, advanced radiography, dynamic materials testing, materials shelf life experiments, and enhanced surveillance research. These NNSA-assigned campaigns and programs require continued and increasing use of plutonium. NNSA is working on a long-term solution for disposal of plutonium, but no pathway for LLNL to dispose of excess plutonium currently exists, requiring an increase in the plutonium administrative limits. Therefore, NNSA would increase the administrative limit for plutonium to 1,400 kilograms from the existing 700 kilograms. The limit for enriched uranium would remain unchanged at 500 kilograms.

A.2.4.3 *Integrated Technology Project in the Plutonium Facility*

As explained in Section 1.8, the Integrated Technology Project has been removed from the Proposed Action.

A.2.4.4 *Increased Material-at-Risk Limit for the Plutonium Facility*

The Proposed Action would increase the plutonium material-at-risk limit from 20 to 40 kilograms of fuel-grade equivalent plutonium in each of two rooms of the Plutonium Facility. The material-at-risk limit for all other rooms would remain 20 kilograms fuel grade equivalent plutonium. This increase is needed to meet future Stockpile Stewardship Programs such as the casting of plutonium parts. These activities support campaigns for advanced radiography, pit manufacturing, and certification programs.

A.2.4.5 *Increase of Tritium Facility Material Limits*

The Proposed Action would increase the Building 331 Tritium Facility tritium administrative limit from 30 to 35 grams and the material at risk at a single workstation from 3.5 to 30 grams. These increases are needed to support future planned Stockpile Stewardship Program activities such as the high-energy density physics target fill and the Test Readiness Program. The activities support the campaign for inertial confinement fusion and high yield and the readiness to resume testing, if directed.

A.2.4.6 *National Ignition Facility Neutron Spectrometer*

A neutron spectrometer would be constructed and operated as part of the NIF core facility diagnostics capability. The neutron spectrometer would provide a sensitive and accurate measure of the neutrons generated in experiments. The construction would not start before FY2008 and when completed, the neutron spectrometer would become part of the NIF operational facility. The neutron spectrometer would be installed in a specially constructed concrete shaft from the target chamber to a point 52 feet below the surface. The neutron spectrometer would reside at the end of the shaft and contain solid plastic scintillation sheets layered between sheets of lead, with a total mass of approximately 20 tons.

A.2.4.7 *Materials Science Modernization Project*

The Materials Science Modernization Project would provide LLNL with modern infrastructure in the areas of materials fabrication, characterization, and testing relevant to LLNL's national security mission. The 60,000-square-foot facility would be engineered to conduct precision experiments and precision fabrication of designer materials to a level not currently available. The goal is for the Materials Science Modernization Project to serve as a center of excellence for materials research.

A.2.4.8 *Chemical and Biological Nonproliferation Program Expansion*

NNSA proposes to perform research and development activities to develop a variety of biodetector technologies in Building 132S, the NAI/Physics Facility and Building 153, the Microfabrication Laboratory at the Livermore Site. Two classes of detectors would require DNA sequences or antibodies to identify and characterize biological pathogens. Planned activities would include fluid manipulation experiments using LLNL equipment for optical or flow cytometer analysis. This activity would be performed no sooner than FY2005.

Other experiments would evaluate the performance of an electrophoresis detection system for applications involving trace detection of biological warfare agents and precursors. Lasers and an ultra-violet-visible-near-infrared spectrometer would also be used in the laboratories.

A.2.4.9 *Petawatt Laser Prototype*

The proposed petawatt laser prototype would be installed and operation would begin no earlier than FY2005. The petawatt laser is a short-pulse, high-power laser that can be generated by modifying existing solid-state glass laser technology developed at LLNL and other laboratories. The first petawatt laser prototype was demonstrated in Building 391, the Inertial Confinement Fusion Laser Facility and then dismantled when the NOVA laser facility was shut down. To continue this area of research, a second petawatt prototype is proposed for installation and operation in Building 381, the Laser Facility.

A.2.4.10 *Consolidated Security Facility*

The proposed Consolidated Security Facility project would involve the physical consolidation of security services to improve functionality, efficiency, and effectiveness. The scope of work would include the construction of a multipurpose security structure of approximately 50,000 square feet. The facility would contain offices, vaults, conference and meeting rooms, interview rooms, shops, and specialized technical support areas. The new facility would be collocated with the existing Security Department Administration Facility, Building 274.

A.2.4.11 *Waste Management*

Under the Proposed Action, waste management activities would change to accommodate increased waste generation and to improve overall operational methods. These changes would include modifications to permit status for existing facilities to allow different types of waste to be stored or treated; e.g., obtain hazardous waste facility permits for areas now used for nonhazardous or radioactive waste management, and to improve operational flexibility and efficiencies; e.g., raise storage limits and relocate permitted waste treatment units from old facilities to newer facilities.

A.2.4.12 *Building 625 Waste Storage*

The amount of transuranic waste stored in Building 625 radiological and hazardous waste storage facility would be increased to consolidate waste from LLNL facilities planned for decontamination and decommissioning and to accept drums from facilities prior to shipment to the WIPP. The maximum curie limit under the Proposed Action would be equivalent to an array of drums where one drum contains 60 plutonium-equivalent curies and the other surrounding drums contain 12 plutonium-equivalent curies.

A.2.4.13 *Direct Shipment of Transuranic Wastes from the Superblock*

NNSA is proposing to develop the capability to load transuranic waste into pipe overpacks in the Superblock, beginning in FY2005. These pipe overpacks allow for significantly higher actinide loading into each drum for disposal at the WIPP. The pipe overpack is allowed to have up to 80 plutonium-equivalent curies per drum and up to 200 fissile-gram equivalents. The pipe overpack provides a way for LLNL to dispose of waste, such as plutonium with high americium levels. The pipe overpack can be loaded, stored, loaded into TRUPACT-II shipping containers, and shipped from Superblock to the WIPP without increasing the nuclear material inventory or hazard levels in other LLNL facilities. The TRUPACT-II shipping containers would be loaded to the limits of the WIPP waste acceptance criteria.

A.2.4.14 *Berkeley Waste Drums*

DOE/NNSA is proposing that LLNL accept 5 drums of mixed transuranic waste from the Lawrence Berkeley National Laboratory. All liquids would be solidified and corrosive waste mixed waste would be neutralized before shipment to LLNL. DOE would use mobile vendors to certify the waste for shipment to the WIPP. The packaged waste would then be shipped directly to WIPP in a single TRUPACT-II container. This activity would be performed no sooner than FY2005. This one-time shipment is proposed in order to remove legacy mixed waste from the Lawrence Berkeley National Laboratory expeditiously.

A.2.4.15 *Building Utilities Upgrades*

Within the next 10 years, many of LLNL's key facilities will be past their expected life, severely outdated, and code deficient. The building utilities upgrade project would provide state-of-the-art technological upgrades and reduce maintenance backlog items to selected mission-critical laboratory and office buildings at the Livermore Site. Examples of technological upgrades include expanding building network capability for computing environments; rewiring facilities for high speed networking; replacing secondary electrical distribution system components such as transformers, panelboards, wiring, lighting systems, and power conditioning equipment for sensitive computing and instrumentation equipment; and increasing capacities of mechanical systems to handle increased cooling requirements for computing and laboratory environments (LLNL 2003cj).

A.2.4.16 *Building Seismic Upgrades*

Executive Order 12941 "Seismic Safety of Existing Federally Owned or Leased Buildings" (EO 12941) requires that all federally owned and leased buildings that do not meet current seismic design and construction standards should be identified and mitigated if necessary. There were 108 buildings identified at LLNL as having potential seismic deficiencies relative to current codes. The deficiencies of these buildings have been prioritized based on a scoring approach that incorporated building vulnerability, failure consequence, and mission-essential factors. This project includes the design and installation of seismic upgrades needed to bring these 108 buildings into compliance with the applicable seismic design and construction standards (LLNL 2003cj).

A.2.4.17 *Building 696R Mixed Waste Permit*

The purpose and scope of the Part B permit modification needed for Building 696R is to create a new permitted hazardous and mixed waste storage and treatment facility in a section of Building 696R to replace existing capacity and operations. This project would involve the activities specified below and any others necessary as directed by the California Department of Toxic Substances Control.

- Permit a 3,000-cubic-foot liquid storage capacity at Building 696
- Reduce the solid storage capacity in Area 612-5 to 23,900 cubic feet
- Move a 600-ton-per-year drum/container crusher from Area 612 to Building 696. Inform the Department of Toxic Substances Control of a second 600-ton-per-year drum/container crusher to be placed in the same area for managing radioactive waste only.
- Move a 250-ton-per-year size reduction unit from Area 612 to Building 696
- Partially close or delay closure of size reduction unit and drum/container crusher areas at Area 612

See Appendix B for additional information.

A.2.4.18 *Deactivation, Decommissioning, and Demolition Projects*

Under the Proposed Action, LLNL would D&D 155 excess facilities at the Livermore Site encompassing approximately 691,000 gross square feet of floorspace, including 234,443 square feet under the No Action Alternative. Facility deactivation may include disposition of stored or surplus materials that may be potentially contaminated. These materials and equipment are designated as legacy items, meaning there is no identified sponsor or program. Most legacy materials are materials that were placed in storage or set aside for a future need that never materialized.

Deactivation support activities may include material abatement, characterization, spot decontamination, material containment, spill cleanup, waste packaging, and disposal. Buildings that are obsolete and too expensive to rehabilitate will undergo demolition. The demolition effort would include electrical and mechanical isolation from the LLNL utility grid, sampling for contamination, characterization and proper disposal of all subsystems and components, and dismantling and disposal of the structure. Where feasible, building materials that could be recovered may be segregated and transported offsite for recycling.

The list of excess facilities, including gross square footage and estimated waste generation, is provided in Table A.2.3–2.

A.2.4.19 *Increased Administrative Limit for Highly Enriched Uranium for Building 239*

Building 239, Radiography Facility, contains equipment for performing nondestructive evaluations. Facility operations involving radiography are carried out in the basement of the building. The Proposed Action would increase the Building 239 HEU administrative limit from 25 to 50 kilograms to support Stockpile Stewardship Program activities. The use of 50 kilograms of HEU is analyzed in Appendix D and is bounded by the consequences of an accident involving the use of plutonium in Building 239.

A.2.5 Reduced Operation Alternative, Livermore Site

The Reduced Operation Alternative is broadly defined as approximately a 30 percent scaledown from the Stockpile Stewardship Program operations under the No Action Alternative. The following operations reductions would occur under the Reduced Operation Alternative. These initiatives are summarized in Table A.2.3–1 and are considered to be changes to the baseline operations described under the No Action Alternative.

A.2.5.1 *Integrated Technology Project*

As explained in Section 1.8, the Advanced Materials Program and Integrated Technology Project have been removed from the No Action Alternative and the Proposed Action respectively.

A.2.5.2 *National Ignition Facility Operations Reduction*

Under the Reduced Operation Alternative, the NIF would reduce the annual yield by approximately 30 percent from 1,200 megajoules to 800 megajoules and reduce the tritium throughput from 0.175 grams per year to 0.15 grams per year. The individual experiment yields would remain at up to 20 megajoules (45 megajoules maximum credible yield), but the total number of experiments with high yield would be reduced. These changes would reduce specific environmental impacts such as low-level waste generation, but would not meet the full NIF stockpile stewardship mission. However, by maintaining the full operations and support facilities staff, the facility would be in complete operational readiness, and could be ramped back to full operations if NNSA so directed. Under the Reduced Operation Alternative, the capability to perform tests with either indirect drive or direct drive, after reconfiguration of laser beams and final optics assemblies, would exist.

A.2.5.3 *Reduce Number of Engineering Demonstration Units*

LLNL fabricates engineering demonstration units to demonstrate the acceptability of different nuclear weapon pit technologies for several weapons systems in the U.S. stockpile. Under the

Reduced Operation Alternative, NNSA proposes to only fabricate engineering demonstration units for half of the pits in the U.S. stockpile. Engineering demonstration units are used to recapture the technology needed to manufacture pits of various types and to develop and demonstrate pit fabrication processes. These changes would reduce specific environmental impacts such as transuranic waste generation and worker dose. However, this reduction in the number of engineering demonstration units would not meet the full stockpile stewardship mission (LLNL 2002bf).

A.2.5.4 *Reduce Pit Surveillance Efforts*

LLNL performs surveillance activities for all pits in the active and inactive U.S. stockpiles. Pit surveillance activities include determination of the important pit characteristics and destructive examination of the pits to assess suitability for safety and performance. Under the Reduced Operation Alternative, NNSA proposes to perform pit surveillance activities on LLNL-designed pits only, a reduction of 50 percent from the No Action Alternative. These changes would reduce specific environmental impacts such as transuranic waste generation and worker dose. The reduction in pit surveillance activities, however, would not meet the full stockpile stewardship mission (LLNL 2002bf).

A.2.5.5 *Reduce the Number of Subcritical Assemblies*

LLNL fabricates subcritical assemblies for the U.S. Stockpile Stewardship Program. Under the Reduced Operation Alternative, NNSA proposes to fabricate subcritical assemblies for the LLNL testing program only. This nearly 50-percent reduction in operations would reduce specific environmental impacts such as transuranic waste generation and worker dose. However, the reduction would not meet the full stockpile stewardship mission (LLNL 2002bf).

A.2.5.6 *Terascale Simulation Facility Operations Reduction*

Under the Reduced Operation Alternative, NNSA proposes to operate Terascale Simulation Facility at 60 percent capacity (e.g., 60 teraflops). These changes would reduce energy requirements for the facility from 25 megawatts to 15.3 megawatts, but would not meet the full stockpile stewardship mission. However, by maintaining the facility in full operational readiness in terms of hardware, software, and operations staff, the facility could be ramped back to full capacity in a very short time. Therefore, the Reduced Operation Alternative for the facility would include no reduction in staff.

A.3 SITE 300

Site 300 occupies approximately 7,000 acres, approximately 11 square miles, in Alameda and San Joaquin counties, approximately 15 miles southeast of the Livermore Site. Site 300 was established in 1955 as a remote explosives testing ground for the theoretical weapons developed at LLNL. Site 300 facilities offer approximately 381,000 gross square feet of operational space, with 4 percent in temporary facilities. The area surrounding Site 300 is sparsely settled and is used for sheep and cattle ranching, wind farming, and off-road vehicle recreation at the Carnegie State Vehicular Recreation Area. Fireworks America Corporation and SRI International maintain explosives test facilities in the area (LLNL 2002l). The Tracy Hills Development, a planned mix of residential, schools, offices, commercial, industrial, and public service was approved by Tracy

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City Council in 1998. The development would be located northeast of and adjacent to the test site. Residential development was limited within the city of Tracy by the passage of Measure A, a slow-growth ordinance, in 2000. The residential development portion of the Tracy Hills Development cannot begin until 2007. There are no similar time constraints for the commercial/industrial portion of the development plan, although individual project permits would still require approval by the city of Tracy (Newcorn 2003).

Activities at Site 300 include (LLNL 2002l):

- Test firing of explosives that allows sophisticated diagnostic recovery of high explosives test data
- Dynamic and thermal testing of explosives
- Explosives formulation, processing, machining, radiography, and assembly
- Nonexplosives experimentation
- Testing of weapons components
- Explosives waste treatment
- State-of-the-art destructive and nondestructive materials and weapons design
- Diagnosis of the chemical reactions involved in explosives detonations
- Compatibility and reaction studies of explosives
- Storage of explosives
- Transportation of explosives

Site 300 includes two remote test areas (thermal and dynamic test areas); a chemistry area, process area, a pistol range area, and a general services area (Figure A.3–1 and Figure A.3–2).

A.3.1 Existing Infrastructure

Site 300 infrastructure includes telephones, lighting, other utilities, landscaping, drainage, parking, pathways, and roads. LLNL would continue to maintain, upgrade, and expand this infrastructure under the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative as described in Chapter 3 of this LLNL SP/SWEIS. Figure A.3–1 shows the site map, which illustrates the major roadways. Utilities at Site 300 include domestic water, compressed air, sewage, and electric power. These utilities are described below.

Domestic water is supplied by onsite wells with a current capacity of 930,000 gallons per day. In 2002, the peak usage was approximately 67,900 gallons per day (LLNL 2003aq). A new water supply project has been completed that will supply Site 300 with water from the city of San Francisco's Hetch Hetchy water supply system. The new supply system has an estimated capacity of approximately 648,000 gallons per day with an expansion capacity of 1.2 million gallons per day.

Metered power is supplied by Pacific Gas & Electric Company's Tesla substation. In 2002, the instantaneous electrical load at Site 300 averaged 3.4 megawatts. Site 300 has the capacity to provide up to 20 megawatts (LLNL 2003aq).

Sanitary sewage is piped from the general services area to an oxidation and percolation pond system. In 2002, sewage was pumped at the rate of approximately 2,100 gallons per day. The system has a current capacity of 7,000 gallons per day. Sewage from other areas is disposed of in septic tanks, leachfields, or cesspools at each building (LLNL 2000a).

At the high explosive process area, compressed air is supplied at 125 pounds per square inch from a central air plant at Building 815. Individual air compressors supply the remainder of Site 300's compressed air needs (LLNL 2000a).

A.3.2 Existing Facilities

Facilities at Site 300 are shown in Figure A.3–1 and Figure A.3–2. The following descriptions are limited to facilities with potentially hazardous inventories. Facilities associated with waste management, security, health services, and emergency response are also briefly described.

The selected facilities at Site 300 are described in Sections A.3.2.1 through A.3.2.27 and are listed in Table A.3.2–1, with information on location, square footage, operations, and hazard assessment. Figure A.3.2–1 highlights the selected facilities. Hazards may be radiological, chemical, or other. Radiological hazards include low-level ionizing radiation, which could cause cancer, genetic defects, or noninheritable birth defects. Chemical hazards include chemicals that may be toxic, flammable, corrosive, poisonous, and/or carcinogenic. Other hazards include high explosives, non-ionizing radiation, biological agents, compressed gas cylinders, and electrical equipment. A brief summary discussion on generated wastes and effluents is included. For a more detailed discussion on waste generation and waste management, refer to Appendix B.

An overview of all facilities is included in Table A.3.2–2. Several facilities at Site 300 that were described in the 1992 LLNL EIS/EIR (LLNL 1992a) have been excessed. Excessed refers to a facility, materials, etc. that are no longer necessary to meet a program's mission and are being returned to LLNL's Director of Operations for future use.

TABLE A.3.2–1.—*Overview of Selected Facilities at Site 300*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other	Hazard		
								Chemical	Radiological	Other[a]
801	Contained Firing Facility	51,000	Yes	Yes	Yes			Yes	Yes	Yes
804	Low-level Waste Staging Area	3,733				Yes			Yes	
805	HE Assembly/Machining	6,802	Yes		Yes			Yes		Yes
806	HE Machining	8,314	Yes		Yes	Yes		Yes		Yes
807	HE Machining	1,575			Yes			Yes		Yes
809	HE Pressing Facility	3,005	Yes		Yes	Yes		Yes	Yes	Yes
810	HE Assembly	5,079	Yes		Yes	Yes		Yes	Yes	Yes
812	Explosives Test Facility	5,532		Yes	Yes	Yes		Yes	Yes	Yes
816	Explosives Waste Storage Facility	1,200				Yes		Yes		
817	HE Pressing	2,739			Yes	Yes		Yes		Yes
819	Decontamination Facility	811			Yes	Yes		Yes		
821	Chemistry Storage	454				Yes		Yes		
822	Controlled Materials Storage Vault	296				Yes		Yes	Yes	
823	LINAC Radiography	2,748	Yes		Yes			Yes	Yes	Yes
825	Chem Process Facility (explosives research)	1,224		Yes				Yes	Yes	Yes
826	Chem Process Facility (explosives research)	1,742	Yes	Yes				Yes	Yes	Yes
827	Chemistry Process Facility	7,744	Yes	Yes	Yes	Yes		Yes	Yes	Yes
829	Energetic Materials Processing Center	40,000	Yes	Yes	Yes	Yes		Yes	Yes	Yes
832	Materials Management Shipping/Receiving Facility	10,970	Yes		Yes	Yes		Yes	Yes	Yes
834	Thermal Test Facility	8,267		Yes		Yes		Yes	Yes	
836	Dynamic Test Facility	13,288	Yes	Yes	Yes			Yes	Yes	
845	Explosives Waste Treatment Facility	666				Yes		Yes		Yes
850	Hydrodynamic Test Facility	5,840	Yes	Yes	Yes			Yes	Yes	Yes
851	Hydrodynamic Test Facility	13,681	Yes	Yes	Yes			Yes	Yes	Yes
854A, H, V	Site 300 Response Training Facility	6,142		Yes		Yes		Yes	Yes	Yes

TABLE A.3.2–1.—*Overview of Selected Facilities at Site 300 (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other	Hazard		
								Chemical	Radiological	Other[a]
857	Materials Management Storage Facility	440						Yes		
882	PFD Communication Center	4,912	Yes		Yes					
883	EPD/RHWM Container Storage	1,733				Yes		Yes		
889	Health Services/Badging Facility	2,709	Yes		Yes					Yes
890	Fire Station	6,752	Yes		Yes					
NA	HE Rinsewater Surface Impoundment Ponds	42,000					Yes			Yes

Source: Original.

[a] Other hazards include high explosives, accelerators, x-ray machines, lasers, biological, the storage and handling of compressed gas cylinders, and electrical hazards.

CNG = Compressed Natural Gas; DPRF = Defense Program Research Facility; DWTF = Decontamination and Waste Treatment Facility; EPD = Environmental Protection Department; HC = Hydrocarbon; HEA = Health and Ecological Assessment; HE = high explosive; HETB = Hardened Engineering Test Building; HWM = hazardous waste management; ICF = Inertial Confinement Fusion; LINAC = LLNL Electron-Positron Accelerator; LTAB = Laser and Target Area Building; MeV = million electron volts; NIF = National Ignition Facility; PFD = Protective Force Division; RHWM = Radioactive and Hazardous Waste Management; TSDF = Treatment, Storage, Decontamination Facility; WMRDF = Weapons Materials Research and Development Facility; YMP = Yucca Mountain Project.

TABLE A.3.2–2.—*Overview of All Other Facilities at Site 300*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
802A	Camera Test Facility (optic lab – inactive)	2,934	Yes	Yes			
803	Wildlife Management Warehouse	1,484				Yes	
808	Vacant	1,440				Yes	
811	Storage	1,006				Yes	
813	Change House	2,822	Yes		Yes		
814	Vacant	2,150	Yes	Yes	Yes		
815	Central Air Plant	1,219				Yes	
820	Vacant	2,219			Yes	Yes	
828	HE Machining - inactive	683			Yes		
830	PE/Storage - electrical	1,735				Yes	
832F	Storage	2,995	Yes			Yes	
833	EPD/ERD Service-R&D	1,851	Yes	Yes		Yes	
835	EPD/ERD Storage	1,196				Yes	
837	DTED Storage	1,2426				Yes	
838	Vacant	601				Yes	
840	Vacant	777		Yes		Yes	
841	Pesticide Storage - C&M Shop	1,680				Yes	
842	Communication Hut	458			Yes		
843	EPD/ERD Storage/Yard	952			Yes	Yes	
844	Booster 1 (water)	374			Yes		
846	Central Power Substation	497			Yes		
847	Booster 2 (water)	292			Yes		
848	Weather Station	765		Yes		Yes	
853	Booster 3 (water)	292			Yes		
854B-G, J	Dynamic Test Complex	10,610		Yes	Yes	Yes	
855	Disassembly Facility (mothball)	1,934		Yes	Yes		
856	Industrial Storage	1,484				Yes	
858	Drop Tower Complex	2,420		Yes		Yes	
859	Storage	1,484				Yes	
860	Storage	313				Yes	
865	Advanced Test Accelerator	64,731				Yes	
866	Communications Hut	610			Yes		
867	Bunker Support Facility	4,342				Yes	
869	PE/Maintenance Shop Storage	358				Yes	
870	Project Management/ Chemistry/NNSA	3,890	Yes		Yes	Yes	
871	Administration	7,895	Yes				
872	PE Paint Shop	1,925	Yes		Yes		
873	PE Main Shops	17,447	Yes		Yes		
874	Mechanical Shops	19,231	Yes	Yes	Yes	Yes	
875	PE/Supply & Maintenance	14,903	Yes		Yes		
876	Gas Cylinder Storage	2,400				Yes	
877	Computer Technical Support	3,352	Yes		Yes		
878	PE/Maintenance Shop Storage	440				Yes	
879	Motor Pool & Garage	2,797	Yes		Yes		
880	Cafeteria	2,759				Yes	Yes

TABLE A.3.2–2.—*Overview of All Other Facilities at Site 300 (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
886	Well Storage Building	36				Yes	
887	Water Well	144			Yes		
888	Water Well	70			Yes		
890	Fire Station	6,752	Yes		Yes		
891	Main Gate Kiosk	50					Yes
892	Central Control Post	884	Yes		Yes		
894	Process Post/Vacant	143					Yes
895	EPD/ORAD Office	363	Yes				
896	East Observation Post	33					Yes
897	West Control Post	293					Yes
898	West Observation Post	411					Yes
899	Pistol Range	3,021	Yes		Yes		Yes
8340	EPD/ERD TF834 Monitoring	273		Yes			
8710	Administration	520	Yes				
8711	Training Facility	482					
8726	EPD/ERD Offices	1,000	Yes				
8801	PE Inspection	360	Yes				
8806	Video Conference/Training	536	Yes				Yes
8825	Security Fitness	370					Yes
8826	Shower Facility	943					Yes
8990	B 899 A&B Wash-up Facility	240					Yes
8991	Security Training Facility	546	Yes				
	Storage Magazines						
1	Magazine - Storage Vault	386				Yes	
2	Magazine - EWSF	418				Yes	
3	Magazine - EWSF	137				Yes	
4	Magazine - EWSF	137				Yes	
5	EWSF magazine	140				Yes	
7	Magazine - Storage Vault	386				Yes	
8	Magazine - Storage Vault	386				Yes	
10	Magazine - Storage Vault	120				Yes	
21	Magazine - Storage Vault	425				Yes	
22	Magazine - Storage Vault	425				Yes	
23	Magazine - Storage Vault	427				Yes	
24	Magazine - Storage Vault	67				Yes	
30	Magazine - Storage Vault	386				Yes	
31	Magazine - Storage Vault	386				Yes	
32	Magazine - Storage Vault	386				Yes	
33	Magazine - Vault	139				Yes	
34	Magazine - HE Cubical	52				Yes	
35	Magazine - Storage Vault	386				Yes	
36	Magazine - Storage Vault	386				Yes	
37	Magazine - HE Cubical	52				Yes	
38	Magazine - Storage Vault	751				Yes	
41	Magazine - Storage Vault	751				Yes	

TABLE A.3.2–2.—*Overview of All Other Facilities at Site 300 (continued)*

Facility Number	Facility Name	Square Feet	Office	Laboratory/ Research	Service/ Support	Storage	Other
51	Magazine - Vault	138				Yes	
52	Magazine - Storage Vault	492				Yes	
58	Magazine	NA				Yes	
70	Magazine - Storage Vault	288				Yes	
71	Magazine - Storage Vault	138				Yes	
72	Magazine - Storage Vault	138				Yes	
80	Ready Vault	386				Yes	
80A	Magazine - Magazette	14				Yes	
80B	Magazine - Magazette	14				Yes	
82	Magazine - Storage	55				Yes	
83	Ready Vault	373				Yes	
83A	Magazine - Magazette	12				Yes	
83B	Magazine - Magazette	12				Yes	
816	EWSF Magazine	1,200				Yes	
817C	HE Storage	345				Yes	
818A	HE Storage Facility	1,244				Yes	
818C	HE Storage Facility	291				Yes	
824	HE Storage Facility	294				Yes	
834M	Thermal Test Facility	1,690				Yes	
854V	Storage	500				Yes	
855	Magazine (planned)					Yes	
858A	Storage	865				Yes	

Source: Original.
C&M = Construction & Management; DTED = Defense Technologies Engineering Division; EPD = Environmental Protection Department; ERD = Environmental Restoration Division; EWSF = explosives waste storage facility; HE = high explosive; NNSA = National Nuclear Security Administration; ORAD = Operations and Regulatory Affairs Division; PE = Plant Engineering; R&D = research and development.

A.3.2.1 *Building 801 Complex*

The Building 801 Complex comprises Buildings 801A, 801B, and 801D and is approximately 51,000 gross square feet. The Building 801 Complex is part of the explosives test facilities and is in the northeast quadrant of the site, called the east firing area (LLNL 2001ao).

An indoor firing chamber was added as part of the contained firing facility modifications made between 1998 and 2001. Performing test explosions in the firing chamber dramatically reduces particle emissions and minimizes the generation of hazardous waste, noise, and blast pressure (LLNL 2002cl). The modifications also included a new support facility, mechanical/electrical equipment area, and a diagnostics equipment facility in Building 801A. Additional office facilities were added to Building 801D (LLNL 2001ao).

The Building 801 Complex is designed to obtain explosives test data through the use of the flash x-ray accelerator, designed to accelerate charged particles and generate x-rays; a high-speed camera; and a laser-doppler interferometry operation. This equipment measures the velocity of explosively driven surfaces. Other electronic and mechanical systems capable of diagnosing various aspects of the high explosives tests are housed in Building 801 Complex facilities (LLNL 2001ao).

Hazards Assessment

The common hazards at this firing complex are associated with the handling and firing of explosives, high voltage electricity, toxic and radioactive materials, high levels of ionizing radiation, lasers, cranes and machine tools, and high-pressure systems. Personnel could be exposed to x-rays from the flash x-ray accelerator or non-ionizing radiation from high-power lasers. The high-speed rotor cameras, if allowed to revolve at too high a speed, will come apart, scattering parts of the beryllium rotor around the camera room.

The hazards in the photoprocessing operations are various laboratory reagents, photochemicals, and chemicals in spent developers, fixers, and rinsewaters. When film is processed, the developers and fixers are automatically replenished and waste is captured in separate barrels.

Formal operational safety procedures have been prepared for the facility as a whole. These are supplemented for individual tests. Procedures are reviewed by the Hazards Control Department. All explosives are handled, transported, and test fired following these procedures. All work with radioactive materials and toxic materials conforms to established health and safety guidelines.

In the explosive firing facilities, personnel safety is enhanced by positive key control of the various aspects of the operation, including enabling the firing console. Personnel are excluded from areas of x-ray flux by fences, barriers, and interlocked access doors and gates. The interferometer room is also interlocked. Equipment is electrically isolated from the shot assembly until personnel are under cover. A muster or positive accounting is used for control of personnel access to the test area.

Personnel are not allowed to enter the firing chamber after a shot until specific conditions are met, including waiting for a specified period of time in case of malfunction or misfire. Re-entry into the firing chamber is performed after the chamber ventilation has purged hazardous atmospheres. Personnel use personal protective equipment that is appropriate to the exposure potential of the hazardous materials in the chamber (LLNL 2001ao).

Generated Wastes and Effluents

The containment chamber is equipped with a portable, manually operated water washdown system that uses an articulating nozzle. This system washes detonation residue that may contain radioactive materials, such as depleted uranium, or hazardous contaminants, such as beryllium, from the firing chamber walls and floor. A manually operated hose and a high-pressure washer are also used, when necessary, to complete the cleanup process. The washdown water from the chamber is diverted to a 20,000-gallon holding tank, filtered, and reused. However, if it becomes necessary to dispose of the washdown water stored in the holding tank, the water would be sampled and transferred to the Livermore Site for discharge to the sanitary sewer if parameters are within acceptable limits. If not, the water would be transferred to RHWM for appropriate disposal. Other wastewater, including photographic wastewater and water generated from a protective clothing washing process, would be handled in a similar manner that could include transferring the water to the Site 300 Class II surface impoundments (LLNL 2001ao).

Tritium has contaminated the firing chambers in the past and will be a contaminant in the future. The hazardous wastes generated from the photoprocessing operations, the flash x-ray, and the interferometry operations include solvents, lubricating fluids, dielectric fluids, and photographic wastes. These nonradioactive wastes are temporarily stored in the workplace waste accumulation area and transferred to RHWM for treatment and/or disposal (LLNL 2001ao).

A.3.2.2 *Building 804*

Building 804 is a 3,733-gross-square-foot facility in the northeast quadrant of Site 300. This facility is currently used exclusively as the staging area for low-level radioactive wastes generated in any of the Site 300 facilities before the wastes are shipped to a proper disposal site. A small bunker at this facility is currently not being used but may be used in the future (LLNL 2001ao).

Low-level radioactive wastes are generated at bunker firing tables where test assemblies are detonated. The waste debris consists of gravel, wood, steel, aluminum, concrete, plastic, glass, burlap bags, cables, and other inert testing materials. RHWM prepares the containerized gravel at Building 804 for offsite disposal (LLNL 2001ao).

Other specific waste streams handled at Building 804 include empty containers, contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, HEPA filters contaminated with radioactive constituents, nonhazardous residues, metals, and contaminated equipment.

Hazard Assessment

Wastes stored at this facility consist primarily of low-level radioactive wastes. The low-level radioactive wastes consist of depleted uranium and, on rare occasions, small amounts of thorium. Mixed wastes also contain metal components (LLNL 2001ao).

Proper segregation and control of the packaging and handling operations are essential for the safety of personnel and protection of equipment. Operational safety features include characterizing firing table waste to segregate low-level radioactive waste from mixed waste; specifying containers for shipment and disposal or reprocessing of low-level radioactive wastes at an offsite location; following procedures for sampling and analysis, containerization, staging, and certification of wastes; fulfilling record keeping requirements; and conducting radiation measurements. The external radiation measurements for shipping or disposal containers are included on the computerized record keeping system and are also noted on each container (LLNL 2001ao).

Generated Wastes and Effluents

This facility is used primarily as a staging area for low-level radioactive wastes before reconditioning or shipment to an offsite disposal location. No wastes are generated at Building 804 (LLNL 2001ao).

A.3.2.3 *Building 805*

Building 805 is a 6,802-square-foot facility in the southeast quadrant of Site 300, known as the process area. Building 805 is used for machining metal and nonmetal parts; i.e., stainless steel, brass, plastic, etc., and mock explosives. The packaging or repackaging of explosives waste is also performed at this facility prior to storage at the Explosives Waste Storage Facility (EWSF) or shipment to the Explosives Waste Treatment Facility (EWTF) for treatment (LLNL 2002ap).

Hazards Assessment

The major hazard associated with packaging and repackaging waste explosives is the possibility of detonation of the explosives by mishandling. The hazards associated with the machining process involve rotating equipment and toxic chemicals in the explosives waste and mock explosives (LLNL 2002ap).

Generated Wastes and Effluents

Wastes generated during the machining of mock explosives consist of dust. The nonhazardous dust is collected in a air district permitted dust collector and disposed of in the general trash (LLNL 2002ap).

A.3.2.4 *Building 806 Complex*

The Building 806 Complex is located in the process area in the southeast quadrant of Site 300 and consists of Buildings 806A and 806B. This 8,314-gross-square foot complex is used for machining and inspecting explosive parts. Explosives are also temporarily stored at the complex (LLNL 2002ap).

Hazards Assessment

The major hazard associated with this complex is the detonation of explosives during the machining process. Risks also include those associated with the operation of the machinery and chemicals used in the machining process. Machining is performed both with an operator present and remotely from a control room. During remote operations, all operations personnel are alerted, fences are secured with warning lights and alarm systems, and the limited personnel present are restricted to the control room (LLNL 2002ap).

Generated Wastes and Effluents

Wastes contaminated with high explosives are generated in the Building 806 Complex. The water used during the machining process is passed through two filter bags, and the trapped explosives waste is placed in plastic-lined containers for storage and treatment at the EWTF. The filtered water passes through a conical clarifier, settling basin, and weir and then drains to surface impoundments south of the complex. Scrap explosive pieces are wrapped, boxed, and labeled for treatment at the EWTF and storage at the EWSF (LLNL 2002ap).

A.3.2.5 *Building 807*

Building 807 is located in the process area in the southeast quadrant of Site 300 and is used for activities similar to those of the Building 806 Complex. This 1,575-gross-square-foot facility is used to machine and inspect explosives parts and to decontaminate potentially contaminated equipment. Explosives parts are also temporarily stored at the complex (LLNL 2002ap).

Hazards Assessment

The major hazard associated with this building is the detonation of the explosives during the machining process. Risks also include those from the rotation of the machinery and chemicals used in the machining process. Machining is performed both with an operator present and remotely from a control room. During remote operations, all operations personnel are alerted, fences are secured with warning lights and alarm systems, and the limited personnel present are restricted to the control room (LLNL 2002ap).

Generated Wastes and Effluents

Wastes contaminated with high explosives are generated in Building 807. The water used during the machining process is passed through two filter bags, and the trapped explosives waste is placed in plastic-lined containers for storage and treatment at the EWTF. The filtered water passes through a conical clarifier, settling basin, and weir and then drains to surface impoundments south of the complex. Scrap explosive pieces are wrapped, boxed, and labeled for treatment at EWTF and storage at the EWSF (LLNL 2002ap).

A.3.2.6 *Building 809 Complex*

The Building 809 Complex is located in the process area in the southeast portion of Site 300. This 3,005-gross-square-foot complex consists of Buildings 809A, 809B, and 809C. Building 809A is currently being modified to install an isostatic press for pressing explosives powders into parts. Building 809B is under construction as a utilities service building. Building 809C is under construction and will house ovens for preheating explosives powders prior to pressing. A new magazine has also been constructed at this complex (LLNL 2002ap).

Hazards Assessment

The major hazard associated with machining explosives is the possibility of ignition from the forces involved. There are also hazards associated with high temperatures and pressures and the toxic nature of the chemicals in the explosives that present the risk of injury to personnel. Rotating equipment also presents the risk of injury to personnel. Heating and pressing of explosives are conducted remotely, under controlled temperature conditions (LLNL 2002ap).

Operational safety plans are enforced in the Building 809 Complex to ensure personnel safety. During remote operations, all personnel and the process security post operator are alerted, the gate to the area is locked warning lights and alarm systems are activated and the limited personnel present are restricted to the control room (LLNL 2002ap).

Generated Wastes and Effluents

Currently, there are no explosives-contaminated wastes generated at this building complex, but in the future, there will be wastes that will be handled following the process described for Building 817 (LLNL 2002ap).

A.3.2.7 *Building 810 Complex*

The 5,079-gross-square-foot Building 810 Complex is located in the process area, in the southeast quadrant of Site 300, and consists of Buildings 810A, 810B, and 810C. Building 810A and 810B are used to assemble explosives parts into test components. Building 810A is also used for the temporary storage of explosives parts. Building 810C is used for storing nonexplosive parts for test components. The test components may also include beryllium, lithium, tritium, thorium, or depleted uranium (LLNL 2002ap).

Hazards Assessment

The major hazard associated with this complex is the detonation of the explosives by dropping or mishandling. The number of personnel is limited in these buildings (LLNL 2002ap).

Generated Wastes and Effluents

High explosives-contaminated wastes are generated at this complex. Explosives waste is placed in plastic-lined containers for treatment at the EWTF and storage at the EWSF (LLNL 2002ap).

A.3.2.8 *Building 812 Complex*

The Building 812 Complex is an active open-air explosives firing facility. The complex includes five buildings (Buildings 812A, 812B, and 812C, 812D [currently inactive], and 812E), two magazines, and an open-air firing table. Building 812E is currently used to repair and test portable x-ray equipment. The current complex total operational building area is 5,532 gross square feet (LLNL 2001ao).

Hazards Assessment

The common hazards associated with the Building 812 firing facility are handling and firing explosives, high-voltage electrical equipment, toxic and radioactive materials, high levels of ionizing radiation, operational and maintenance equipment, and high-pressure systems. There may be exposure to ionizing radiation from portable radiation generating devices (LLNL 2001ao).

The hazards in the photoprocessing operations are various laboratory reagents, photochemicals, and chemicals in spent developers, fixers, and rinsewaters. When film is processed, the developers and fixers are automatically replenished and the generated waste is captured in separate barrels (LLNL 2001ao).

Formal operational safety procedures have been prepared for the facility and these are supplemented for the peculiarities of individual tests and reviewed by the Hazards Control Department. All explosives are handled, transported, and test fired only while strictly following these procedures. All work with radioactive toxic materials conforms to established health and safety guidelines. Additional restrictions are imposed during the grass fire season (LLNL 2001ao).

Personnel safety is enhanced by positive key control in the explosive firing facilities. Personnel are excluded from areas of x-ray flux by fences, barriers, and/or interlocked access doors and gates. Equipment is electrically isolated from the shot assembly until personnel are under cover. A muster is used for positive control of personnel access to the test area (LLNL 2001ao).

Personnel are not allowed to enter the firing table area after a shot until specific conditions are met, including waiting for a specified period of time in case of malfunction or misfire. Appropriate personal protective equipment is used to re-enter the firing table after experiments involving hazardous materials. Water may be used to put out fires on the table and minimize dust production.

Generated Wastes and Effluents

Debris may consist of gravel, wood, steel, aluminum, concrete, plastic, glass, burlap bags, cables, and other inert testing materials. These wastes may be contaminated with depleted uranium or thorium. Small amounts of metals; e.g., lead, beryllium, copper, barium, vanadium, etc., may also be present (LLNL 2001ao). In the past, tritium was a contaminant at this facility, but tritium experiments will be discontinued at this facility in the future (LLNL 2003i). The detonation debris is characterized to segregate the low-level radioactive waste from hazardous waste. The low-level radioactive waste is placed in containers for recycling or transported to the Building 804 waste staging area. All hazardous wastes are transported to Building 883 for storage prior to transfer to Livermore Site or shipment offsite for disposal (LLNL 2001ao).

The hazardous wastes generated from the photoprocessing operations and the portable x-ray operations include solvents, lubricating fluids, dielectric fluids, and photographic wastes. These nonradioactive wastes are temporarily stored in the workplace waste accumulation area until transferred by RHWM for treatment or offsite disposal (LLNL 2001ao).

A.3.2.9 *Building 817 Complex*

The High Explosives Pressing and Oven Complex, the Building 817 Complex, is located in the southeast quadrant of Site 300. This 2,739-square-foot complex comprises Buildings 817A through 817H and includes laboratories, mechanical equipment areas, a control room, and storage space for the preparation and isostatic pressing of bulk explosives and mock high explosives (LLNL 2002ap).

Building 817A is a control room, Building 817B is the high explosives pressing facility, Building 817C is a temporary storage magazine, and Buildings 817D and 817E are currently inactive, but may become active if needed. Building 817F is the oven facility used for heating and annealing explosives. The oven facility contains two ovens, a scrub water tank and pump unit, an insulated transport cart, and handling trays. Building 817G is the boiler room facility and Building 817H is used for storage of inert parts, pressing bags, and general chemicals (LLNL 2002ap).

Hazards Assessment

The major hazard at this complex is an inadvertent explosion as the result of the handling, heating, and pressing of explosives. There is also the risk of injury to personnel associated with high temperatures and pressures or the toxic chemicals in the explosives. Heating and pressing of explosives are conducted remotely, under controlled temperature conditions. During remote operations, all personnel are alerted, the fenced area is locked, and warning lights and alarm systems are activated. Operating personnel are limited in number and restricted to the control room during remote operations. Explosives are permitted only in approved and posted areas, and an insulated cart is used to transfer hot material from the oven and from pressing operations. The work areas are frequently washed, and equipment, tools, fixtures, and other parts that may have become contaminated are decontaminated. Safety protocol and procedural documentation are used to ensure personnel safety (LLNL 2002ap).

Generated Wastes and Effluents

Wastes contaminated with high explosives are generated in this complex. Water is used in the cleanup process. The high explosives wastewaters are passed through two filter bags, and the trapped explosives waste are placed in plastic-lined containers for treatment at the EWTF and storage at the EWSF. The filtered water passes through a conical clarifier, settling basin, and weir and then drains into a retention tank that pumps automatically to the surface impoundment south of the complex. The scrap explosive pieces are wrapped, boxed, and labeled for treatment at the EWTF and storage at the EWSF (LLNL 2002ap). Other wastes include explosive-contaminated debris such as paper, protective clothing, and laboratory equipment and cleaning solutions.

A.3.2.10 *Building 819*

The Decontamination Facility, Building 819, is located in the southeast quadrant of Site 300. This 811-square-foot facility is used for pesticide mixing and storage, construction material storage, and equipment (vacuum pump) repair. Pesticides are mixed in a small room measuring 6 feet square. Pesticide containers are steam cleaned beneath a canopy adjacent to the facility.

Rinsewaters are collected and stored in tanks prior to treatment and/or disposal by RHWM (LLNL 2002co).

Hazards Assessment

The pesticide chemicals are toxic and care must be taken to prevent uptake by personnel. Operational safety procedures provide that the Hazards Control Department surveys the work area regularly to detect unsafe conditions, personnel wear pesticide cartridge respirators and natural rubber gloves when working with pesticides and take a shower after the work is completed, personnel wear organic vapor respirators and rubber gloves when working with solvents, the pesticides are stored in locked areas, and empty pesticide containers are disposed of properly (LLNL 2002co).

Generated Wastes and Effluents

The rinsewaters from cleaning pesticide containers are stored in tanks and cannot be discharged into the Building 819 drainage system. The tanks are handled by RHWM for proper treatment and disposal. The empty pesticide containers are rinsed thoroughly and inspected by the San Joaquin County Agricultural Commission before disposal at a local municipal landfill. The wastewater generated from the steam-cleaning operations is stored in a retention tank. When the tank is full, its contents are sampled and analyzed. Wastewater is then transferred by RHWM for treatment or disposal (LLNL 2002co).

A.3.2.11 *Building 821*

Building 821 is a 454-square-foot building in the southeast quadrant of Site 300 where flammable liquids are stored for use in the chemistry area (LLNL 2002ap).

Hazards Assessment

The major hazards are exposure to toxic effects of flammable material through inhalation of vapors and absorption by skin contact or ingestion (LLNL 2002ap).

Generated Wastes and Effluents

No waste is generated at Building 821 (LLNL 2002ap).

A.3.2.12 *Building 822*

The Building 822 storage facility is in the southeast quadrant of Site 300. This 296-square-foot building consists of four storage cells (A, B, C, and D) that are used to store nonexplosive controlled materials such as radioactive materials (solid depleted uranium, solid thorium, and tritium), deuterium, lithium hydride, sealed sources (Class 1 and 2 only), mock explosives, and solid beryllium. Explosives and other hazardous materials are not permitted in the building (LLNL 2000u).

Hazards Assessment

Safety features within this building include alarms and warning signs. The cell doors are secured by combination locks and have alarms. Access to the cells is limited to authorized personnel. Even though there are no adverse exposure consequences to onsite workers from normal operations, site personnel may receive exposures from radioactive materials, including sealed sources and depleted uranium, due to container ruptures during transfer operations. Materials are packaged to meet DOT requirements for transportation and would offer no adverse exposure risks unless the containers are breeched (LLNL 2002l, LLNL 2000u).

Generated Wastes and Effluents

This facility is used primarily for the storage of controlled materials; therefore, no wastes are generated (LLNL 2002l).

A.3.2.13 *Building 823 Complex*

The 2,748-square-foot LINAC Radiography Complex, Building 823, is in the southeast quadrant of Site 300 and consists of two buildings. Building 823A contains office space, a darkroom with a radiographic film processor, and control panels for three real-time imaging systems housed in Building 823B. These units include a transportable 9-million-electron-volt, a 2-million-electron-volt, and 120-thousand-electron-volt x-ray machines. Building 823B contains staging and real-time imaging systems, and a doubly encapsulated cobalt-63 isotope source in a lead-shielded radiographic projector. The isotope source is no longer operational and is being stored in Building 823 in a transportainer until it is sent back to the manufacturer for disposal. This complex provides the means for radiographic inspection of pressed explosives parts and weapon test components. After x-ray film has been exposed in Building 823B, it is processed through the automatic film processor in Building 823A. The authorized materials in this facility include explosives, natural and depleted uranium, and beryllium in metallic form. Fissile materials currently are not allowed at Site 300 but may be allowed only after thorough review and approval by Site 300 management and after proper operational safety procedures are applied (LLNL 2002ap).

Building 823B has an earth berm on two sides that provides radiation shielding for the office/control building located east of the berm. The Varian 9-million-electron-volt LINAC is used in Building 823B to beam into the open space directly to the west (LLNL 2002ap).

Hazards Assessment

The potential hazards in the Building 823 Complex arise primarily from the intense levels of radiation associated with the generated x-ray beam, the high voltages associated with the power supplies, and the handling of test units containing explosives, radioactive, or toxic materials. Explosives in powder form are not permitted at this facility, and explosives are not permitted at the facility when fissile materials are present. The number of personnel is limited to five when explosives are present. Protection from inadvertent exposure to x-radiation is provided by physical barriers, warning lights and chimes, safety interlocks, signs, and remote area monitoring. Before starting an x-ray operation, all personnel evacuate the fenced enclosures. A remote area monitor in the complex, which indicates radiation levels on a local readout meter and on a duplicate meter in the control room, activates the warning lights and chimes when radiation levels become high. Flashing magenta lights and pulsed chimes indicate an x-ray exposure is in progress. No one is allowed to enter the area at that time. The operating area is enclosed by a safety fence and all gates are locked during operation of the machine (LLNL 2002ap).

Generated Wastes and Effluents

The wastes generated from this facility include photochemicals, spent fixers and developer, and photochemical rinsewaters. The photochemical rinsewaters are stored in retention tanks and pumped to the surface impoundment. The spent fixers and developers are handled by the materials management group and taken to the Livermore Site for silver recovery (LLNL 2002ap).

A.3.2.14 *Buildings 825, 826, and Building 827 Complex*

The Chemistry Area Complex comprises Buildings 825 and 826 and the Building 827 Complex and is used for processing, developing, and testing explosives. Buildings 825 and 826 are in the southeast quadrant of Site 300 and have areas of 1,224 square feet and 1,742 square feet, respectively. The Building 827 Complex, consisting of Buildings 827A, B, C, D, and E, with office, laboratory, and storage areas, is located in the south-central section of Site 300 and has a total area of 7,744 square feet (LLNL 2002ap).

Building 825 houses mechanical presses for pressing explosives and a Monel detonation sphere. A vacuum gas sampling system associated with the Monel detonation sphere, which measures detonation products, is currently nonoperational (LLNL 2002ap).

Building 826 houses a vertical temperature-controlled mixer for mixing explosives; binders, plasticizers, and other compounds; and a 2-ton mill for mixing extrudable (paste) explosives. A 50-cubic-inch deaerator loader is used for processing the extrudable explosives (LLNL 2002ap).

The Building 827 Complex consists of Buildings 827A, B, C, D, and E. Building 827A contains offices, a control room and a small-scale explosives cell. Building 827B contains a machine shop and inert storage area. Buildings 827C, D, and E are identical buildings each containing two explosives operating cells, an equipment room, an inert storage area, and a temporary explosives storage vault. The complex also contains three steam ovens for drying materials, small ball mills for reducing particle size, a 50-pound deaerator loader for processing extrudable explosives, blenders, slurry kettles for preparing explosives, and slurry-coating equipment. Equipment includes an environmental chamber and associated control and interlock modules, electrical resistance measurement devices, a gas sampling oven, a laser particle-size analyzer, and a computer system (LLNL 2002ap).

Hazards Assessment

Hazards associated with these facilities include the detonation of explosives powder during the pressing process and exposure to the toxics effects through the inhalation of dusts or vapors and absorption by skin contact or ingestion. Pressing explosives is conducted remotely. During remote operations, all personnel are alerted. Hazards also are associated with handling explosives, propellants, pyrotechnics, and oxidizers and burning or detonating materials through impact, frictional heat, shock, electrical arcs, or sparks from static electricity. Hazards also include those associated with a small, enclosed laser. Mixing and loading of the explosives is conducted actively and remotely depending upon the requirements. The fenced area around the building is locked and warning lights and alarm systems are activated. Operating personnel are restricted to Buildings 827A or 827B. Safety documentation, including operational safety plans and the facility safety plans, is used to help ensure personnel safety (LLNL 2002ap).

Generated Wastes and Effluents

Wastes contaminated with high explosives are generated from activities performed in this complex. The explosives-contaminated trash is placed in plastic-lined containers for treatment at the EWTF and storage at the EWSF. Typical wastes include alkaline and acid solutions such as lab-packed solutions; lab-packed waste chemicals; nonhalogenated organic solutions; empty containers; debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, wood and metal parts, and HEPA filters contaminated with explosives and other hazardous constituents; wastewater; residues; metals; flammable liquids; cleaning solutions, including solvents; waste oil with trace gasoline, diesel, organics, and metals; and contaminated equipment.

Water used in the cleanup is passed through two bag filters that trap the explosives waste. The waste is placed in plastic-lined containers for treatment at EWTF and storage at the EWSF. The filtered water is collected in a retention tank where it is sampled prior to being trucked to the permitted surface impoundment or offsite (LLNL 2002ap).

A.3.2.15 *Building 816, Explosive Waste Storage Facility*

The EWSF is in the process area in the southeast quadrant of Site 300. The EWSF consists of a main structure (Building 816) and four earth-covered waste storage magazines and comprises approximately 1,200 square feet. The EWSF is permitted under a hazardous permit issued by the California Department of Toxic Substances Control for 1-year storage of explosives waste. Storage of other hazardous, radioactive, or mixed waste materials is prohibited (LLNL 2002ap).

Hazards Assessment

The major hazard associated with storing waste explosives is the possibility of detonation of the explosives through mishandling (LLNL 2002ap).

Generated Wastes and Effluents

The facility is used as a storage facility. No wastes are generated by this facility (LLNL 2002ap).

A.3.2.16 *Building 845, Explosive Waste Treatment Facility*

The EWTF is a 666-square-foot facility located in the north-central section of Site 300. The EWTF replaces Building 829, which has been closed. The EWTF consists of an earth-covered control room, Building 845A; an inert storage area, Building 845B; a thermal treatment unit (burn cage), an open burn unit (burn pad), and an open detonation unit (detonation pad). The EWTF is permitted under a hazardous waste permit issued by the California Department of Toxic Substance Control for the treatment of explosives waste. Treatment of other hazardous, radioactive, or mixed waste materials is prohibited (LLNL 2002ap).

Hazards Assessment

The main hazard associated with treating waste explosives is the possibility of detonation by mishandling. Personnel are limited in number and operations are conducted remotely. During operations, personnel are restricted to the control room, fencing is secured, and warning lights and alarm system are activated appropriately (LLNL 2002ap).

Generated Wastes and Effluents

Ash resulting from the burning of explosives waste in the thermal treatment cage and open burn unit is collected, weighed, and stored in an approved storage area within the facility. The ash is hazardous and is shipped offsite for proper disposal (LLNL 2002ap).

A.3.2.17 *Building 832 Complex*

The Building 832 Complex is in the southeast quadrant of Site 300 and consists of five buildings labeled 832A through 832E, two magazettes labeled M-832-1 and M-832-2, and the explosives vehicle inspection station, for a total gross area of 10,970 square feet. The Building 832 Complex is the central explosives materials shipping and receiving facility for LLNL, and the facility for shipping and receiving other controlled materials at Site 300 (LLNL 2000u).

Buildings 832A through 832C are storage facilities. Inert nonhazardous materials are stored in Buildings 832A and 832C. Building 832B is limited to the interim storage of explosives and explosives assemblies that may contain other controlled materials; i.e., depleted uranium, thorium, tritium, beryllium, lithium, deuterium, and mock explosives. Long-term storage is not allowed in Building 832B (LLNL 2000u).

Building 832D is limited to shipping and receiving of explosives and explosives assemblies that may contain other controlled materials, and sealed sources. Interim storage is permitted in Building 832D to complete shipping and receiving operations (LLNL 2000u).

Building 832E is limited to shipping and receiving of nonexplosive controlled materials, classified parts, sealed sources, and liquid nitrogen. Explosives and other hazardous materials are not permitted in the building. Interim storage is permitted in Building 832E to complete shipping and receiving operations (LLNL 2000u).

The explosives vehicle inspection station is used to inspect incoming commercial explosives transport vehicles prior to entering the Building 832 Complex. Explosives loading, unloading, and transloading are permitted at the explosives vehicle inspection station (LLNL 2000u).

Hazards Assessment

The primary hazards associated with the Building 832 Complex include exposure to explosives; toxic, reactive, pyrophoric, and carcinogenic materials; and ionizing and non-ionizing radiation. Activities within this complex are controlled by facility and operation safety plans. All work with radioactive or toxic materials conforms to established health and safety guidelines. Safety features include alarms and warning signs. The cell doors are secured by combination locks and are alarmed. Access to these facilities is limited to authorized personnel (LLNL 2000u).

Generated Wastes and Effluents

This complex is used primarily for shipping and receiving explosives and other controlled materials. No hazardous wastes or effluents are generated during normal facility operations. The quantity of waste generated is less than one cubic meter per year (LLNL 2000u).

A.3.2.18 *Building 834 Complex*

The Thermal Test Complex, Building 834, is in the southeast quadrant of Site 300 and consists of 12 buildings labeled 834A through 834H and 834J through 834M. The total gross area of these buildings is 8,267 square feet. This complex is used primarily for the thermal testing (cycling, shocking, and soaking) of specimens that may contain explosives or toxic materials and mock high explosives (LLNL 2002j). The use of a portable 9-million electron volts LINAC has been approved for occasional use at this facility.

The complex consists of four test buildings (834E, G, H, and J) three mechanical equipment buildings (834B, C, and D) three storage buildings (834F, K, and L) a storage magazine (834M) and a control building (834A). The test buildings, also known as test cells, are behind large earth berms. The control building and the mechanical equipment buildings are designed to withstand accidental detonation of explosives in the test cells (LLNL 2002j).

The principal operation here is the thermal testing of specimens that may contain explosives, radioactive, and/or toxic materials. During testing, a component is exposed to a given temperature for a specified time. The component may be cycled between cold and hot temperatures for hours or days and may be thermally shocked by introducing hot or cold air over the specimen (LLNL 2002j).

Hazards Assessment

A variety of materials and equipment are tested in this complex. Authorized materials used include high explosives, mock explosives, depleted uranium, thorium, lithium, and beryllium in metallic form (LLNL 2002j).

All operations in the Building 834 Complex are controlled by the facility safety plan (LLNL 2002bt). The plan ensures that explosives and explosives-contaminated materials are permitted only in test cells. No drilling, machining, sawing, or sanding of explosives and no operation requiring blending or mixing of explosives with other materials such as plastics, binders, adhesives, or metal dusts is permitted. Hazards also include those associated with the occasional use of a portable LINAC unit. Safety features in this complex include alarms and warning signs. The cell doors are secured by combination locks and have alarms. Access to these facilities is limited to authorized personnel (LLNL 2002j).

Generated Wastes and Effluents

This complex is used primarily as a test facility, and there are no hazardous wastes generated. Occasionally, scrap and solid waste are left after testing is completed. The quantity of solid waste generated is less than 1 cubic meter per year (LLNL 2002bt).

A.3.2.19 *Building 836 Complex*

The Dynamic Test Complex, Building 836, is in the southeast quadrant and consists of four buildings, 836A through 836D, with a total area of 13,288 square feet. The complex is used for the dynamic (vibration shock) testing of specimens containing explosives, radioactive materials, and/or toxic materials. An electrodynamic shaker can be programmed by computer to perform sine and random vibration and transient pulses. These tests can be performed at various temperatures in a thermal chamber. A portable 9-million-electron-volt LINAC is approved for occasional use at this complex (LLNL 2002bu).

The Dynamic Test Complex consists of a reinforced concrete control building (836A); a steel mechanical equipment and storage building (836B); an earth-covered, reinforced-concrete test cell (836C); and a reinforced-concrete electrodynamic shaker building (836D) (LLNL 2002bu).

Each test cell houses a large reaction mass needed as a counterweight and its associated hardware. This equipment is used in the testing and evaluation of various weapons systems and mechanical equipment subjected to vibration and shock environments. The complex has also been used for shock and vibration testing of rocket motors, seismic qualification of turbine-generator sets, and performance analysis of the rock bolts used in mine-tunnel construction (LLNL 2002bu).

Hazards Assessment

A variety of materials and equipment are tested in this complex. A portable 9-million-electron-volt LINAC is approved for occasional use at this complex. Authorized materials include explosives, mock high explosives, metallic beryllium, depleted uranium, thorium, and lithium hydride (LLNL 2002bu). In the thermal and dynamic tests, there is a possibility of putting sufficient energy into the test to detonate the explosives (LLNL 2002bu).

Personnel and operational safety controls are in effect. Tests with a moderate to high risk of reaction are done remotely. Remote procedures are required for tests involving mechanical shock or extrusion to the explosives and when the temperature of the explosives is above 170 degrees

Fahrenheit (^oF). These remote operations are controlled from a central control room protected from blast and fragments. During dynamic testing, musters limit the areas that personnel can enter. Continuous air monitoring is used during the test operation (LLNL 2002bu).

Fissile material and explosives are not permitted within a test assembly or within a facility at the same time. Explosives or explosive-contaminated material is permitted only in test cells. No operation is permitted that intentionally generates explosives dust or powder or that requires blending or mixing of explosives with other materials such as plastic, binders, glues, adhesives, or metal dust (LLNL 2002bu).

When a test cell has been flushed with nitrogen during a thermal conditioning test, the air within the facility is monitored prior to allowing personnel to re-enter the facility (LLNL 2002bu).

Generated Wastes and Effluents

This complex is used primarily for dynamic testing of equipment containing hazardous and toxic materials. Typical wastes would include alkaline and acid solutions; lab-packed waste chemicals; nonhalogenated organic solutions; empty containers; debris such as contaminated paper and rags, protective clothing, glassware, plasticware, tubing and fittings, and wood and metal parts; wastewater; residues; metals; cleaning solutions, including solvents; waste oil with trace gasoline, diesel, organics, and metals;, and contaminated equipment. Occasionally, scrap and solid waste is left over when testing is completed. The quantity of this solid waste is less than 1 cubic meter per year (LLNL 2002bu).

A.3.2.20 *Building 850 Complex*

The Hydrodynamics Test Facility, Building 850 Complex, is an explosives test facility. This 5,840-gross-square-foot complex consists of Bunker 850 and a magazette in the northwest quadrant of the site (called the west firing area) and comprises an active firing, explosives test, and high-speed camera repair and test facility. The multidiagnostic facility includes a permanently mounted, smooth-bore, 155-millimeter gun for conducting impact experiments, high-speed rotating-mirror cameras, gigalumen light sources, portable flash x-ray sources, and various other diagnostic equipment (LLNL 2001ao).

This facility has an outdoor detonation firing table with gravel covered pads for stands of concrete, wood, or steel. During an experiment, the explosive is placed on the test stand and fired. The firing debris may consist of wood, plastic, wiring, and gravel. This debris is potentially contaminated with high explosives, beryllium, and depleted uranium (LLNL 2001ao).

Hazards Assessment

The common hazards associated with the firing facilities are those associated with the handling and firing of explosives, high-voltage equipment, toxic and radioactive materials, cranes and machine tools, high-pressure systems, and high levels of ionizing radiation. Potential hazards include firing malfunctions, misfires, and grass fires (LLNL 2001ao).

The hazard associated with the high-speed photographic equipment is use of high-speed rotors. Some camera rotors are made of beryllium; if these rotors are allowed to revolve at too high a speed, they will come apart, causing damage and scattering parts of the beryllium rotor around the camera room (LLNL 2001ao).

HEPA filtration systems in the intake of the open-air bunker ventilation system mitigate any hazardous material released into the facility environment. The risk of an inadvertent firing of a propellant-driven gun or an improper projectile trajectory is low due to design and administrative controls. Formal operational safety procedures have been prepared for the facility as a whole; these are supplemented for the unique requirements of individual tests and are reviewed by the Hazards Control Department. All explosives are handled, transported, and test fired following these procedures. All work with radioactive and toxic materials conforms to established health and safety guidelines. Additional restrictions are imposed during the grass fire season (LLNL 2001ao).

Personnel safety is enhanced by positive key control of the various phases and aspects of the operation, including the enabling of the firing console. Personnel are excluded from areas of x-ray flux by fences, barriers, and interlocked access doors and gates. Equipment is electrically isolated from the shot assembly until personnel are under cover. A muster is used for positive control of personnel access to the test area (LLNL 2001ao).

Following the shot, personnel are not allowed to enter the firing table area until specific conditions are met, including waiting for prespecified periods of time in case of malfunction or misfire. Appropriate personal protective equipment is used to re-enter the firing table after experiments involving hazardous materials. Water may be used to put out fires on the table and minimize dust production. Finally, table gravel is changed if the beryllium and radioactivity levels are above the derived working limits: 500 micrograms per gram for beryllium, 5,000 picocuries per gram for alpha emitters, and 10,000 picocuries per gram for beta or gamma radiation (LLNL 2001ao).

Generated Wastes and Effluents

The firing table debris consists of gravel and fragments of wood, metal, and glass; larger debris consists of tent poles, wood, steel, aluminum, concrete, plastic, glass, burlap bags, cables, and other inert testing materials. These wastes may be contaminated with low levels of depleted uranium and thorium. Small amounts of lead, beryllium, copper, barium, and vanadium may also be present (LLNL 2001ao). In the past, tritium was a contaminant at this facility, but tritium experiments will be discontinued at this facility in the future (LLNL 2003i). Typical wastes would include alkaline and acid solutions, including lab-packed solutions; lab-packed waste chemicals; nonhalogenated organic solutions; empty containers; debris such as contaminated paper and rags, protective clothing, and other test debris contaminated with explosives and other hazardous constituents; wastewater; cleaning solutions, including solvents; and contaminated equipment (LLNL 2001ao).

The firing table debris is characterized to segregate the low-level radioactive waste from chemically hazardous waste. The former is placed in containers and transported to the Building 804 waste staging area. All hazardous wastes (nonexplosive-contaminated) are transported to Building 883 for storage prior to shipment to Livermore Site for treatment or disposal at offsite locations (LLNL 2001ao).

A.3.2.21 *Building 851*

The Hydrodynamics Test Facility, Building 851, is part of the explosive test facility operations. This 13,681-gross-square-foot complex is in the northwest quadrant of the site and houses a LINAC, a laser room, several laboratories, a portable x-ray room, several shop areas, and offices (LLNL 2001ao).

Building 851 includes an open-air firing table of gravel-covered pads with stands of concrete, wood, or steel. During an experiment, an explosive device is placed on the test stand and fired. The firing debris may consist of wood, plastic, wiring, and gravel. The debris is potentially contaminated with unexpended explosives, beryllium, and depleted uranium (LLNL 2001ao).

Building 851 is equipped for the radiography of explosives devices during intentional detonation testing, including high-speed rotating-mirror cameras; optical interferometry for precise, free-surface velocity measurements; electronic pin timing diagnostics; and various other photoprocessing operations that involve both manual and automatic film and paper developing (LLNL 2001ao).

Hazards Assessment

The common hazards associated with the firing facilities are handling and firing explosives, high voltages, toxic and radioactive materials, high levels of ionizing radiation, firing malfunctions and misfires, grass fires, lasers, cranes and machine tools, and high pressure systems (LLNL 2001ao).

The hazards associated with the photoprocessing operations are laboratory reagents, photochemicals, and chemicals in spent developers, fixers, and rinsewaters. When film is processed, the developers and fixers are automatically replenished; and the generated waste is captured in separate barrels (LLNL 2001ao).

The hazard associated with the high-speed photographic equipment is use of high-speed rotors. Some camera rotors are made of beryllium; if these rotors are allowed to revolve at too high a speed, they will come apart, causing damage and scattering parts of the beryllium rotor around the camera room (LLNL 2001ao).

Formal operational safety plans have been prepared for the facility as a whole; these are supplemented for the unique requirements of individual tests and reviewed by the Hazards Control Department. All explosives are handled, transported, and test fired strictly following these procedures. All work with radioactive materials and with toxic materials conforms to established health and safety guidelines. Additional restrictions are imposed during the grass fire season (LLNL 2001ao).

Personnel safety is enhanced by positive key control of the various phases and aspects of the operation, including the enabling of the firing console. Personnel are excluded from areas of x-ray flux by fences, barriers, and interlocked access doors and gates. The interferometer room is also interlocked. Equipment is electrically isolated from the shot assembly until personnel are under cover. A muster is used for positive control of personnel access to the test area (LLNL 2001ao).

Following a shot, personnel are not allowed to enter the firing table area until specific conditions are met, including waiting for a prespecified period of time in case of malfunction or misfire. Appropriate personal protective equipment is used to re-enter the firing table after experiments involving hazardous materials. Water may be used to put out fires on the table and minimize dust production. Finally, table gravel is changed if the beryllium and radioactivity levels are above the derived working limits: 500 micrograms per gram for beryllium, 5,000 picocuries per gram for alpha emitters, and 10,000 picocuries per gram for beta and gamma radiation (LLNL 2001ao).

Generated Wastes and Effluents

The firing table debris consists of gravel and fragments of wood, metal, and glass; larger debris consists of tent poles, wood, steel, aluminum, concrete, plastic, glass, burlap bags, cables, and other inert testing materials. These wastes may be contaminated with low levels of depleted uranium and thorium. Small amounts of lead, beryllium, copper, barium, and vanadium may also be present (LLNL 2001ao). In the past, tritium has been a contaminant at this facility and it will continue to be so in the future (LLNL 2003i).

The firing table debris is characterized to segregate the low-level radioactive waste from chemically hazardous waste. The former is placed in containers and transported to the Building 804 waste staging area. All hazardous wastes (nonexplosive-contaminated) are transported to Building 883 for storage prior to shipment to Livermore Site for treatment or to offsite disposal facilities (LLNL 2001ao).

The photoprocessors automatically develop and fix film, and the waste generated is captured in separate barrels. This hazardous waste is taken from the barrels to the containers at the satellite accumulation area outside of the building. These containers are inspected weekly and properly labeled. These wastes in containers are temporarily stored in this area and transferred by RHWM to the Livermore Site for treatment and/or disposal at offsite facilities (LLNL 2001ao).

A.3.2.22 *Building 854 Complex*

The Dynamic Test Complex, Building 854, is in the southwest quadrant of Site 300. This 11,216-square-foot complex consists of 10 buildings, 854A through 854H, 854J, and 854V, originally designed for the vibration and physical shock testing of assemblies containing hazardous materials at various temperatures. During its operating life, a variety of materials were tested in this complex, including explosives, natural uranium, depleted uranium, thorium, beryllium in metallic form, and fissile and other radioactive materials (LLNL 2002j).

Buildings in the complex, with the exceptions of Buildings 854A, H, and V, are inactive or used as industrial storage while awaiting demolition. Current operations at these facilities (Buildings 854B-G, J) consist of monitoring and surveillance activities (LLNL 2002j). Building 854A, H, and V (2,458 square feet, 3,184 square feet, and 500 square feet, respectively) currently are used as part of the Site 300 Response Training Facility. LLNL conducts emergency response exercises at Site 300, which simulate field-implemented weapon disarmament. Explosives training devices are assembled in Building 854H. Any intentional explosives detonation activities will be performed at explosives test facilities by qualified personnel. Non-LLNL personnel performing explosives work will be observed by qualified LLNL personnel who are familiar with Site 300 safety controls and procedures.

Hazards Assessment

General industrial hazardous operations in this facility are associated with decommissioning powered equipment and include solvents, oils, regulated metals, and compressed gases (LLNL 2002j). Building 854H hazards include exposure to explosive assemblies. The exercises use a number of Site 300 facilities in their current configuration. Minor modifications involving the construction of fences within and around Building 854H would be required for training activities (DOE 2002n).

Generated Wastes and Effluents

Hazardous waste and nonhazardous waste produced during decommissioning of the machine shop include spent halogenated and nonhalogenated solvent solutions (both organic and inorganic), petroleum and mineral-based oils, empty containers, metal filings, and contaminated equipment (LLNL 2002j). No wastes are associated with the explosives training facility.

A.3.2.23 *Building 857*

The Materials Management Storage Facility, Building 857, is in the southwest quadrant of Site 300. This 440-gross-square-foot facility is used to store explosives and explosive assemblies that may contain depleted uranium, thorium, and mock explosives (LLNL 2000u).

Hazards Assessment

The explosives are properly packaged and monitored by periodic inspections. There is no compatibility problem in this facility because the explosives and detonators are not stored together, and only explosives of the same storage group are allowed to be stored together (LLNL 2000u).

Safety features in this building include alarms and warning signs. The cell doors are secured by combination locks and have alarms. Access to the cells is limited to authorized personnel (LLNL 2000u).

Generated Wastes and Effluents

This facility is used for the long-term storage of explosives and explosives assemblies, and there are no operational-generated wastes or effluents. Occasionally, maintenance and support activities generate waste.

A.3.2.24 *Building 883*

The RHWM Container Storage Facility, Building 883, is located in the southeast quadrant of Site 300. This building consists of two sections. The southern section of the building is a RCRA-permitted facility, which consists of a fenced, covered area measuring approximately 1,733 square feet and surrounded by a concrete berm. Building 883 is used to store nonexplosive, nonradioactive hazardous wastes from generator facilities within Site 300. The northern section of Building 883 houses a waste accumulation area. The waste accumulation area is used to accumulate waste for up to 90 days for characterization and/or repackaging. In addition to the waste allowed in the permitted facility, the waste accumulation area will accept some radiological materials, radioactive and mixed waste, improperly packaged waste or waste in damaged containers, and improperly characterized waste. Generators identify and package waste and then transfer it to Building 883 where it is stored prior to shipment to the Livermore Site or offsite for disposal (LLNL 2001av).

Hazards Assessment

The hazards at this facility involve personnel exposures to hazardous materials including aqueous wastes, flammable liquids, acids, caustics, oxidizers, flammable solids, other toxic materials, and PCB-contaminated materials. There are no radioactive wastes stored in the RCRA-permitted southern section of this facility (LLNL 2001aj).

Generated Wastes and Effluents

This facility stores wastes generated at Site 300 facilities. Typical stored wastes include acids (liquids), asbestos, combustible liquids, compressed gases, flammable liquids, halogenated and nonhalogenated solvents, lab packs, laboratory debris (solids), mercury and mercury-contaminated waste, miscellaneous chemical waste and contaminated debris, mixed waste (liquid/solid waste containing both hazardous and radioactive constituents), oils (liquid/solid), PCBs (liquid/solid), paints (liquid/solid), photochemicals, liquid poisons, radioactive waste (liquid/solid), reactive materials, and wastewaters (LLNL 2001av).

A.3.2.25 *Explosives Storage Magazines*

All explosives at Site 300 are stored in vaults or bunkers called magazines or magazettes. There are about 60 magazines located throughout the site, with floor areas typically ranging from 50 to 500 square feet.

A magazine is defined as an approved structure specifically designed for the storage of explosives, excluding operating buildings. A storage magazine is used for the long-term storage of bulk explosives and assemblies. A service or ready magazine is used for short-term (maximum of 180 days) storage of explosives and assemblies currently being used in an operation. A magazette is a small magazine (not large enough for an entry) used to store explosives that require separate storage (LLNL 2000u).

In addition to these storage magazines, a laboratory or building may contain a storage vault, which is typically a locked room or cabinet, for short-term storage of explosives that are currently being used in the operations (LLNL 2000u).

Hazards Assessment

Proper packaging, explosives deterioration, and chemical compatibility are the major areas of safety concern. Packaging is monitored by periodic inspection of the magazines. Compatibility problems are controlled by assignment of explosives into storage compatibility groups and the storage review program is designed to control the use of explosives that have deteriorated (LLNL 2000u).

Each magazine has an associated weight limit, and the weight limit signs are posted near the entrance to the magazine. An inventory record is kept for each magazine and reflects the actual weight stored in the magazine. Storage magazines are inventoried once every 6 months and service magazines are inventoried every 3 months to verify that the weight of their contents is equal to or less than the posted weight limits (LLNL 2000u).

The safety and operational controls are described below (LLNL 2000u).

- Explosive assembly components are the only materials stored in the magazines.
- Propellants containing nitrocellulose vary widely with respect to stability, and the decomposition of some may lead to incidents of spontaneous ignition. There is a special surveillance system program for these propellants. One sample from each lot or batch is designated as a control item and is inspected annually. Deteriorated propellants are sent to disposal.
- Explosives devices such as actuators, detonators, squibs, and ammunition are never retained beyond the manufacturer's recommended shelf life.
- No smoking is permitted in the magazine area out to a distance of 50 feet.
- Most magazines are vented. Some magazines may require air conditioning or special ventilation systems to reduce deterioration of explosives due to hot, stagnant conditions. For safety reasons air conditioning is also used in some instances to prevent overheating.
- Empty explosives containers must be marked as empty, but may not be removed from the magazines. Packaging materials such as wood and paper are handled as explosives-contaminated waste and are removed from the magazine.
- The magazine areas are equipped with emergency telephones. There are posted personnel limits for each magazine area and only qualified personnel are allowed.

Generated Wastes and Effluents

The magazines are used for storage of explosives and explosive assemblies; no explosive wastes are generated in them. Only small quantities of packaging materials are handled as explosives-contaminated wastes.

A.3.2.26 *High Explosives Rinsewater Surface Impoundment Ponds*

Two connected surface water impoundments are in the southeast quadrant of Site 300. These impoundments were constructed in response to a Central Valley Regional Water Quality Control prohibition against discharge of nonhazardous rinsewaters to the ground surface or to unlined basins (LLNL 2002ap). Wastewater generated in Buildings 806, 807, 809, 817, and 829 passes through filter bags, a conical clarifier, a settling basin, and a weir before entering the surface impoundments (LLNL 2000z). The impoundment ponds are comprised of an upper and lower pond that together comprise approximately 42,000 square feet. The basins are lined with 2 feet of clay and a 60-mil thick, high-density polyethylene synthetic liner (LLNL 2002ap). A leachate collection and removal system, installed between the high-density polyethylene liner and the clay liners, allows the system to be monitored for leaks (LLNL 2002cr). Process and photo rinsewater from the process area, chemistry area, and B-Division firing areas are also discharged into the surface impoundments (LLNL 2002ap).

Hazards Assessment

The major hazards associated with the impoundments are slips and falls and natural hazards such as rattlesnakes, scorpions, spiders, etc. (LLNL 2002ap).

Generated Wastes and Effluents

Typically, no waste is generated at the surface impoundments. However, the liners are nearing the end of their predicted life span and will be replaced, probably during calendar year 2004. Replacing the liners will result in removal of the sludge, recently characterized as nonhazardous, as well as the old liners (LLNL 2002ap).

A.3.2.27 *Security, Medical, and Emergency Response Facilities and Services*

The security, medical, and emergency response facilities are in the southeast quadrant of Site 300. Building 882 (4,912 gross square feet) houses the Protective Services Division communication center. Building 889 (2,709 gross square feet) houses the badge office and the medical center, which provides services including physicals, blood tests, and record keeping. Building 890 (6,752 gross square feet) houses the Site 300 Fire Department, which not only provides services to the 11-square-mile test site, but also responds to emergencies along Corral Hollow Road and surrounding regions under mutual aid agreements. The Fire Station also provides decontamination facilities that are shared with Building 889 (DOE/UC 2000).

Biomedical wastes generated from the medical facility include needles, syringes, gauze, gloves, and other materials that could be contaminated with infectious agents. These wastes are transported to BBRP at Building 361 for autoclaving. Spent alcohols are also generated. All wastes are handled by RHWM for proper disposal. The LLNL emergency response capabilities for the Livermore Site and Site 300 are described in Appendix I.

A.3.3 No Action Alternative, Site 300

This section describes the projects and programs under the No Action Alternative for Site 300. Projects required to maintain the existing infrastructure, such as building maintenance, minor modification to buildings, general landscaping, road maintenance, and similar support activities, are part of the No Action Alternative and are described here. Operational modifications to existing projects, projects involving new facilities or maintenance, and major deactivation and D&D projects are summarized in Table A.3.3–1. Figure A.3.3–1 shows the locations of these projects. A list of all D&D projects at Site 300 is provided in Table A.3.3–2.

TABLE A.3.3–1.—*Site 300 Program Projections*

Project Name	Square Feet	Map Location
No Action Alternative		
Site 300 Revitalization Project	N/A	N1
Site 300 Wetlands Enhancement	N/A	N2
Site 300 Tritium Use	N/A	a
Site 300 as a Response Training Facility	N/A	N3
Site Utilities Upgrade (SURUP)	N/A	a
Remove and Replace Offices	20,000/year	a
Deactivation, Decommissioning, Demolition	20,202	b
Proposed Action would include the following projects in addition to the No Action Alternative projects		
High Explosives Development Center	23,000	P1
Energetic Materials Processing Center	40,000	P2
Deactivation, Decommissioning, Demolition	109,333	b
Reduced Operation Alternative would affect the following project		
Reduce number of hydroshots at Site 300	N/A	a

Source: Original.
a several site-wide locations.
b See Table A.3.3–2 for Site 300 Deactivation, Decommissioning, and Demolition projects.

TABLE A.3.3–2.—*Site 300 Deactivation, Decommissioning, and Demolition Projects*

Facility Number	Facility Name	Square Feet	Waste Generation (LLW, MLLW, transuranic, solid sanitary waste, etc.) (tons)
No Action Alternative			
808	Vacant	1,484	0.742
814	Vacant	2,122	1.061
820	Vacant	2,208	1.104
838	Vacant	601	0.3005
840A	Vacant	388	0.194
840B	Vacant	389	0.1945
854B	Dynamic test facility	331	0.1655
854C	Dynamic test facility	1,623	0.8115
854D	Dynamic test facility	331	0.1655
854E	Dynamic test facility	905	0.4525
854F	Dynamic test facility	826	0.413
854G	Dynamic test facility	1,278	0.639
854J	Dynamic test facility	5,316	NA
865C	Advanced Test	2,400	1.2
Proposed Action Includes all the projects under the No Action Alternative and the following additional projects			
OSM23	Magazine - storage vault	3,970	NA
OSM24	Magazine - storage vault	560	NA
805	HE assembly/machining	6,802	3.401
806A	HE machining	3,408	1.704
806B	HE machining	4,074	2.037
806C	HE machining	640	0.32
806D	HE machining	192	0.096
807	HE machining	1,575	0.7875
812A	Explosives test	2,283	1.1415
812D	Explosives test	241	0.1205
812E	Explosives test	1,295	0.6475
813	Change house	2,810	NA
817A	HE pressing	459	0.2295
817B	HE pressing	639	0.3195
817C	HE Storage	185	0.0925
817E	Vacant	183	0.0915
817F	HE pressing	565	0.2825
817G	HE pressing	217	0.1085
817H	HE pressing	859	0.4295
821	Chemistry storage	454	NA
823A	LINAC radiography	1,020	0.51
823B	LINAC radiography	1,728	0.864
825	Chem process	1,323	NA
826	Chem process	1,668	NA

TABLE A.3.3–2.—*Site 300 Deactivation, Decommissioning, and Demolition Projects (continued)*

Facility Number	Facility Name	Square Feet	Waste Generation (LLW, MLLW, transuranic, solid sanitary waste, etc.) (tons)
828A	Inactive	212	NA
828B	Inactive	199	NA
828C	Inactive	258	NA
832F	Storage	2,995	1.4975
854A	Response training	2,458	1.229
855A	Disassembly facility	685	0.3425
855B	Disassembly facility	637	0.3185
855C	Disassembly facility	612	0.306
856	Industrial storage	1,484	0.742
858	Drop tower complex	1,460	0.73
858A	Storage	865	0.4325
865	Advanced test	60,318	30.159

Source: LLNL 2003cj.
HE = high explosive; LINAC = LLNL Electron-Positron Accelerator; LLW = low-level waste; MLLW = mixed low-level waste; NA = Not available. Data will be in separate NEPA documentation for the facility.

A.3.3.1 *Site 300 Revitalization Project*

Site 300's infrastructure was revitalized in the 1990s. The project was essential to provide the needed infrastructure to support LLNL programs such as stockpile stewardship. The Site 300 revitalization project included improvements to the main entrance and the heavily traveled roads going up to the firing areas and construction of the automated central control post. The revitalization project also included upgrades to the flash x-ray radiographic machine, the many beam velocimeter, and other related hydrotest diagnostics.

The final phase of the Site 300 revitalization project involves improvements to the water system by establishing a connection and line extension to the San Francisco Hetch Hetchy aqueduct. Onsite water pipelines have been extended and upgraded and are currently waiting for the distribution of water to begin (LLNL 2000a).

A.3.3.2 *Site 300 Wetlands Enhancement Project*

Continued operations at Site 300 would remove up to 0.62 acre of wetland habitat. LLNL would mitigate the 0.62-acre artificial wetland removal by protecting and enhancing selected areas and increasing breeding opportunities for the California red-legged frog and California tiger salamander. A minimum of 1.86 acres; i.e., a 3:1 replacement ratio, of wetland habitat would be enhanced and managed for these two species. Two mitigation sites for enhancement would include the wetlands at Mid Elk Ravine near the Building 812 complex and the seep at the Super High Altitude Research Project (SHARP) Facility, Building 865. A third site, the Oasis, is designated for set-aside and monitoring.

A.3.3.3 *Site 300 as a Response Training Facility*

LLNL would conduct emergency response exercises at Site 300 that would simulate field-implemented weapon disarmament. Explosives training devices would be assembled in Building 854H. Setup and firing of explosives systems would be done by qualified DoD explosive ordinance disposal personnel under the observation of a limited number of LLNL personnel who are familiar with Site 300 safety controls and procedures. The exercises would use a number of Site 300 facilities in their current configuration. Minor modifications involving the construction of fences within and around Building 854H have occurred (DOE 2002n).

A.3.3.4 *Site 300 Tritium Use*

Each facility could have 20 milligrams of tritium resulting in a credible release scenario of this amount. The need to perform several intentional detonation experiments with a few micrograms of tritium and a small number of experiments with a few milligrams of tritium is anticipated and serves as the basis for the annual emissions value of 20 milligrams. This annual emissions value is considered a maximum amount. The actual emissions may vary widely depending on the specific experiments needed to support the programmatic mission.

In addition, as part of the No Action Alternative, LLNL would suspend the performance of all tritium experiments at Buildings 812 and 850. Because experiments that do not contain tritium would likely contain other radioisotopes, no reduction in the level of other low-level radioactive waste generated is anticipated.

A.3.3.5 *Site Utilities Upgrade*

Significant replacements and life extension improvements (over and above normal repair by replacement) would be required for LLNL's utility systems at Site 300. The scope of the project would include various upgrades to mechanical utilities including upgrades to the Site 300 heating and cooling systems, potable water system, and a transmission line looping system at Site 300. Asbestos-containing building materials would also be addressed by the implementation of an asbestos management program which would include surveying buildings and structures, removing damaged asbestos-containing building materials discovered during the surveys, and as-needed asbestos abatement (LLNL 2003cj).

A.3.3.6 *Remove and Replace Offices*

This project would consist of the removal, relocation, and replacement of temporary facilities. These facilities consist of trailers and modular units that house temporary offices. The facilities would be replaced by modular or permanent structures in previously developed areas and would include site preparation and construction of new parking areas or improvement to existing parking areas.

Land disturbance associated with the demolition and new construction would be minimal. Sites would be evaluated for archaeological and biological impacts prior to, and in the case of, potential archaeological impacts during new construction activities. Debris from the demolition and construction process would be handled and disposed of (or recycled, if appropriate) in accordance with established LLNL procedures.

A.3.3.7 *Deactivation, Decommissioning, and Demolition Projects*

This project would D&D 14 excess facilities at Site 300, encompassing 20,200 gross square feet. Facility deactivation could include disposition of stored or surplus materials that may be potentially contaminated. These materials and equipment are designated as legacy items, meaning there is no identified sponsor or program. Most legacy materials are materials that were placed in storage or set aside for a future need that never materialized.

Deactivation support activities could include material abatement, characterization, spot decontamination, material containment, spill cleanup, waste packaging, and disposal. Buildings that are obsolete and too expensive to rehabilitate would undergo demolition. The demolition effort would include electrical and mechanical isolation from the LLNL utility grid; sampling for contamination, characterization, and proper disposal of all subsystems and components; and dismantling and disposal of the structures. Where feasible, building materials that could be recovered would be segregated and transported offsite for recycling.

The list of excess facilities, including gross square footage and estimated waste generation, is provided in Table A.3.3–2.

A.3.4 Proposed Action, Site 300

The Proposed Action at Site 300 would include the projects and programs described under the No Action Alternative (Section A.3.3) and the additional projects and programs described in this section. Planned projects and programs are listed in Table A.3.3–1. Figure A.3.3–1 shows the locations of these projects.

A.3.4.1 *High Explosives Development Center*

The High Explosives Development Center (HEDC) Project would construct approximately 23,000 square feet of new buildings and renovate the existing Building 827 complex located in the south-central section of Site 300. This project would consolidate operations currently conducted in Buildings 825 and 826 and the Building 827 complex. The HEDC will modernize and replace chemistry and materials science facilities built in the 1950’s and 1960’s at Site 300. These facilities must be rehabilitated or replaced to keep pace with the future work envisioned for mission-critical activities of the supporting facilities at Site 300 such as the Contained Firing Facility, the EMPC, and weapons life extension programs.

Operations and equipment would include mechanical pressing; vertical temperature-controlled mixers for mixing explosives binders, plasticizers, and other compounds; a 50-cubic-inch deaerator loader for processing the extrudable explosives; vacuum ovens for drying materials; mills for reducing particle sizes; a loader for processing extrudable explosives; blenders and kettles for preparing explosives; an environmental chamber and associated control and interlock modules; electrical resistance measurement devices; a gas sampling oven; and a computer system (LLNL 2003cj, LLNL 2002ap).

A.3.4.2 *Energetic Materials Processing Center Project*

Existing energetic materials processing facilities and equipment at Site 300 are becoming obsolete and inadequate to meet LLNL requirements. This project is intended to move the operations currently conducted in Buildings 805, 806, 807, 810A-C, 813, and 823A-B into a new modern facility. The Building 810A-C complex would be retained for some assembly operations currently conducted there and for waste package operations currently conducted in Building 805. All other facilities would be demolished (see Section A.3.4.3). The proposed Energetic Materials Processing Center (EMPC) would be located at the Site 300 process area in the vicinity of the Magazine 21-24 loop. The project would include the construction of a new 40,000-gross-square-foot processing facility and four magazines, two capable of storing 1,000 pounds of high explosives and two capable of storing 500 pounds of explosives. Typical explosives anticipated to be used in EMPC are the same as those currently in use at Site 300 and include HMX, PETN, RDX, TATB, and TNT. The EMPC is required to provide ongoing energetic materials processing capabilities which, when combined with increased computational capabilities, will add greatly to the understanding of weapons physics resulting in increased confidence in certification of the stockpile. The EMPC would house explosives machining, pressing, assembly, inspection, and radiography. Additionally, the facility would provide a machine shop, offices, storage, showers/change room facilities, equipment rooms, and miscellaneous support spaces (LLNL 2002ap).

Because the EMPC would replace certain functions in Buildings 805, 806, 810A-C, 813, and 823A-B, impacts from EMPC operations would be similar to those from existing operations in those buildings. For example, the facilities that EMPC would replace have approximately 7 employees. The EMPC would have 7 to 10 employees. Process water consumption would consist primarily of water sprayed on explosives during machining and washdowns, which would be similar to current usage in the process area facilities. Electric power consumption could decrease slightly from current levels as a result of energy conservation measures that would be designed into the new facility. Impacts to other environmental resource areas as a result of EMPC operations would remain unchanged. The facility design and operation would include careful attention to Federal, state, and local environmental laws and regulations.

Construction of the EMPC would occur over a period of approximately 2 years and would employ approximately 75 workers during peak construction periods. Site improvements would include clearing and grading approximately 2.5 acres of grassland for the building, magazines, roadways, and parking area. Existing utilities would be extended approximately 2,500 feet to the new building. The extension of utilities would involve minor trenching. Construction debris and any excess soils would be analyzed and disposed of in accordance with Federal, state, and local regulations, applicable DOE Orders, and LLNL procedures.

Construction activities would result in short-term impacts to air quality in the form of fugitive dust and emissions from construction equipment and motor vehicles. General construction practices at Site 300, including contract specifications, would require that fugitive emissions be reduced by means such as water spraying of roads and the wheels and lower portions of construction vehicles and covering exposed piles of excavated material. Thus, application of periodic water spray would mitigate, to the extent feasible, the potential impact of fugitive dust generated during the EMPC construction on ambient air quality at Site 300.

Noise levels to both onsite and offsite populations would not be increased by the construction activities. Workers involved with the EMPC construction would wear appropriate hearing protection when necessary.

The proposed EMPC construction site would not be located within or near any identified wetlands area or 100-year floodplain. Best management practices appropriate for site conditions would be followed during construction to prevent the transport of disturbed soils or construction materials from the construction site.

Preconstruction surveys for threatened and endangered species would be conducted within 60 days prior to ground-disturbing activities. Depending upon the results of the survey, mitigation measures such as the establishment of exclusion zones, would be implemented to protect any observed species.

No known cultural resources are located within the proposed construction area. Any subsurface cultural resources that could be unearthed during construction activities would be reported to the LLNL archaeologist. Construction activities within the vicinity of the find would be halted until the find is assessed and any necessary mitigation measures are developed in consultation with DOE, the State Historic Preservation Office, and the Advisory Council on Historic Preservation.

Normal construction hazards would be present during the construction phase for the proposed action. Workers would receive proper safety training prior to construction, and all activities would be in accordance with all relevant *Occupational Safety and Health Act* requirements. The results from the preconstruction sampling would determine if worker protection measures would be required. These would consist of approved LLNL procedures that govern work in areas of known contamination to minimize worker exposure and prevent the tier spread of contamination from excavation activities.

A.3.4.3 *Deactivation, Decommissioning, and Demolition Projects*

This project would D&D 50 excess facilities at Site 300, encompassing 129,535 gross square feet of floorspace, including 20,200 square feet under the No Action Alternative. Facility deactivation could include disposition of stored or surplus materials that may be potentially contaminated. These materials and equipment are designated as legacy items, meaning there is no identified sponsor or program. Most legacy materials are materials that were placed in storage or set aside for a future need that never materialized.

Deactivation support activities could include material abatement, characterization, spot decontamination, material containment, spill cleanup, waste packaging, and disposal. Buildings that are obsolete and too expensive to rehabilitate would undergo demolition. The demolition effort would include electrical and mechanical isolation from the LLNL utility grid; sampling for contamination, characterization, and proper disposal of all subsystems and components; and dismantling and disposal of the structures. Where feasible, building materials that could be recovered would be segregated and transported offsite for recycling.

The list of excess facilities, including gross square footage and estimated waste generation, is provided in Table A.3.3–2.

A.3.5 Reduced Operation Alternative, Site 300

The following project would be curtailed under the Reduced Operation Alternative. This would be a change to the baseline operations described under the No Action Alternative. The project is summarized in Table A.3.3–1.

A.3.5.1 *Reduce Number of Hydroshots at Site 300*

Under the Reduced Operation Alternative, NNSA proposes to perform fewer intentional detonation experiments at Site 300 firing tables or the Building 801 Contained Firing Facility, resulting in a reduction of both hazardous and radioactive materials including tritium. This would result in a reduction in the maximum annual tritium emissions from 200 curies to 150 curies. Other types of experiments such as environmental testing of explosives assemblies would continue unchanged in the number of experiments and amounts of tritium. The programmatic impacts of this alternative could include having less confidence in the evaluation of two types of component functions within weapon systems.

A.4 RADIOACTIVE MATERIALS AND CHEMICAL INVENTORIES—LIVERMORE SITE AND SITE 300

Radioactive and chemical inventory data for the Livermore Site and Site 300 are listed in Table A.4–1 through Table A.4–6. Emission rates are listed in Tables A.4–7 and A.4–8.

Waste and inventory data include:

- Radioactive materials inventories for the selected facilities (Tables A.4–1 and A.4–2)
- Chemical inventories for the selected facilities (Tables A.4–3 and A.4–4)
- Estimated emission rates, based on 2001 fuel use (Tables A.4–5 and A.4–6)
- High explosives, maximum quantities – 100,000, annual facility average quantities – 15,000 pounds, facility locations LLNL-wide.

The inventory data listed in Tables A.4–1 through A.4–6 represent only the selected facilities described in this appendix. The tables show typical quantities rather than maximum limits. These chemicals and radioactive materials are subject to change as LLNL experimental requirements change. Additionally, the chemical inventory data presented in this appendix for both sites were reduced from an extensive list and were limited to extremely hazardous chemical quantities greater than 1 pound and all other chemical quantities greater than 500 pounds present in these selected buildings. Therefore, some chemicals listed in the building descriptions may be used in smaller quantities and may not appear in the tables. Figures A.4–1 and A.4–2 show waste management facilities at the Livermore Site and Site 300, respectively.

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TABLE A.4–1.—*Radionuclide Inventories[a] for Selected Livermore Site Facilities*

Building Number	Radionuclide	Approximate[c] Quantity or Limit (kg, lb, or Ci)	Status[d]
Building 131 High Bay	Natural thorium Depleted uranium	0.5 kg 7,700 kg Inventory maintained below Category 3 thresholds	Radiological facility
Building 132N	Natural uranium Depleted uranium Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 132S	Natural uranium Depleted uranium Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 151	15 radionuclides	Inventory maintained below Category 3 thresholds. Ratio approximately 0.633[b]	Radiological facility
Building 152	Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 154	Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 190	Tritium Cobalt-60 Americium-241 Plutonium-238 Plutonium-239	20.0 Ci 1.43×10^{-4} Ci 1.11×10^{-5} Ci 0.027 Ci 1.50 Ci	Radiological facility
Building 191	Depleted uranium	0.008 Ci	Radiological facility
Building 194	Uranium-235 Plutonium-239 Sealed sources	0.192 kg 0.003 kg Inventory maintained below Category 3 thresholds	Radiological facility
Building 231	Natural thorium Natural uranium Depleted uranium Rhenium	0.5 kg 9.5 kg 3,000 kg 60 kg	Radiological facility
Building 231 vault	Natural thorium Uranium-235 Uranium-238	11 kg 3.4 kg 1,700 kg	Radiological facility
Building 232 Fenced Area and 233 Vault	Thorium Low enriched uranium Natural or depleted uranium	150 kg 0.3 kg 4,000 kg	Radiological facility
Building 239	Plutonium, fuel grade equivalent[e] Highly enriched uranium[e] Depleted uranium Tritium	6 kg 25kg/50 kg[f] 500 kg 0.02 kg	Varies; resident inventory maintained below Category 3 thresholds

TABLE A.4–1.—*Radionuclide Inventories[a] for Selected Livermore Site Facilities (continued)*

Building Number	Radionuclide	Approximate[c] Quantity or Limit (kg, lb, or Ci)	Status[d]
Building 241	Depleted uranium	2,650 kg	Radiological facility
	5 radionuclides	Inventory maintained below Category 3 thresholds	
Building 251	42-Category 2 radionuclides	Inventory maintained below Category 2 thresholds	Category 2 facility
Building 255E	Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 261/262	16 Radionuclides	Inventory maintained below Category 3 thresholds	Radiological facility
	Thorium	100 lbs (Metal)	
	Natural uranium	100 lb	
	Depleted uranium	300 lb	
Building 322	Depleted uranium	30 kg	Radiological facility
Building 327	Depleted uranium	95 kg	Radiological facility
Building 331[g]	Tritium[e]	0.030kg/0.035 kg[f]	Inventory is distributed between two segments; small quantities of other radionuclides may be present but the facility will remain a Category 3 facility
	Plutonium-239	900 g	
	Plutonium, fuel-grade equivalent	260 g	
	Uranium-235	700 g	
	HEU	5 kg	
Building 332	Plutonium [e]	700kg/1,400 kg[f]	Category 2 facility
	Enriched uranium[e]	500 kg	
	Depleted or natural uranium[e]	3,000 kg	
Building 334 [g]	Plutonium, fuel grade equivalent[e]	18 kg	Category 3 facility
	Enriched uranium	100 kg	
	Depleted uranium	500 kg	
	Tritium	0.0001 kg	
Building 361	Phosphorus-32	0.027 Ci	Radiological facility
	Sulphur-35	0.008 Ci	
	Carbon-14	0.131 Ci	
	Tritium	0.29 Ci	
Building 362	Carbon-14	0.036 Ci	Radiological facility
	Tritium	0.006 Ci	
Building 363	Carbon-14	0.002Ci	Radiological facility
	Tritium	0.001 Ci	
Building 364	Cesium-137 (sealed Source)	3.5×10^3 Ci	Radiological facility
Building 366	Phosphorus-32	0.007 Ci	Radiological facility
Building 378	20 radionuclides (Sealed sources)	Inventory maintained below Category 3 thresholds	Radiological facility
Building 379	20 radionuclides (Sealed sources)	Inventory maintained below Category 3 thresholds	Radiological facility
Building 381	Tritium	8.5 Ci (storage limit – 20 Ci)	Radiological facility
	Sealed sources	Inventory maintained below Category 3 thresholds	

TABLE A.4–1.—*Radionuclide Inventories[a] for Selected Livermore Site Facilities (continued)*

Building Number	Radionuclide	Approximate[c] Quantity or Limit (kg, lb, or Ci)	Status[d]
RHWM Facilities (Area 514)	Miscellaneous radionuclides	Inventory maintained below Cat 3 thresholds	Radiological facility
RHWM Facilities (Area 612)	Cat 2 radionuclides	See Appendix B for inventory limits	Category 2 facility
DWTF Buildings 695/696S	Cat 3 radionuclides	See Appendix B for inventory limits	Category 3 facility
DWTF Building 693/ 696RWSA	Cat 2 radionuclides	See Appendix B for inventory limits	Category 2 facility
Cargo Container Testing facility (planned)	Depleted or natural uranium Uranium-235 Plutonium-239 Sealed sources	50 kg 1.0 kg (metal), 0.2 kg (oxide) 0.40 kg Inventory maintained below Category 3 thresholds	Radiological facility

Source: LLNL 1999b, g; LLNL 2000d, k, l, o, p; LLNL 2001b,e, f, aw; LLNL 2002ar, co, cq.
[a]Summary information, additional radionuclides may be present in these facilities.
[b]Ratio of activity to Category 3 threshold must be below 0.8 in order for a radiological accident analysis to not be required in a hazard analysis report.
[c]Inventories are snapshots in time. The information is provided to give the reader a degree of scale and is not (unless otherwise stated) a limit.
[d]Category 2 – Hazard analysis shows the potential for significant onsite consequences. Category 3 – Hazard analysis shows the potential for only significant localized consequences. Radiological–Facilities that do not meet or exceed Category 3 threshold criteria but still possess some amount of radioactive material. Category 2 and Category 3 thresholds are defined in DOE Standard DOE-STD-1027-92 (DOE 1997d).
[e]Administrative limit.
[f]Values are included for No Action Alternative and the Proposed Action, respectively.
[g]Materials in Buildings 331 and 334 are within the Superblock Administrative Limits for plutonium and uranium.
Ci = curies; DWTF = Decontamination and Waste Treatment Facility; kg = kilograms; RHWM = radioactive and hazardous waste management; RWSA = radioactive waste storage area.

TABLE A.4–2.—*Radionuclides Inventories[a] for Site 300 Facilities*

Material	Use	Approximate Quantities[b]
Depleted uranium	Assembly	4.2 Ci
	Components	10,640 kg
Thorium-232	Assembly	0.1 Ci
	Components	910 kg
Tritium	Assembly	193 Ci
	Components	20 mg

Source: LLNL 2002l.
[a] Inventories are snapshots in time. The information is provided to give the reader a degree of scale and is not (unless otherwise stated) a limit.
[b] Approximate quantities are for each authorized facility.
Ci = curies; kg = kilograms; mg = milligrams.

TABLE A.4–3.—*Livermore Site Chemical Quantities in 2002*

Material	2002 Report Year[a,b]		Unit
	Maximum Quantity	Average Quantity	
Beryllium oxide	500	350	lb
Boron	2,600	500	lb
Bright Plating solution	130	55	gal
Brulin MP 1793	200	100	gal
BSP Captor Solution	170	55	gal
Bulls Eye 1-2-3 Primer/Sealer	750	55	gal
Butyl alcohol (n-Butanol)	510	55	gal
Calcium chloride	3,200	500	lb
Calcium sulfate	1,300	500	lb
Carbon, activated	800	500	lb
Carbon dioxide	176,000	124,000	ft^3
Carbon monoxide	4,000	1,300	ft^3
Celite 535	2,000	950	lb
Cement, Kast-o-lite	1,300	500	lb
ChemTreat BL-1253	1,200	1,200	gal
ChemTreat BL-1302	600	600	gal
ChemTreat BL-1543	110	55	gal
ChemTreat BL-1776	1,000	140	gal
ChemTreat BL-1821	700	55	gal
ChemTreat CL-1467	700	55	gal
ChemTreat CL-2111	800	300	gal
ChemTreat CT9001-Antifoulant	55	55	gal
Chlorine	150	100	lb
Chloroform	110	55	lb
Chrome or Chromium	4,700	1,500	lb
Chromium (III) chloride	12	1	lb
Citric acid, anhydrous	1,600	400	lb
Cobalt	16,500	14,000	lb
Concresive Adhesive, Part A/B	330	55	gal
Copper sulfate, crystals & solution	1,100	500	lb
Cutting fluid, Aluminum A-9	100	90	gal
Cutting Fluid, Cool Tool (I & II)	390	55	gal
Cyanuric acid	2,500	500	lb
Dascool 2227	500	55	gal
DDO-19, Lubricating oil	500	55	gal
Delvac Motor oil	300	55	gal
DESMODUR	110	55	gal
Detergent, ND 150	300	55	gal
Diesel	30,000	10,000	gal
Dimethyl sulfoxide	220	55	gal
4,4'-Diphenylmethane diisocyanate	1,000	500	lb
DowTherm SR-1 30 Heat Transfer Fluid	110	55	gal
ELNIC 100 C-5	250	55	gal
ELNIC 100 RP-1	60	60	gal
ELNIC 100 RP-2	150	110	gal
Epolene Wax, Polyethylene, oxidized	110	55	gal
Ethyl alcohol	2,000	1,500	gal

TABLE A.4–3.—*Livermore Site Chemical Quantities in 2002 (continued)*

Material	2002 Report Year[a,b] Maximum Quantity	Average Quantity	Unit
Ethylene, compressed	5,700	1,900	ft^3
Ethylene glycol	500	110	gal
Ethyl silicate	150	55	gal
Ferric chloride, Iron chloride(III)	1,400	500	lb
Ferric sulfate	3,500	700	lb
Fertilizer, Pro-Turf 25-3-10	11,000	5,500	gal
Freon 11 (Trichlorofluoromethane)	10,000	5,000	lb
Freon 12 (Dichlorodifluoromethane)	6,300	4,000	lb
Freon 14 (Tetrafluoromethane)	2,500	500	ft^3
Freon 22 (Chlorodifluoromethane)	9,000	5,000	lb
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	17,000	5,000	ft^3
Gasoline	24,000	24,000	gal
Glass Cleaner, variety	2,300	200	gal
Glycerine	110	55	gal
Hafnium oxide	4,700	4,500	lb
Halocarbon 23	400	200	ft^3
Halon 1301 (Bromotrifluoromethane)	2,000	1,600	lb
Helium	5,000,000	300,000	ft^3
Herbicide, Ronstar	2,000	700	lb
Herbicide, Roundup	220	40	gal
Hexane	250	160	gal
Hydrochloric acid	600	400	gal
Hydrofluoric acid	1,500	850	lb
Hydrogen, compressed	1,500,000	50,000	ft^3
Hydrogen peroxide<52%	350	55	gal
Insulating Oil, Inhibiting	1,800	1,200	gal
Isopropyl alcohol	650	550	gal
Joint Compound, All purpose	45,000	12,100	lb
Kerosene (Naphtha Petroleum)	300	55	gal
Kodak Fixer & Replenisher	650	250	gal
Krypton, compressed	1,600	1,100	ft^3
Lead Bricks or ingots	950,000	950,000	lb
Lithium Grease	110	55	gal
Lithium Hydride	4,000	4,000	lb
Lubricating Oil	500	300	gal
Macro Brite L-7	220	110	gal
Magnesium chloride	6,000	500	lb
Manganese	3,500	3,000	lb
Mastic Patch adhesive, variety	400	55	gal
Metex L-5B	220	55	gal
Methane	100,000	30,000	ft^3
Methyl alcohol	1,800	500	gal
Methylene chloride	2,000	55	gal
Methyl ethyl ketone	400	55	gal
Mineral dust, Aquaset	10,000	4,500	lb
Mineral oil	2,000	55	gal
Mineral spirits	400	55	gal

TABLE A.4–3.—*Livermore Site Chemical Quantities in 2002 (continued)*

Material	2002 Report Year[a,b] Maximum Quantity	Average Quantity	Unit
Modified Bitumen adhesive	350	200	gal
Neodymium oxide	7,000	1,350	lb
Neon, compressed	750,000	500,000	ft^3
Nickel	1,500	500	lb
Nickel chloride	80	70	gal
Nickel sulfate	220	110	gal
Nitric acid	5,000	1,800	lb
Nitric oxide	1,000	500	lb
Nitrogen, compressed (Liquified, gaseous)	38,000,000	18,000,000	ft^3
Nitrous oxide	4,000	1,200	ft^3
Oakite (Liqui-det)	80	55	gal
Oil, Diala AX	2,200	1,050	gal
Oil, DTE-24	700	440	gal
Oil, DTE-25	450	355	gal
Oil, DTE-26	2,000	400	gal
Oil, DTE, extra heavy	500	165	gal
Oil, DTE heavy	850	55	gal
Oil, DTE Medium	220	55	gal
Oil, Spindle	700	355	gal
Oil, Tellus, variety	275	55	gal
Oil, Vactra, variety	500	400	gal
Oil, Vacuum Pump fluid, variety	1,500	55	gal
Oil, Waste	2,500	1,000	gal
Oxalic acid	700	500	lb
Oxygen, compressed	870,000	75,000	ft^3
OzzyJuice SW3, Cleaner/Degreaser	300	55	gal
Paint (variety)	700,000	320,296	lb
Perchloroethylene (Tetrachloroethylene)	250	55	gal
Phosphoric acid	3,600	1,000	lb
Potassium chloride	3,500	1,200	lb
Potassium hydroxide	15,000	400	lb
Potassium Phosphate, Monobasic	10,000	2,000	lb
Potassium silicate	1,100	500	lb
Power Plus, Cleaner & Degreaser	110	55	gal
Printing Ink, variety	1,000	850	lb
Propane	45,000	1,000	gal
Refrigerant, 123 SUVA, (2,2-Dichloro-1,1,1-Trifluoroethane)	35,000	1,500	lb
Refrigerant 406A	720	500	lb
Rough Rider Emulsion Degreaser	110	55	gal
Rubinate fluid	110	55	gal
Sanding Sealer	200	90	gal
sec-Butanol	130	122	gal
Shur-Stik Wall Covering Adhesive	110	55	gal
Silane, compressed	2,100	200	ft^3
Silicon carbide	3,200	500	lb

TABLE A.4–3.—*Livermore Site Chemical Quantities in 2002 (continued)*

Material	2002 Report Year[a,b]		Unit
	Maximum Quantity	Average Quantity	
Silicone Transformer Fluid/Dow	700	165	gal
Simple Green Degreaser	140	55	gal
Sodium bicarbonate	3,600	500	lb
Sodium chloride	3,200	800	lb
Sodium cyanide	250	100	lb
Sodium hydroxide	25,500	14,000	lb
Sodium hypochlorite (Bleach)	12,000	1,000	gal
Sodium nitrate	1,500	350	lb
Solvent AZ-EBR	165	55	gal
Spill clean-up kit, Acids	1,600	500	lb
Spill clean-up kit, Caustic	1,000	500	lb
Spill clean-up kit, Solvent	710	500	lb
Strontium phosphate	1,400	350	lb
Sulfur hexafluoride, compressed	25,000	10,000	ft^3
Sulfuric acid	11,000	4,500	lb
Super Dropout	1,590	1,590	lb
Suva MP39 (R401A)	800	600	lb
Suva MP66 (R401B)	180	180	gal
Tantalum	75,000	20,000	lb
Tantalum oxide blend	17,000	8,500	lb
Thinner, Lacquer	3,000	500	gal
Toluene	480	300	gal
TPX	800	800	lb
Transmission fluid, Dexron II (ATF)	220	55	gal
Trichloroethylene	350	165	gal
Trim Clear	110	55	gal
Trim Sol, coolant	660	165	gal
Tungsten	2,500	500	lb
Voranol	110	55	gal
Wax, Floor	300	300	gal
Xenon, compressed	2,000	500	ft^3
ZEP Formula 50	110	55	gal

Source: LLNL 2002bg.
[a] Summary information. Numbers may be rounded.
[b] Estimates are snapshots in time. The information is provided to give the reader a degree of scale and is not (unless otherwise stated) a limit.
ft^3 = cubic feet; gal = gallons; lb = pounds.

TABLE A.4–4.—*Site 300 Chemical Quantities in 2002*

Material	2002 Report Year[a,b]		Unit
	Maximum Quantity	Average Quantity	
Acetone	400	30	gal
Acetylene	10,000	7,500	ft^3
Activated Carbon	20,000	15,000	lb
Air	28,000	15,000	ft^3
Alcoa Atomized Powder	3,000	2,000	lb
Ammonium Perchlorate	760	760	lb
Argon	30,000	30,000	ft^3
Asphalt Emulsion	300	200	gal
Auto Transmission Fluid (including Dexron)	400	300	gal
Bacticide Solution	220	110	gal
n-Butyl Acetate	55	55	gal
Calla Soap	165	55	gal
Carbon Dioxide	44,000	5,000	ft^3
Cast Iron, Shot (Chips)	6,000	6,000	lb
Chlorine	2,250	1,500	lb
Cleaner, Degreaser, Big Orange	110	55	gal
Cleaner, Butcher's Hot Springs	55	55	gal
Cleaner, Degreaser, Clean-Way II	110	55	gal
Cleaner, Degreaser, OzzyJuice SW-3	330	110	gal
Coating, Acrylic Terpolymer	244	90	gal
Coating, Polytherm, FP-576	220	110	gal
Coating, Polyurethane, Vulkem 350, Gray	60	60	gal
Coating, Polyurethane, Vulkem 351, Gray	110	55	gal
Coating, Roof, Acrylic	2,500	500	gal
Condensate wastewater	4,500	3,600	gal
Cyanuric Acid	500	50	lb
Diesel	12,000	10,000	gal
Dimethyl Sulfoxide	400	55	gal
2,2-Dinitropropanol in EDC	275	275	gal
Ethyl Acetate	100	30	gal
Ethyl Alcohol	56	56	gal
Ethylene Glycol	200	100	gal
FEFO SOL (in methylene chloride)	1,100	10	gal
Floor wax	165	110	gal
Freon 12	660	220	lb
Freon 13	478	478	ft^3
Freon 22	1,400	870	lb
Freon 113 (Freon, TF)	150	110	gal
Gasoline	15,000	15,000	gal
Glycerin	165	165	gal
Helium	25,000	25,000	ft^3
n-Hexane	220	220	gal
High Explosives	100,000	10,000	lb
Hydrogen	700	700	ft^3
Isoamyl alcohol	55	55	gal
Isopropyl Alcohol	300	100	gal

TABLE A.4–4.— *Site 300 Chemical Quantities in 2002 (continued)*

Material	2002 Report Year[a,b] Maximum Quantity	Average Quantity	Unit
Kerosene	160	5	gal
Krovar I DF Herbicide	2,000	500	lb
Lacquer Thinner	110	35	gal
Lead (bricks, ingots)	25,000	5,000	lb
Lubricant, Synthetic Summit/Vactra, etc.	330	165	gal
Methane	3,000	1,500	ft^3
Methyl alcohol	90	5	gal
Methyl Ethyl Ketone	100	5	gal
Mixed Gas, Freon 502	500	200	ft^3
Mixed Gas, Freon 503	500	200	ft^3
Mixed Gas, Compressed, Not Otherwise Specified (nonhazardous)	1,000	1,000	ft^3
Mixed gas, TCE/Nitrogen	7,400	50	ft^3
Nalco-71-D5	165	55	gal
Nalco-2508	110	55	gal
Nalco-2536	55	55	gal
Nalco-2593	55	55	gal
Nalco-2802	110	55	gal
Nalco-2833	55	55	gal
Nalco-2858	200	55	gal
Nalco-2896	450	250	gal
Nitrogen	312,000	280,000	ft^3
Nitroplasticizer	175	110	gal
N-Octane	55	55	gal
Oil, Crankcase, 76 Guardol QLT 30	220	55	gal
Oil, Hydraulic (DTE, Unocal, CITGO, 76 UNAX AW32)	1,400	700	gal
Oil, Inhibited Insulating	25,000	5,000	gal
Oil, Mineral	220	55	gal
Oil, Motor (all weights)	650	400	gal
Oil, Shell Oil Tellus 23	110	55	gal
Oil, Transformer, Shell Diala-AX/Equivalent	15,000	15,000	gal
Oil, Turbine (Extra Heavy, HD 92)	110	55	gal
Oil, Vacuum Pump	330	55	gal
Oil, Vitrea 100	55	55	gal
Oil, Waste	1,000	110	gal
Oxygen	16,000	5,000	ft^3
Paint, acrylic (e.g., semi-gloss)	600	100	gal
Paint, Street Markings	300	55	gal
Paint Spray Wastewater	1,200	600	gal
Pentane	85	85	gal
Petroleum ether	220	55	gal
Photo wastes	400	110	gal
Polyol	120	55	gal
Propane	20,000	8,000	ft^3
Roundup herbicide	100	90	gal
Sodium bicarbonate	550	40	lb

TABLE A.4–4.— *Site 300 Chemical Quantities in 2002 (continued)*

Material	2002 Report Year[a,b]		Unit
	Maximum Quantity	Average Quantity	
Sodium chloride	7,400	100	lb
Sodium hypochlorite/Purechlor Sanitizer/bleach	500	55	gal
Sodium nitrate	1,000	16	lb
Steam Cleaning Solution/Split Equipment Cleaner	3,000	400	gal
STIK-IT Asphalt Base Seal	560	5	gal
Stoddard solvent/paint thinner	200	60	gal
Sulfur hexafluoride	19,500	7,700	ft^3
Sulfuric Acid	845	60	lb

Source: LLNL 2002bg.
[a] Summary information. Numbers may be rounded.
[b] Estimates are snapshots in time. The information is provided to give the reader a degree of scale and is not (unless otherwise stated) a limit.
ft^3 = cubic feet; gal = gallons; lb = pounds.

TABLE A.4–5.—*Typical Hazardous Chemicals at Some Selected Facilities [a] at the Livermore Site*

Facility	Material	Approximate Quantity	Unit
Building 131 High Bay	Beryllium	760	kg
	Beryllium oxide	120	kg
	Lithium hydride/Lithium deuteride	230	kg
	Mercury	9	kg
Building 132N	Ethylene dibromide	2.92	lb
	Arsenic	2.2	lb
	Arsenic trioxide	2.97	lb
	Benzene	44.7	lb
	Beryllium	0.44	lb
	Carbon Tetrachloride	60.2	lb
	Chloroform	166.3	lb
	Potassium dichromate	23.7	lb
	Lead	30.3	lb
	Mercury	3.17	lb
	Selenium	1.5	lb
	Silver Nitrate	5.58	lb
	Sodium	17.8	lb
	Potassium cyanide	3.2	lb
	Sodium cyanide	2.2	lb
Building 132S	Beryllium	b	–
	Chloroform	0.26	gal
	Cupric sulfate	1.1	lb
	Formaldehyde	5.13	gal
	Mercury	5	lb
	Trichloroethylene	48	lb
	Hydrogen chloride gas	15	ft^3
Building 141	Arsenic	3.5	lb
	Phosphorus	3.5	lb
	Chromium trioxide	240	lb
	Cupric sulfate, anhydrous	2.6	lb
	Methylamine, anhydrous	24	lb

TABLE A.4–5.— *Typical Hazardous Chemicals at Some Selected Facilities [a] at the Livermore Site (continued)*

Facility	Material	Approximate Quantity	Unit
Building 151	Hydrogen chloride gas	b	–
	Chromium (III) chloride	b	–
	Arsenic pentoxide	b	–
	Arsenic trioxide	b	–
	Hydrazine	b	–
	Carbon tetrachloride	b	–
	Chloroform	b	–
	Benzene	b	–
	Lead	b	–
	Mercury	b	–
	Arsenic	b	–
	Hydrofluoric acid	b	–
	Silver nitrate	b	–
	Selenium	b	–
Building 153	Hydrogen chloride gas	b	–
Building 191	1,2-dibromoethane	2	lb
	Hydrazine	<1	lb
	Silver nitrate	<1	lb
	1,2-dichloroethane	100	lb
	Captan	15	lb
	Xylene	125	lb
	Carbon tetrachloride	65	lb
	Chloroform	75	lb
	Benzene	25	lb
	Chloroacetic acid	<1	lb
Building 194	Arsine	b	–
	Beryllium	b	–
	Phosphine	b	–
	Silane	b	–
	Sulfur hexafluoride	3,000	ft^3
Building 197	Arsenic pentafluoride	1	lb
	Arsine	0.28	lb
	Boron trifluoride	0.15	lb
	Chlorine gas	8.25	lb
	Diborane	0.16	lb
	Hydrogen chloride gas	0.32	lb
	Nitrogen trifluoride	11	lb
	Phosphine	0.12	lb
	Phosphorous pentafluoride	0.15	lb
	Silane	11	lb
	Hydrofluoric acid	500	ml

TABLE A.4–5.— *Typical Hazardous Chemicals at Some Selected Facilities* [a] *at the Livermore Site (continued)*

Facility	Material	Approximate Quantity	Unit
Building 231	Sodium nitrate	80	lb
	Hydrogen chloride (gas)	15.2	lb
	Selenium	10.4	lb
	Trichloroethylene	116	lb
	4,4'-Methylenedianiline	10.6	lb
	Hydrogen (gas)	120	lb
	2-Butanone, peroxide	39.6	lb
	Sodium cyanide	4.3	lb
	Lead	210	lb
	Nickel	111.8	lb
	Fluorine	100	lb
	Dichloromethane	1,200	lb
	Beryllium	4.4	lb
	Lithium hydride/deuteride	4.4	lb
Building 231V	Lithium hydride	300	kg
	1,1,1-Trichloroethane	~10	kg
	Beryllium (solid)	<5	kg
	MDI	~127	kg
Building 232 Fenced Area and 233 Vault	Lithium	555	kg
Building 235	Dichromic acid, disodium salt	1	lb
	Potassium cyanide	1.1	lb
	Chloroform	0.13	gal
	Lead	13.2	lb
	Beryllium powder	69	lb
	Cupric chloride	1.1	lb
	Hydrofluoric acid	10.33	kg
	Potassium bichromate	2	lb
	Trichloroethylene	3.17	gal
	Aluminum oxide, powder	547.64	kg
	Chromium trioxide	2.77	kg
	Sulfur hexafluoride	2,500	lb
Building 239	Lead	1,000	lb
	Beryllium/Beryllium Oxide	25/50	kg
	Lithium Hydride	50	kg
Building 241	Acetic acid	1.31	gal
	Benzene	0.26	gal
	Lead	9.42	lb
	Mercury	282	lb
	Potassium hydroxide	226.88	lb
Building 261	Acetic acid	0.25	gal
	Acetone	0.13	gal
	Cadmium metal	5.5	lb
	Sodium Fluoride	0.28	lb
Building 262	Acetone	7.82	lb
	Beryllium metal	60	lb
	Cadmium metal	2.5	kg
	Thorium metal	100	lb
	Lithium hydride	167	lb
	Lead	2,000	lb
	Xylene	35	lb

TABLE A.4–5.— *Typical Hazardous Chemicals at Some Selected Facilities* [a] *at the Livermore Site (continued)*

Facility	Material	Approximate Quantity	Unit
Building 321	Beryllium	454	kg
	Lithium hydride	95	kg
	Acetone	18	gal
Building 322	Ammonium bifluoride	750	lb
	Chromic trioxide	750	lb
	Chromic acid (25-30%)	1,000	lb
	Chloroform	40	lb
	Copper Cyanide	1,200	lb
	Cupric Sulfate	5,000	lb
	Ferrous chloride	3,000	lb
	Hydrofluoric acid	150	lb
	Lead fluoroborate	500	lb
	Nickel ammonium sulfate	650	lb
	Nickel chloride	1,000	lb
	Nickel sulfate	1,200	lb
	Nitric acid (69-71%)	9,600	lb
	Potassium cyanide	600	lb
	Potassium dichromate	50	lb
	Sodium chromate	50	lb
	Sodium dichromate	50	lb
	Sodium cyanide	600	lb
	Sodium hydroxide (98% and less)	2,000	lb
	Silver nitrate	80	lb
	Chromic acid	83.5	lb
	Nitric acid (69-71%)	5,189	lb
	Cyanide solution	55	lb
Building 327	1,2-Dichloroethane	0.26	gal
	Hexane	1.0	gal
	Xylene	0.13	gal
	Methanol	1.13	gal
	Acetone	1.06	gal
	Propane	2.62	lb
	Hydrogen Peroxide	0.26	gal
	2-Butanone	2.38	gal
Building 332	HCl gas	55	lb
	Chlorine gas	100	lb
Building 334	Mercury	8	lb
	Lead	<2,300	lb
	Beryllium/beryllium oxide	200/400	kg
	Lithium hydride	200	kg
	NO_2	40	kg
	High Explosives	10	g
Building 360 Complex [c]	1,2-Dibromo-3-chloropropane	1	lb
	Arsenic disulfide	1	lb
	Arsenic trioxide	1	lb
	Benzene	10	lb
	Cacodylic Acid	1	lb
	Cadmium dichloride	10	lb
	Carbon Tetrachloride	10	lb
	Chloroform	10	lb
	Cupric sulfate, anhydrous	10	lb

TABLE A.4–5.— *Typical Hazardous Chemicals at Some Selected Facilities [a] at the Livermore Site (continued)*

Facility	Material	Approximate Quantity	Unit
	Dichromic acid, disodium salt	10	lb
	Emetine dihydrochloride	1	lb
Building 360 Complex[c] (cont.)	Ether, anhydrous	100	lb
	Formaldehyde	100	lb
	Lead	10	lb
	Potassium cyanide	10	lb
	Selenium	1	lb
	Silver nitrate	1	lb
	Sodium cyanide	10	lb
	Xylene	100	lb
	Mercury	1	lb
Buildings 378/379	Perchloric acid	b	–
	Nitric acid	b	–
	Hydrofluoric acid	b	–
	Hydrochloric acid	b	–
Building 392	Acetone	19	L
	Ethanol	208	L
	Sol-Gel (97% Ethanol/3% tetraethyl orthosilicate)	284	L
	Hydrofluoric acid	55	gal
	Ammonia	8	gal
	Epoxy ECA-1	5	L
	Epoxy ECA-2.5	5	L
	Tetraethyl orthosilicate	30	L
Building 519	Acetone	1.24	lb
	Dichloroethane	3.8	lb
	Methanol	19.1	lb
Buildings 581/681	Acetone	210	L
	Ethyl alcohol	256	L
	Isopropyl alcohol	20.5	L
	Chloroform	0.5	L
	Nitric acid	2,800	L
	Phosphoric acid	2,800	L
	Mercury, metallic	3.5	L
	Sodium hydroxide	1,906	kg
	Toluene	18	L
	Xylene	18	L
Building 695	Sulfuric acid (98%)	2,786	kg
	Sodium hydroxide (50%)	1,737	kg
	Hydrogen peroxide (50%)	1,665	kg
	Ferric sulfate (50%)	1,709	kg
Container Security Testing Facility	Cadmium	<10	lb
	Arsenic	1	lb
	Lead	<4,000	lb
	Carbon tetrachloride	<20	lb

Source: DOE 2003a; LLNL 1997f, 1997g; LLNL 1999b, 1999g; LLNL 2000b, 2000d, 2000j, 2000k, 2000l, 2000o, 2000p; LLNL 2001a, 2001b, 2001e, 2001f, 2001m, 2001x, 2001y, 2001z, 2001ag, 2001ah, 2001aw; LLNL 2002k, 2002ak, 2002aq, 2002ar, 2002by, 2002cq, 2002cu, 2003cw, 2002g, 2002s.
[a] Facilities not listed may also have small quantities of similar types of chemicals.
[b] May be present in small laboratory quantities.
[c] The 360 complex is comprised of the following buildings: 361, 362, 363, 364, 365, 366, 367, 373, 376, 377, and 368 (planned).
ft^3 = cubic feet; gal = gallons; kg = kilograms; L = liters; lb = pounds; ml = milliliter.

TABLE A.4–6.— *Typical Hazardous Chemicals at Some Selected Facilities at Site 300*

Facility	Material	Approximate Quantity	Unit
Building 801	Isopropyl alcohol	3	kg
	Ethyl alcohol (cleaner)	3	kg
	Bromoform	500	ml
	Ethyl alcohol (coolant)	100	ml
	Freon 12	640	lb
	Kodak Industrial Starter	5	L
	Kodak Industrex Developer	10	kg
	Mercury	<0.4	kg
	Methane	55	kg
	Methanol	1	L
	Sulfur hexafluoride	1,000	kg
	Acetone	6	kg
Building 812	Isopropyl alcohol	3	kg
	Ethyl alcohol (cleaner)	3	kg
	Bromoform	500	ml
	Ethyl alcohol (coolant)	100	ml
	Freon 12	640	lb
	Kodak Industrial Starter	5	L
	Kodak Industrex Developer	10	kg
	Mercury	<0.4	kg
	Methane	55	kg
	Methanol	1	L
	Propane	40	kg
	Sulfur hexafluoride	1,000	kg
	Acetone	6	kg
Building 850	Isopropyl alcohol	3	kg
	Ethyl alcohol (cleaner)	3	kg
	Bromoform	500	ml
	Ethyl alcohol (coolant)	100	ml
	Freon 12	640	lb
	Kodak Industrial Starter	5	L
	Kodak Industrex Developer	10	kg
	Mercury	<0.4	kg
	Methane	55	kg
	Methanol	1	L
	Propane	40	kg
	Sulfur hexafluoride	1,000	kg
	Acetone	6	kg

TABLE A.4–6.— *Typical Hazardous Chemicals at Some Selected Facilities at Site 300 (continued)*

Facility	Material	Approximate Quantity	Unit
Building 851	Isopropyl alcohol	3	kg
	Ethyl alcohol (cleaner)	3	kg
	Bromoform	500	ml
	Ethyl alcohol (coolant)	100	ml
	Freon 12	640	lb
	Kodak Industrial Starter	5	L
	Kodak Industrex Developer	10	kg
	Mercury	<0.4	kg
	Methane	55	kg
	Methanol	1	L
	Propane	40	kg
	Sulfur hexafluoride	1,000	kg
	Acetone	6	kg
Building 883	Acetone	4.99	kg
	Acetyltriethyl citrate	139	kg
	Acrylic resin	36	kg
	Alkyloxypolyethylene Oxyethanol	106	kg
	Alumina	5.9	kg
	Ammonium carbonate	15	kg
	B-napthol	6.3	kg
	Carbon tetrachloride	25	kg
	Chloro-fluoro hydrocarbon	8.2	kg
	Cyanuric acid	20.4	kg
	Cyclohexane	30.8	kg
	Dextrin	2.7	kg
	Dibutylin dilaurate	2.7	kg
	Diethyleneamine	24.9	kg
	Dimethyl ether	16.8	kg
	Dimethyl sulfoxide	63	kg
	Dioctyl sebacate	5.9	kg
	Ethanol	15.9	kg
	Ethyl Acetate	60.3	kg
	Ethylene glycol	13.2	kg
	Glycerol	5.4	kg
	Hexane	50.3	kg
	Hydrochloric acid	27.2	kg
	Hydroquinone	2.7	kg
	Insulation oil	1,156	kg
	Isobutane	2.7	kg
	Isodecyl perarsonate	27.2	kg

TABLE A.4–6.— *Typical Hazardous Chemicals at Some Selected Facilities at Site 300 (continued)*

Facility	Material	Approximate Quantity	Unit
Building 883 (cont.)	Isopropanol, fluorochemical trivalent chromium	82.5	kg
	compound	28.1	kg
	Lead chromate	0.14	kg
	Lead dioxide	0.08	kg
	Mercury	1.5	kg
	Methyl-ethyl ketone	44.9	kg
	Naptha	18.6	kg
	N-butyl acetate	43.1	kg
	Nitromethane	3.4	kg
	Oxalic acid	0.45	kg
	Petric acid	260.7	kg
	Petroleum hydrocarbon	5.4	kg
	Phenol	74.8	kg
	Phosphorous trichloride	0.086	kg
	Potassium chromate	4.3	kg
	Potassium iodide	1.8	kg
	Propane	1.4	kg
	Silica	0.38	kg
	Silver	38.5	kg
	Sodium bicarbonate	3.2	kg
	Sodium bromide	2.9	kg
	Sodium hydroxide	14.9	kg
	Sodium iodide	5.2	kg
	Sodium nitrate	13.6	kg
	Sodium phosphate	59	kg
	Styrene	2.9	kg
	Sulfuric acid	14.5	kg
	Thorium nitrate	1,270	kg
	Titanium dioxide	17.7	kg
	Toluene	109.3	kg
	Transformer oil	0.9	kg
	Trisodium phosphate dodecahydrate		

Source: LLNL 2001ao, 2001av; LLNL 2002j, 2002l.
kg = kilograms; L = liters; lb = pounds; ml = milliliters.

TABLE A.4–7.—*Livermore Site Criteria Pollutant Emissions in 2002*

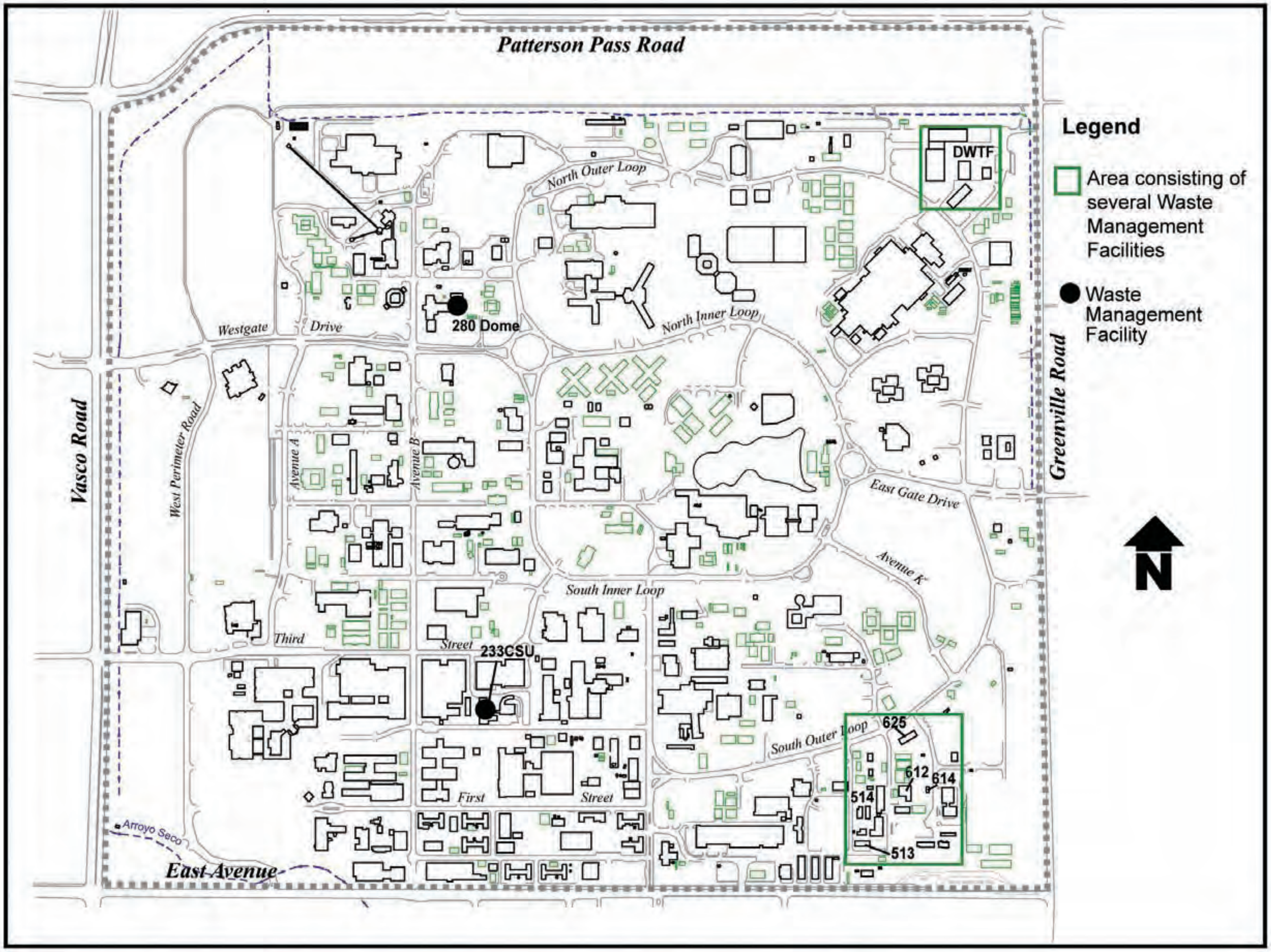
Pollutant	Emissions (kilograms per day) [a,b,c]
Precursor organic compounds	16
Nitrogen oxides	67
Carbon monoxide	17
Particulates (PM_{10})	6.1
Oxides of sulfur	2.8

Source: LLNL 2003l.
[a] Summary information. Numbers may be rounded.
[b] Estimates are snapshots in time. The information is provided to give the reader a degree of scale and is not (unless otherwise stated) a limit.
[c] One kilogram equals 2.2 pounds.

TABLE A.4–8.—*Site 300 Criteria Pollutant Emissions in 2002*

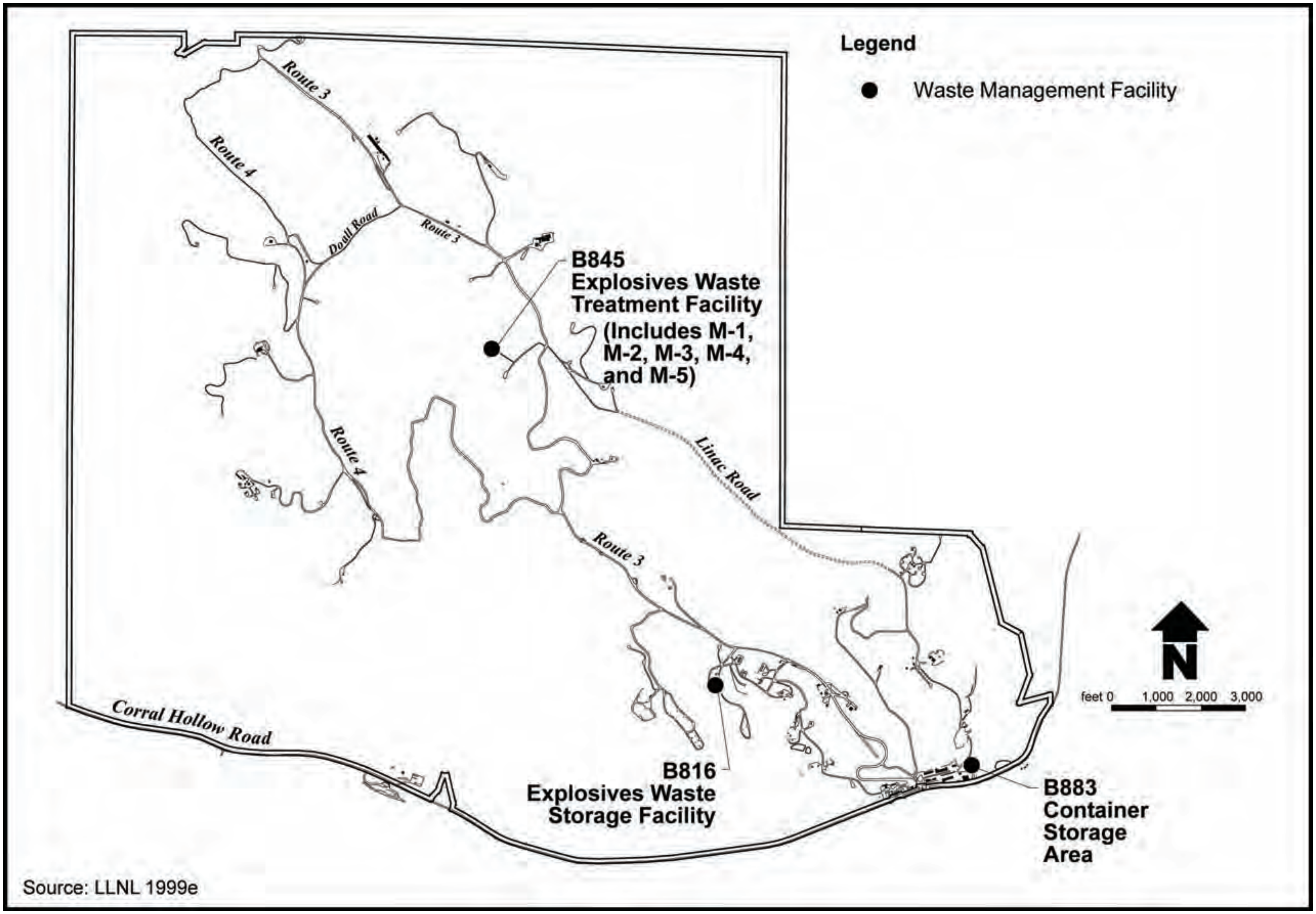
Pollutant	Emissions (kilograms per day) [a,b,c]
Precursor organic compounds	0.23
Nitrogen oxides	1.1
Carbon monoxide	1.0
Particulates (PM_{10})	0.09
Oxides of sulfur	0.07

Source: LLNL 2003l.
[a] Summary information. Numbers may be rounded.
[b] Estimates are snap shots in time. The information is provided to give the reader a degree of scale and is not (unless otherwise stated) a limit.
[c] One kilogram equals 2.2 pounds.



Source: LLNL 2003o.

FIGURE A.4–1.—*Waste Management Facilities at the Livermore Site*



Source: LLNL 1999h.

FIGURE A.4–2.—*Waste Management Facilities at Site 300*

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APPENDIX B: WASTE MANAGEMENT

The U.S. Department of Energy (DOE) established its *National Environmental Policy Act* (NEPA) implementing procedures (10 *Code of Federal Regulations* [CFR] §1021.330) that allow preparation of site-wide documents for certain large, multiple-facility sites, such as the Lawrence Livermore National Laboratory (LLNL). Pursuant to the NEPA of 1969 (42 United States Code [U.S.C.] §4321 et seq.), the Council on Environmental Quality's (CEQ's) NEPA regulations (40 CFR Parts 1500-1508), and DOE NEPA implementing procedures (10 CFR Part 1021), the National Nuclear Security Administration (NNSA) decided to complete this appendix as part of this *Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (LLNL SW/SPEIS).

The format was modified in consideration of the California Department of Toxic Substances Control (DTSC) request for information to complete a initial study for LLNL permit modifications in accordance with the *California Environmental Quality Act* of 1970 (CEQA) (*California Public Resources Code* §21000 et seq.) and implementing guidelines (*California Code of Regulations* §15000 et seq.). The objective of this appendix is to provide NNSA, other agencies, and the public with:

- An analysis of the potential environmental impacts caused by ongoing and reasonably foreseeable new operations and facilities and reasonable alternatives at LLNL
- A basis for site-wide decisionmaking
- Improved coordination of agency plans, functions, programs, and resource utilization
- A clearer understanding of the impacts created by LLNL permit modifications and LLNL waste management operations separate from overall LLNL operations
- Sufficient information to facilitate routine decisions by NNSA regarding verification of operational status
- Sufficient information to facilitate permit modification decisions by the DTSC

This appendix will enable NNSA to ''tier'' its NEPA documentation, eliminate repetitive discussion of the same issues in future NEPA reviews, and focus on the actual issues ready for decisions at each level of environmental review.

In December 2002, NNSA identified the need to update waste management benchmark information and impact analysis to support the current LLNL waste management site planning. To meet this need, NNSA decided to prepare this appendix and provide project-specific information in one report.

This appendix includes a comprehensive review of the practices of onsite waste handling, packaging, and treatment; treatment and storage units; and estimates of waste generation types. Unless otherwise specified, the appendix analyzes the Livermore Site and Site 300 collectively to bound potential impacts, and the term "permitted" refers to the *Resource Conservation and Recovery Act* (RCRA) hazardous waste permit from the State of California. Similarly, radioactive and hazardous waste management (RHWM) facilities are considered collectively, including pertinent facilities managed by Plant Engineering and the Chemistry and Material Science Directorate. This review of the Proposed Action, No Action Alternative, and Reduced Operation Alternative includes a series of permit modifications, consolidation of existing capabilities, equipment transfers, increased utilization of the Decontamination and Waste Treatment Facility (DWTF), and several RCRA closures.

Section B.1 introduces waste categories, waste management practices, and waste management facilities, both hazardous and radioactive, at LLNL. Section B.2 presents the agency purpose and need. Descriptions of the alternatives are presented in Section B.3. Section B.4 provides a description of the affected environment, including historical and current waste generation and waste management activities. Section B.5 presents the environmental consequences. This appendix concludes with a summary on levels of significance for each resource area and a brief discussion on CEQA impacts (Section B.6).

Figure B–1 illustrates how major program and facility information, related studies, and historical information flow into the waste management appendix. Additionally, this appendix supports other sections of the LLNL SW/SPEIS.

B.1 INTRODUCTION

Wastes at LLNL are routinely generated from the ongoing programmatic operations and infrastructure support activities described in Volume I of this LLNL SW/SPEIS. Wastes are also generated from special, limited duration projects. This section describes the types of wastes historically generated and managed at LLNL, the steps in the waste generation and management process, the current and proposed facilities in which waste management operations are conducted, and the waste treatment processes used.

B.1.1 Types of Waste Generated and Managed at the Livermore Site and Site 300

LLNL generates and manages both routine and nonroutine wastes. Routine wastes are those generated during the normal operation of laboratories, test facilities, and research and development (R&D) operations. Special, limited-duration projects, such as construction, that generate nonroutine wastes are considered separately from facility operations. These types of projects can make a large contribution to the overall waste generation at LLNL and are difficult to reasonably forecast on an annual basis. Three types of projects are considered special operations: construction, decontamination and decommissioning (D&D), and environmental restoration.

The types of wastes generated and managed at the Livermore Site and at Site 300 include low-level waste (LLW), mixed low-level waste (MLLW), transuranic (TRU) waste, mixed TRU waste, hazardous waste, construction waste, sanitary solid waste, industrial wastewater (nonsewerable), and sanitary wastewater. Descriptions of these waste types are shown in Table B.1.1–1. Table B.1.1–2 lists typical wastes accumulated in a generator area or managed in one of the waste management facilities. Detailed descriptions of actual waste streams, of which there are over 100, are listed in the RCRA permits.

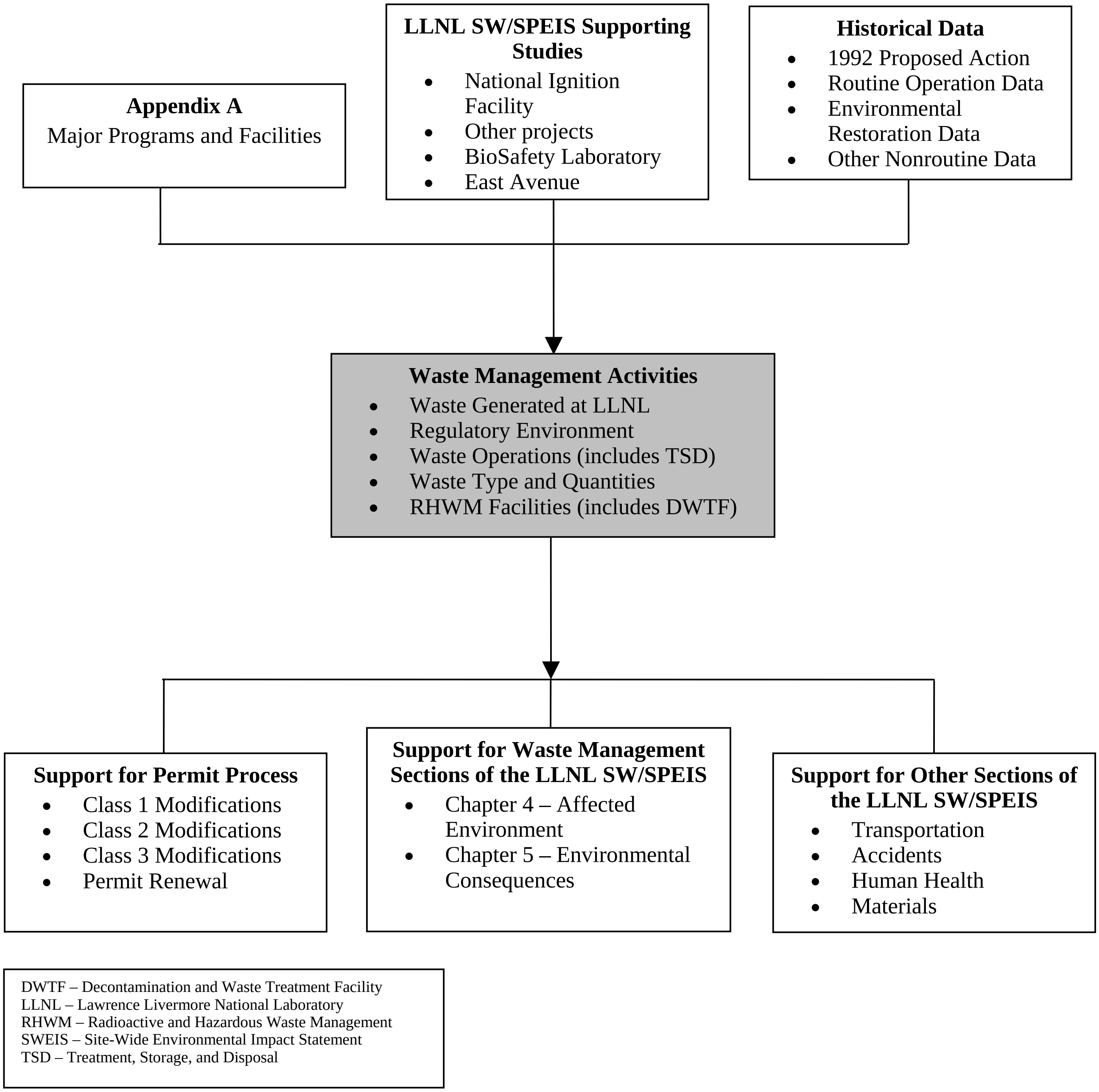

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FIGURE B–1.—*Conceptual Illustration of Appendix B*

TABLE B.1.1–1.—*Types of Waste Generated and Managed at the Livermore Site and Site 300*

Low-Level Waste (LLW)—Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, spent nuclear fuel, or by product tailings containing uranium or thorium from processed ore (as defined in Section 11[e][2] of the *Atomic Energy Act* [42 U.S.C. §2011 et seq.]). Test specimens of fissionable material, irradiated for research and development only and not for the production of power or plutonium, may be classified as LLW, if the concentration of transuranic waste is less than 100 nanocuries per gram.

Mixed Low-Level Waste (MLLW)—Waste that contains both hazardous waste regulated under the RCRA and LLW.

Transuranic (TRU) Waste—TRU waste is waste containing more than 100 nanocuries of alpha-emitting TRU isotopes per gram of waste, with a half-life greater than 20 years, except for (a) high-level radioactive waste; (b) waste that the Secretary of the U.S. Department of Energy (DOE) has determined, with concurrence of the Administrator of the U.S. Environmental Protection Agency (EPA), does not need the degree of isolation required by the disposal regulations; or (c) waste that the Nuclear Regulatory Commission (NRC) has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Mixed Transuranic (Mixed TRU) Waste—TRU waste that contains both hazardous waste regulated under the RCRA and TRU waste.

RCRA Hazardous Waste—Any solid waste (definition includes semisolid, liquid, or gaseous material) listed in Subpart D of 40 CFR Part 261 or having the characteristics of ignitability, corrosivity, toxicity, or reactivity, defined by RCRA.

State-Regulated Waste—Waste regulated by the State of California under Title 22 of the *California Code of Regulations*.

Biohazardous Waste—Waste that is capable of transmitting an infectious agent to a living organism. This includes discarded materials, biological agents (or fragments), biotoxins, (or fragments), and contaminated equipment.

Hazardous Waste—Waste includes RCRA hazardous waste, state-regulated waste, explosive wastes, and TSCA waste.

Explosive Waste—Waste that is RCRA hazardous waste such as waste explosives, waste containing waste explosive materials, and explosive-contaminated debris.

Environmental Restoration Waste—Waste generated while investigating, installing, monitoring, sampling, replacing equipment, restoring, or implementing required tasks as approved by regulatory agency agreements, plans, or other routine operations. Typical wastes include water, soil, pumps, tubing, filters, personal protective equipment, sampling equipment and chemicals, and other items.

***Toxic Substances Control Act* Waste**—Waste that contains materials exceeding identified limits in the Act. LLNL generates and manages two TSCA-regulated wastes: polychlorinated biphenyls (PCBs) and asbestos.

Sanitary Solid Waste—Waste includes office and laboratory trash.

Other Waste—LLNL generates construction waste, demolition and decommissioning waste, and wastewater.

Legacy Waste—For this document, the term legacy waste includes TRU, mixed TRU, LLW, and MLLW and is considered to be these wastes currently in storage pending disposal. This is conservative because some of the waste is ready for shipment.

TABLE B.1.1–2.—*Typical Waste Types Stored in Waste Accumulation Areas*

Waste Types	
Acids (liquid)	Mixed radioactive waste (liquid/solid)
Asbestos	Oils (liquid/solid)
Combustible liquids	Oxidizers (liquid/solid)
Compressed gases	Paints (liquid/solid)
Flammable liquids	PCB waste (liquid/solid)
Halogenated and nonhalogenated solvents	Photochemicals (liquid)
Lab packs	Poisons
Laboratory debris (solid)	Radioactive waste (liquid/solid)
Mercury and mercury-contaminated waste	Reactive materials
Miscellaneous chemical waste and contaminated debris	Wastewaters (liquid)

Source: LLNL 2001aq.
PCB = polychlorinated biphenyl.

B.1.2 Waste Management at Lawrence Livermore National Laboratory

LLNL uses trained personnel and approved program procedures to control waste from the point of generation through storage, treatment, and disposal. LLNL waste management procedures cover identifying, generating, handling, packaging, storing, treating, and transporting all wastes including radioactive, hazardous, mixed, and medical wastes. The generators are primarily responsible for proper waste management in generator areas and receive assistance from several organizations including the LLNL RHWM Division, Environmental Protection Department, Plant Engineering Department, and other staffs. In this appendix, the term RHWM often refers to all activities or facilities at LLNL that manage radioactive and hazardous waste, regardless of organization. Accordingly, waste management facilities managed by the Plant Engineering Department and the Chemical and Materials Science Directorate are included in the term RHWM.

LLNL maintains control of hazardous, radioactive, and mixed wastes that are potentially harmful to human health and/or the environment. This control occurs through four types of waste management areas that can be used to accumulate such wastes:

- At the point of generation (i.e., at a Satellite Accumulation Area [SAA])
- At a Waste Accumulation Area (WAA)
- In a hazardous waste retention tank with a 90-day waste accumulation time limit
- At an interim status or permitted storage and/or treatment unit at LLNL

Specific conditions that govern the accumulation of wastes at each of these areas are described below.

An SAA is an area at LLNL where small quantities of hazardous, radioactive, and mixed wastes are temporarily accumulated at or near the initial point of generation without a California DTSC RCRA permit. Each SAA and the accumulation of waste at that SAA are under the direct control of the individual generating the waste (the term individual includes organization or department, for which a specific point of contact is assigned the lead). These waste generators control the waste container at all times. Hazardous and mixed wastes accumulated at an SAA are transferred to other waste management facilities or shipped offsite before either accumulation time limits or quantity limits are reached. Also, waste containers that have been filled are transferred from the SAA or shipped offsite, as appropriate.

A WAA is an officially designated area at LLNL where hazardous, radioactive, and mixed wastes generated by an organization are accumulated in containers. Before a 90-day time limit expires, hazardous and mixed waste is transported to an approved RCRA-permitted Treatment, Storage, and Disposal Facility (TSDF), either onsite or offsite. A WAA serves an important role in the life cycle of waste management in that it provides temporary waste accumulation, without requiring a permit, after hazardous or mixed wastes reach SAA time or quantity limits. The number of WAAs in service at any time varies with programmatic need. In 2001, there were 22 WAAs in service at the Livermore Site and one in service at Site 300.

Routinely, wastes managed in SAAs and WAAs are transported to LLNL waste management facilities or directly to offsite waste management facilities. Waste management facilities currently in operation at LLNL and facilities that are in the process of being closed are discussed below.

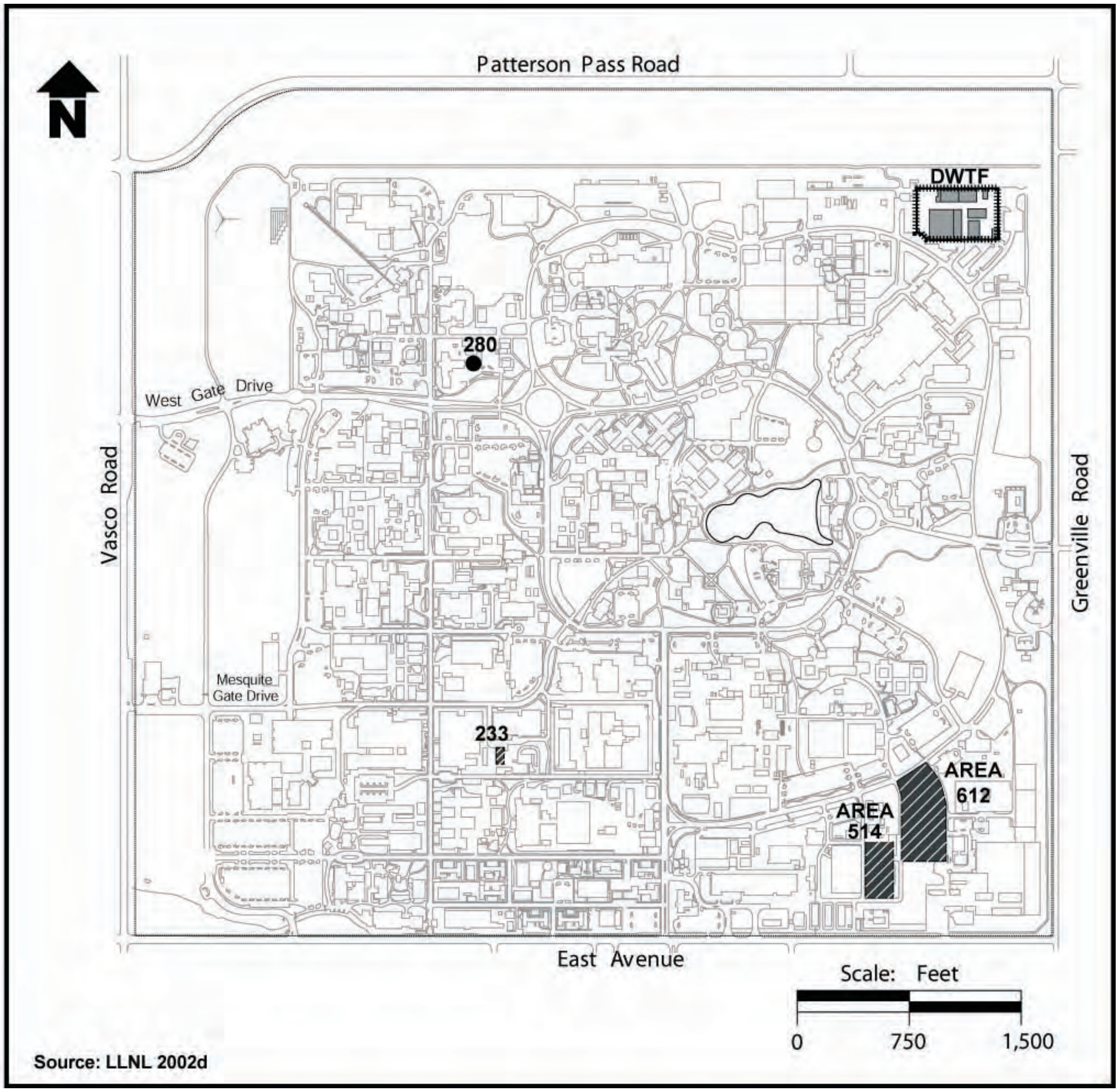
B.1.3 Waste Management Facilities at the Livermore Site

Treatment, storage and other waste management operations have been conducted historically in Building 233, Areas 514 and 612, and Building 693, at the Livermore Site (see Figure B.1.3–1). In 1996, construction of a new, consolidated waste treatment facility, the DWTF began in the northwest corner of the Livermore Site (see Figure B.1.3–1). An assessment of the environmental impacts associated with the DWTF construction and operation can be found in the *Environmental Assessment for the Decontamination and Waste Treatment Facility*, DOE/EA-1150 (LLNL 1996c) and the *Health Risk Assessment for Hazardous and Mixed Waste Management Units at the Lawrence Livermore National Laboratory* (LLNL 1997q). The DWTF construction has been completed and currently consists of Buildings 6951, 693, 694, 695, 696, and 697 and associated yard areas. The DWTF replaces waste management operations in Area 514 and Building 233 and consolidates other waste management activities into one facility. After relocation of waste operations from Area 514 and Building 233 to DWTF is complete, Area 514 and Building 233 will be closed. Waste management operations in Area 612 will continue.

Wastes stored in the Building 233 container storage unit (CSU) were removed in January 2002, and the facility is no longer active. Waste operations in Area 514 are currently being relocated to DWTF. In accordance with RCRA requirements, Area 514 and Building 233 will undergo RCRA closure. Final closure plans were submitted to DTSC in May 2000.

Although Building 419 has historically been used for waste management operations, it has undergone closure and is being maintained in a mothballed state. The State of California has not taken any action to approve the closure. Building 419 will not be mentioned again in this appendix. Another Livermore Site facility, Building 280, is permitted for hazardous and mixed waste storage, but storage operations have not and will not commence. As such, Building 280 will undergo administrative closure using the permit modification process.

The treatment and storage capacities associated with individual units of the various RHWM facilities are indicated in Table B.1.3–1.



Source: LLNL 2002e.

FIGURE B.1.3–1.—*Waste Management Facilities at the Livermore Site*

TABLE B.1.3–1.—*Lawrence Livermore National Laboratory Active Waste Management Facilities and Capacity*

Facility	Unit Type	Waste Type	RCRA, HWCA Wastes – Permit Capacity Totals
Area 612 Facility			
Building 625 CSU	S	H, M, R, TSCA, CT	42,416 gal
Area 612 Tank Trailer Storage Unit	S	CT, H, M, R	5,000 gal
Area 612 Portable Tank Storage Unit	S	CT, H, M, R	10,000 gal
Area 612-1 CSU	S	CT, H, M, R	38,400 ft^3
Area 612-2 CSU	S	CT, H, M, R	10,560 gal
Area 612-5 CSU	S	CT, H, M, R	26,900 ft^3
Building 612 Size Reduction Unit	T	CT, H, M, R	250 short tons/yr
Building 612 Drum/Container Crushing Unit	T	CT, H, M, R	600 short tons/yr
Building 612 CSU	S	CT, H, M, R	7,150 gal
Building 614 West Cells CSU	S	CT, H, M, R	168 gal/cell (4 cells)
Building 614 East Cells CSU	S	CT, H, M, R	880 gal/cell (4 cells)
DWTF			
Building 693 CSU	S	CT, H, M, R	141,240 gal
Building 693 Annex	S	CT, H, M, R	3,060 ft^3
Building 693 Yard—Freezer Storage Unit	S	CT, H, M, R	30 gal
Building 693 Yard—Roll-Off Bin Storage Unit	S	CT, H	2,160 ft^3
Building 695 Airlock	S	H, M	12,000 gal
Building 695 LWPA Waste Blending Station, Tank Blending Unit	T	CT, H, M, R	Part of 695 Tank Farm capacity
Building 695 LWPA Waste Blending Station, Portable Blending Unit	T	CT, H, M, R	Part of 695 Tank Farm capacity
Building 695 LWPA Cold Vapor Evaporation Unit	T	CT, H, M, R	Part of 695 Tank Farm capacity
Building 695 LWPA Centrifuge Unit	T	CT, H, M, R	55,000 gal/yr
Building 695 LWPA Solidification Unit	T	CT, H, M, R	115 short tons/yr
Building 695 LWPA Shredding Unit	T	CT, H, M, R	183 short tons/yr
Building 695 LWPA Filtration Unit	T	CT, H, M, R	2,750 gal/yr

TABLE B.1.3–1.—*LLNL Active Waste Management Facilities and Capacity (continued)*

Facility	Unit Type	Waste Type	RCRA, HWCA Wastes – Permit Capacity Totals
DWTF (continued)			
Building 695 LWPA Drum Rinsing Unit, Bulking Station	T	CT, H, M, R	180 short tons/yr
Building 695 LWPA Debris Washer Unit	T	CT, H, M, R	45 short tons/yr
Building 695 LWPA Gas Absorption Unit	T	CT, H, M, R	0.09 short tons/day
Building 695 LWPA Radwaste Evaporator	T (non-RCRA)	R	
Building 695 LWPA Air Lock	(non-RCRA)	R	
Building 695 RWPA/SSTL Water Reactor	T	CT, H, M, R	0.09 short tons/day
Building 695 RWPA/SSTL Pressure Reactor	T	CT, H, M, R	0.09 short tons/day
Building 695 RWPA/SSTL Amalgamation Reactor	T	CT, H, M, R	0.09 short tons/day
Building 695 RWPA/SSTL Uranium Bleaching Unit	T	CT, H, M, R	0.09 short tons/day
Small Scale Treatment Laboratory	T	H, M, R	0.04 short tons/day
Reactive Waste Storage Room	S	CT, H, M, R	12,400 gal
Building 695 Tank Farm	S, T	CT, H, M, R	45,000 gal (storage), 325,000 gal/yr (treatment)
DWTF Portable Tank Storage Pad	S	CT, H, M, R	22,000 gal
Building 696 Radioactive Waste Storage Area	S	R (only)	N/A. A plan to obtain RCRA permit status would allow for 33,000-gal storage capacity. Currently the storage space manages up to 600 55-gal radioactive waste drums
Building 696 Solid Waste Process Area	N/A	Nonhazardous Nonradioactive Wastes	N/A
Area 514[b]			
Area 514-1 CSU/Treatment Unit Group	S, T	R, M, TSCA	N/A[d]
Area 514-2 CSU	S	R, M, TSCA	N/A[d]
Area 514-3 CSU	S	H, R, M, TSCA	N/A[d]
Area 514 Waste Water Treatment Tank Farm Unit	S, T		N/A[d]
Building 513 CSU	S, T	H, M, R	N/A[d]
EWTF- Site 300			
Open Burn Unit -Pan	T	H[d]	150 lb/event
Open Burn Unit -Cage	T	H[d]	260 lb/event
Open Detonation Unit	T	H[d]	350 lb/event
Storage Unit S1	S	H[d]	275 gal
Storage Unit S2	S	H[d]	110 gal

TABLE B.1.3–1.—*LLNL Active Waste Management Facilities and Capacity (continued)*

Facility	Unit Type	Waste Type	RCRA, HWCA Wastes – Permit Capacity Totals
EWSF-Site 300 (continued)			
Magazine 1	S	H[c]	1,622 lb (net explosive weight)
Magazine 2	S	H[c]	3,209 lb (net explosive weight)
Magazine 3	S	H[c]	5,592 lb (net explosive weight)
Magazine 4	S	H[c]	4,291 lb (net explosive weight)
Magazine 5	S	H[c]	2,744 lb (net explosive weight)
Magazine 816	S	H[c]	168 55-gallon drums (no liquids)
Building 883-Site 300			
Building 883 CSU	S	H	3,300 gal

[a] Typically an operational limit including a combination of Hazardous, Radioactive, and Mixed Waste unless otherwise restricted by Permit or LLNL management practice.

[b] Under several alternatives, all or some of this facility would undergo RCRA Closure and operational capabilities would be transferred to the DWTF.

[c] Explosives and explosive contaminated wastes.

[d] Area 514 capacity is included in Building 695 Part B permit.

CSU = Container Storage Unit; CT = A non-RCRA hazardous waste defined by State of California per Title 22 California Code of Regulations; DWTF = Decontamination and Waste Treatment Facility; EWTF = Explosive Waste Storage Facility; gal = gallon; H = Hazardous; lb = pound; HWCA = *Hazardous Waste Control Act*; LWPA = liquid waste processing area; M = Mixed; N/A = not applicable; R = Radioactive (may include LLW and TRU); RHWM = Radioactive and Hazardous Waste Management; RWPA = reactive waste processing area; S = Storage; SSTL = Small Scale Treatment Laboratory; T = Treatment; TSCA = *Toxic Substances Control Act*; yd^3 = cubic yard.

Note: Many of the facilities listed in this table manage solid waste (waste that does not require a permit and is not radioactive). While the list above is comprehensive it does not include all work areas within a facility where waste is staged, loaded on and off vehicles, inspected, etc. For this information please refer to documents referenced in this appendix.

B.1.3.1 *Area 612 Complex*

Area 612 is divided into two segments, the Building 612 Segment and the Building 625 Segment, based on location and management needs. Each segment contains a number of storage or treatment units. The structures and areas within the Building 612 Segment are:

- Area 612 Portable Tank Storage Unit
- Area 612-1 CSU
- Area 612-2 CSU
- Area 612-5 CSU
- Building 612 Consolidation Waste Accumulation Area
- Building 612 Drum/Container Crushing Unit
- Building 612 Size Reduction Unit
- Building 612 CSU
- Building 614 East Cells CSU
- Building 614 West Cells CSU
- Building 612 Segment Yard Areas

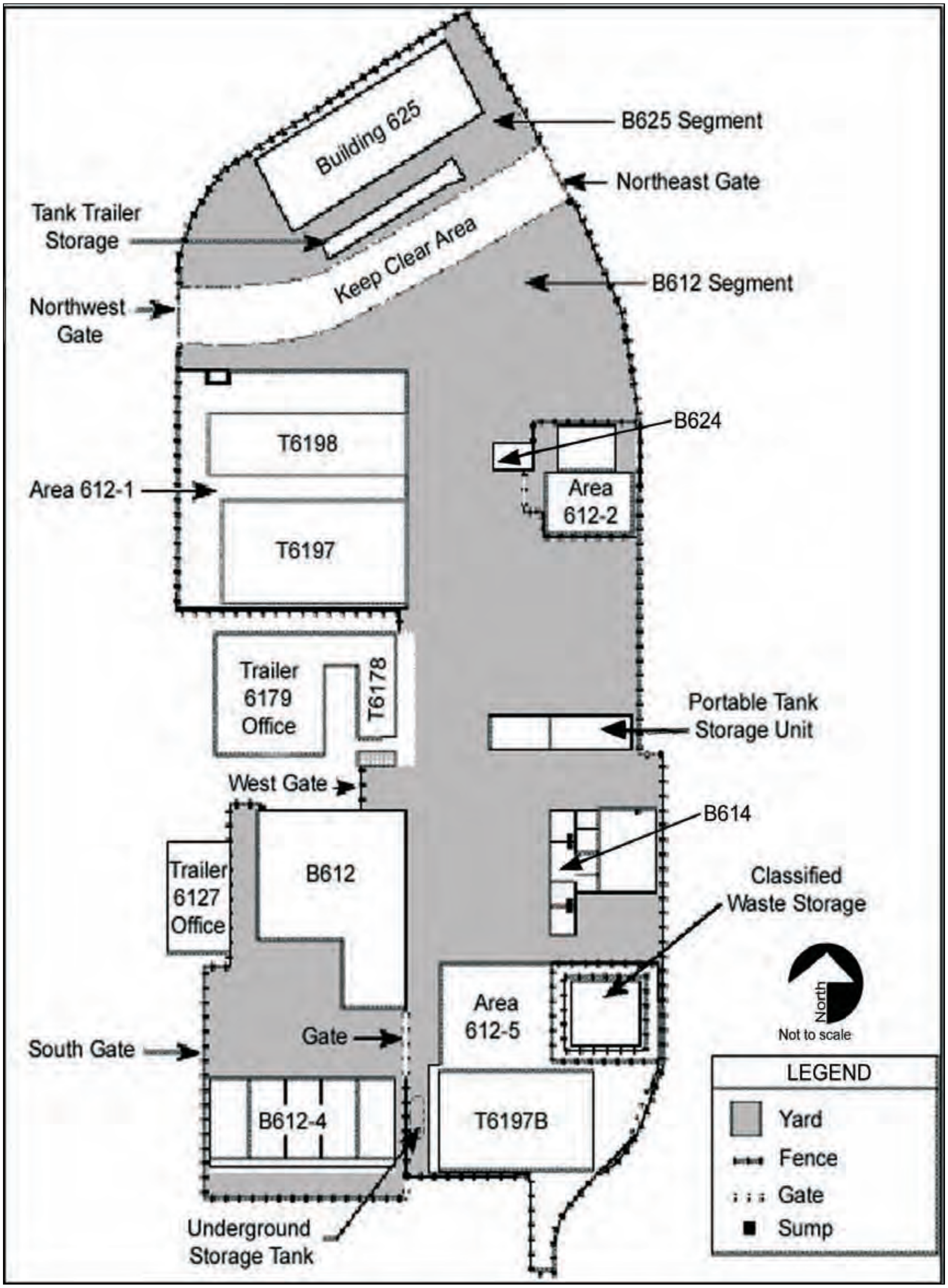
The structures and areas within the Building 625 Segment are:

- Building 625 CSU
- Area 612 Tank Trailer Storage Unit
- Building 625 Segment Yard Areas

Area 612 segments and yard areas are shown in Figure B.1.3.1–1. Detailed descriptions of the Area 612 segments are presented below.

Building 612

Building 612 houses the drum crusher for hazardous or radioactive drums and containers, a radioactivity-measuring unit, the CSU that supports the lab packing of small quantities of nonradioactive waste chemicals, and the bulking of corrosive materials, and a mixed waste storage area. The capacities are identified in Table B.1.3–1. The drum crusher is connected to a high-efficiency particulate air (HEPA) filter to remove any airborne particulate contaminants.



Source: LLNL 2000t.

FIGURE B.1.3.1–1.—*Area 612 Complex*

A small room adjacent to the lab packing area is used for bulking corrosive materials (i.e., mixing smaller quantities together to form larger quantities) and for sorting chemicals prior to taking the materials into the lab packing area.

The mixed waste storage area in Building 612 has a total inventory capacity of 7,150 gallons or approximately 130 55-gallon drums of waste. Hazardous and mixed wastes stored in this building are stored on pallets.

Storage Areas 612-1 and 612-5

Storage Area 612-1 consists of two enclosed tents constructed of plastic-coated canvas. Tent A is 49 feet by 82 feet, while Tent B is 30 feet by 98 feet. The total capacity for Tent A and B is approximately 38,400 cubic feet of solid waste. Storage Area 612-5 consists of a fenced area and a tent made of plastic-coated canvas. The fenced area contains four 8-foot by 8-foot by 40-foot containers used to store classified solid mixed wastes. The tent is 49 × 98 feet with storage capacity of 26,900 cubic feet.

A staging area is available in the yard area where wastes are loaded on and off vehicles, inspected, prepared, and transferred.

Storage Area 612-2

Storage Area 612-2 is a 30-foot by 47-foot, covered area used for storage of hazardous and mixed waste with a capacity of 10,560 gallons, surrounded by a 6-inch-high concrete berm. Liquid wastes are stored in the area in 55-gallon drums or smaller containers (generally 5 gallons or less) that are placed on secondary containment pallets. Liquid waste can also be stored in portable tanks, with capacities of 300, 600, 660, 750, and 1,100 gallons. These tanks are typically not placed on secondary containment pallets unless segregation of incompatible wastes is required.

Storage Area 612-4

Storage Area 612-4 is the primary receipt, segregation, and storage area (less than 90 days) for most wastes generated at LLNL prior to their distribution to the appropriate treatment, storage, process, or disposal site. The 40-foot by 100-foot area is covered by a roof and has an epoxy-coated concrete floor that is subdivided into five areas by berms that provide secondary containment. Three of the areas can store the equivalent of 144 55-gallon drums each and the other two can store the equivalent of 216 55-gallon drums each, totaling 864 55-gallon drums.

Building 614

Building 614 is divided into eight rooms or cells for storage of hazardous wastes and bulking of small quantities of compatible materials. The types of waste handled and stored in these cells may vary depending on need. Only compatible wastes, however, are managed in any single room at one time. Wastes stored in these cells include, but are not limited to, the following:

- Waste mercury
- Oxidizers

- Flammables
- Alkali and earth alkali solids
- Chlorosolvents and oils
- Caustics
- Acids
- Compressed gases
- Radioactive and mixed waste
- Aqueous solutions containing precious metals

The four cells on the west side of the building each have a maximum storage capacity of 168 gallons of waste. The four cells on the east side of the building each have a maximum storage capacity of 880 gallons of waste. In addition to storage, the east cells may also be used for bulking and lab-packing small quantities of compatible materials.

Building 625

This building handles and stores TRU and mixed TRU wastes and wastes regulated under the *Toxic Substances Control Act* (TSCA), such as polychlorinated biphenyls and asbestos. The building has a total floorspace of approximately 4,800 square feet and may store 42,416 gallons of waste volume. An epoxy-coated concrete berm inside the building separates the radioactive wastes (east side) from the nonradioactive wastes (west side) and provides a secondary containment capacity of about 17,954 gallons. Wastes are typically stored in steel drums or steel boxes.

Area 612 Portable Tank Storage Unit

The Area 612 Portable Tank Storage Unit is used to store liquid wastes in portable tanks. The storage unit has a design capacity of 10,000 gallons and is divided into two cells by a concrete curb. Cell A is designed to store up to 4,000 gallons of hazardous waste while Cell B has a design capacity of 6,000 gallons. The area consists of an uncovered 1,200-square-foot concrete pad surrounded on the north, east, and west sides by a concrete curb. The concrete pad slopes northward 11 inches high over 16 feet and the curb heights range from 11 inches along the north side to 0 inches along the southern edge of the storage area.

The internal dimensions of Cell A are 30 feet by 16 feet, and the internal dimensions of Cell B are 45 feet by 16 feet. Cell A is designed for storage of portable tanks as large as 330 gallons, while Cell B can store tanks as large as 660 gallons. The south end of the storage unit provides personnel and equipment access for managing, inspecting, and maintaining the containers.

Area 612 Tank Trailer Storage Areas

The Area 612 Tank Trailer Storage Area is designated for storage of hazardous or mixed liquid wastes in tank trailers or in portable tanks on flatbed trailers. The area has a total storage capacity of 5,000 gallons and the largest volume of any individual container that can be stored in the area is 5,000 gallons. The storage area is an uncovered recessed loading dock. The unit is 9 feet wide and 77.5 feet long and is recessed down to 4 feet below grade with a ramp on the east end for access. More than one tank trailer or flatbed trailer with portable tanks may be stored in the area as long as the wastes are compatible (i.e., will not create an additional hazard if mixed).

B.1.3.2 *Decontamination and Waste Treatment Facility*

The DWTF is a hazardous, radioactive, and mixed waste treatment and storage facility located in the northeast corner of the Livermore Site. Figure B.1.3.2–1 provides a footprint of the DWTF and identifies the facility segments. Hazardous and mixed waste management activities involve five individual facilities: Buildings 693, 694, 695, 696, and 697, and associated yard areas. Building 693 is a container storage unit and activities include waste packaging and storage. Building 695 provides storage and waste treatment capabilities including bulking and blending of wastes into treatment tanks; treating liquid and solid hazardous, mixed, and low-level radioactive wastes; storing; container rinsing; and waste transfer. Building 694 is the operational support facility and Building 697 is a Chemical Exchange Warehouse used for chemical exchange operations. Building 696 provides radioactive waste storage and solid waste receiving and processing capabilities. Building 695 includes a maintenance shop. Areas within the DWTF yard include a rainwater management area, a tanker storage area, a covered truck bay, and truck scales. Yard areas are used by mobile vendors to certify TRU waste and load it for shipment to WIPP.

As with Area 612, the DWTF is divided into three segments, based on location and management needs, for the purpose of safety analysis. Each segment contains a number of storage or treatment units. The segments within the DWTF are:

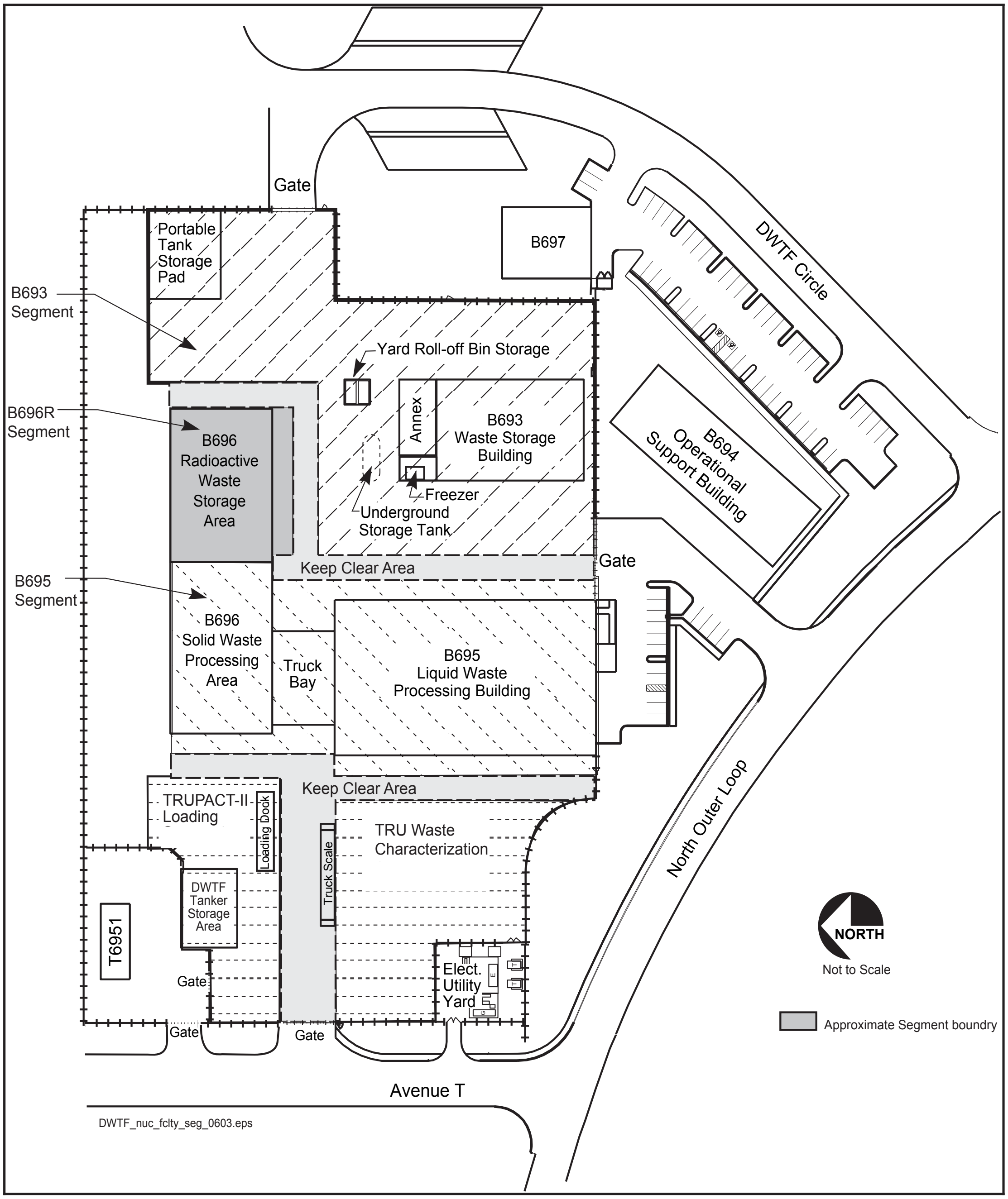
- Building 693 Segment
- Building 695 Segment
- Building 696R Segment

Detailed descriptions of the structures and areas within the DWTF segments are presented below.

Building 693 Segment

The Building 693 Segment consists of the following structures and areas:

- Building 693
- Building 693 Annex CSU
- Building 693 Freezer Storage Unit
- Building 693 Roll-off Bin Storage Unit
- DWTF Portable Tank Storage Unit
- DWTF Underground Storage Tank
- Building 693 Segment Yard Areas



Source: LLNL 2003av.

FIGURE B.1.3.2–1.—*Decontamination and Waste Treatment Facility*

Building 693 is a single-story, rigid structural steel frame building that is 80 feet wide and 120 feet long. The building interior is divided into four cells where wastes are segregated according to compatibility. The cells are approximately 30 by 80 feet and are separated by fire rated partitions. The two end cells (1000 and 1012) are designed to store 21,117 gallons each of hazardous and mixed waste. The center cells (1004 and 1008) are designed to store 21,118 gallons each of hazardous and mixed waste. The foundation floor slab consists of 10-inch-thick, reinforced concrete slab. The curbing system which surrounds the floor slab and divides the four cells is continuous, seamless, 8 inches wide, 6 inches high, and constructed of reinforced concrete. The concrete floor is finished with fiberglass-reinforced epoxy coating to ensure containment and cleanup of any leaks or spills. This unit stores solid, liquid, and gaseous wastes.

The Building 693 CSU is used to store RCRA and DTSC regulated hazardous and mixed wastes as well as TSCA regulated waste and TRU waste. The unit stores solid, liquid, and gaseous wastes. Other handling operations conducted in this unit include lab packing, over packing, bulking, sampling, and transferring. Ignitable, reactive, toxic, and corrosive wastes are grouped by compatibility and segregated appropriately in each of the four cells in Building 693.

As part of the construction of DWTF, the Building 693 Annex was added to the north end of Building 693. The Annex was designed for waste storage as well as providing a pad for the Building 693 Freezer Storage Unit. In addition to its planned use for waste storage, the Building 693 Annex will be used to thermally stabilize TRU waste in preparation for head space gas sampling, one of the processes required to certify the waste for shipment to the Waste Isolation Pilot Plant (WIPP) for disposal.

The Building 693 Roll-off Bin Storage Unit, DWTF Portable Tank Storage Unit and DWTF Underground Storage Tank are located in the Building 693 Segment Yard Area north of the building. The Building 693 Roll-off Bin Storage Unit is a concrete pad on which up to two vendor supplied large metal bins (roll off bins) are stored while collecting RCRA hazardous and non-RCRA hazardous solid waste. The DWTF Portable Tank Storage Unit is a coated, bermed, concrete pad designed to hold portable tanks of liquid waste. The liquid waste could be low-level, hazardous or mixed waste. These liquids primarily contain water. The DWTF Underground Storage Tank is connected by underground pipes to several DWTF facilities, including the Building 693 Annex, to capture overflow water from sprinklers in case of a fire.

Building 695 Segment

The Building 695 segment consists of the following structures and areas:

- Building 695
- Building 696S Solid Waste Processing Area (SWPA)
- Tanker Storage Area
- Other Yard Areas

Building 695 is used to manage both solid and liquid wastes, some of which are regulated under RCRA. The building is approximately 123 feet wide by 213 feet long. Building 695 is used to store and treat radioactive, mixed, and hazardous waste, and it also contains equipment used in conjunction with waste processing operations to treat various liquid and solid wastes. Waste management areas within Building 695 have sloping, epoxy-line concrete floors that provide secondary containment in the case of spills.

Building 695 is divided into the following areas:

- The liquid waste processing area (LWPA) is a high bay that houses various unit operations, such as the Tank Farm for storing and treating wastewater, evaporators, wastewater filtration module, bulking station, carbon adsorption unit, centrifuge, and waste blending station. The wastewater treatment tank farm consists of nine 5,000-gallon treatment tanks, and associated, valves, pumps and controls. The purpose of the tank farm is to treat wastewater that may be contaminated with hazardous constituents and/or radioactive isotopes. The LWPA also houses primary Process Off-Gas Systems that consists of air filtration equipment for treating offgases from waste treatment operations. This equipment includes carbon filters; acid gas scrubbers; volatile organic compound scrubbers; HEPA filters; and other associated air-handling equipment.

- The Building 695 airlock is used for transferring and storing containers, and it may house various portable treatment units when space permits.

- Processing rooms east of the Building 695 airlock house the shredder/chopper, solidification unit, and debris washer.

- The reactive materials area includes the reactive waste processing area (RWPA), four reactive waste storage rooms used for segregated storage of reactive wastes (e.g., water-reactive materials), and the reactive materials cell. The RWPA includes acid fume hoods and the combination, inert, and radioisotope gloveboxes. This area may also include units such as the mercury amalgamation unit, small laboratory operation hardware, and pressure reaction vessel. The reactive materials cell is a general-purpose area used for operations such as repackaging, uranium deactivation, and other bench scale processes.

- The small-scale treatment lab is operated in a manner similar to the reactive-materials area and may include units such as the mercury amalgamation unit, small laboratory operation hardware, and pressure reaction vessel.

- The instrument laboratory houses various analytical instruments, such as a gas-chromatograph/mass spectrometer, x-ray fluorescence spectrometer, and a dry electrolytic conductivity detector, and is used for real-time radiological and almost real-time metals and volatile organic carbon analyses to aid in treating mixed and radioactive wastes and developing improved treatment processes.

- The Building 695 Mezzanine contains air-handling units, water heater, communications equipment, and some power distribution (e.g., those items normally found in industrial complexes). The north section of the mezzanine contains HEPA filters for particulate removal from building air and process vents. The main building stack is located on the mezzanine in the northeast corner of the building.

- Building 695 Lobby, Office Space, Locker Rooms, and Utility Rooms.

Equipment was selected specifically to treat the waste streams RHWM expects will be generated at LLNL. However, some wastes might have unique characteristics that preclude treatment by existing equipment and shipment to an offsite treatment, storage, and disposal facility. Because unique wastes are generated infrequently, installing dedicated equipment is neither practical nor cost effective. Bench-scale, tabletop treatment processes can be developed on a case-by-case basis and conducted in one or more of the reactive materials area work stations.

The SWPA, located at the west end of Building 696, is a one-story, structural steel frame building measuring approximately 83 feet by 135 feet by 35 feet high. The building's exterior walls are metal panels on steel girts with a sloped, corrugated metal roof. The SWPA includes the waste receiving/classification room, solid waste processing room, a room that houses the Building 696S glovebox, and an airlock. The drum crushers are located in Room 1009, the Building 696S glovebox is located in Room 1008, and a fume hood is provided for waste management operations, e.g., lab-packing, in Room 1001. A 5-ton industrial bridge crane is located in both Rooms 1009 and 1001. The SWPA also houses primary air handling and HEPA filtration equipment for treating offgases from waste treatment operations. Building air and air from treatment operations is routed from Building 696S to the main building HEPA filters in Building 695 before passing out the Building 695 stack. The SWPA is used primarily to manage solid radioactive waste. Operations specific to the SWPA include sorting and segregating LLW and TRU waste, lab-packing, sampling, and crushing empty drums that previously contained LLW. The Building 696 SWPA may be used to store hazardous and mixed waste for up to 90 days in compliance with RCRA.

The west yard area includes a covered truck bay located directly between the west end of Building 696S and the north end of Building 695. The truck bay is used to receive incoming vehicles delivering waste containers. The truck bay is a 12-inch-thick concrete slab that has a polymeric coating and measures approximately 80 feet long by 50 feet wide. The pad is sloped towards a central trench. The truck bay is covered with a roof that prevents direct precipitation, and run-on is prevented because the adjacent asphalt drive slopes away from the containment area. To the west of Building 696S is a truck scale and a ramped loading dock used for loading and unloading vendor supplies and some waste transport vehicles. The area on the southwest side of Building 695 includes chemical reagent storage tanks, and a small metal storage shed.

The DWTF tanker storage area is a sloped pad to the west of Building 696S that provides secondary containment. This consists of an outdoor concrete sloping slab with concrete curbing and a collection trench along the north side of the pad. It is used to store tankers containing dilute concentrations of radioactive and hazardous materials, e.g., rainwater. The most common storage containers are tankers that have nominal volumes of 5,000 to 7,000 gallons. The containment pad is capable of holding approximately 18,000 gallons. This area also has a direct connection to the sanitary sewer for releases of liquids that meet sewer discharge limits.

Other nonwaste management areas in the Building 695 Segment include:

- **T6951 Maintenance Area—** This area is for routine maintenance of facility equipment. This building and yard areas are separated from the rest of the DWTF facility by fences, and gates. It contains only small amounts of solvents and lubricants for maintenance purposes, compressed gas cylinders, and fueled vehicles, and does not contain radionuclides.

- **DWTF Transformer Area—** This yard area contains the DWTF emergency generator and transformer. This area is separated from the nuclear facility by fences. It contains only fuel for the generator and does not contain radionuclides.

Building 696R Segment

The Building 696R segment consists of Building 696R and other yard areas.

Building 696R is a single-story, rigid, structural steel frame building approximately 83 feet wide by 120 feet long. The building is divided into two rooms. The foundation floor slab consists of 10-inch-thick, reinforced-concrete slab that slopes to the north of the building. The concrete floor is finished with fiberglass-reinforced epoxy coating to ensure containment and cleanup of any leaks or spills. Building 696R is not connected to the Building 695 ventilation system and has only passive ventilation.

Building 696R is designed for the storage of solid TRU waste, solid and liquid low-level waste, and combined waste (i.e., radioactive and California-regulated hazardous waste). The Building 696R Segment is not currently permitted. Therefore, hazardous and mixed waste will not be allowed in this area until the permit is obtained. However, TRU waste or LLW contaminated with California-only regulated hazardous constituents (that is, combined waste) may be stored in Building 696R. Operations in the Building 696R segment include loading, unloading, staging, storage, over packing, LLW sampling, and periodic visual inspections of waste containers.

TRU Waste Segments

The mission performed in the TRU Waste Segments is to characterize LLNL TRU waste, repackage it as necessary, and load the waste drums into Transuranic Package Transporter–II (TRUPAC-II) casks for offsite shipment. The waste needs to meet both the U.S. Department of Transportation (DOT) shipping requirements and the waste acceptance criteria for the receiving facility, which will be the WIPP.

B.1.4 Descriptions of Radioactive and Hazardous Waste Management Facilities at Site 300

Because Site 300 is part of the LLNL operations, the waste management procedures are similar for identifying, handling, packaging, storing, and transporting radioactive, hazardous, mixed, and medical wastes. The onsite generators have the same responsibilities as those at the Livermore Site and also receive the same assistance from the LLNL waste management staff. Wastes generated at the buildings are accumulated in SAAs and then transported to the Site 300 waste management facilities. Hazardous wastes are stored at the Building 883 Container Storage Area, and low-level radioactive wastes are staged and stored at Buildings 804 and 883 WAAs. Site 300 also stores high explosive wastes at the Explosive Waste Storage Facility (EWSF) and treats high explosives waste at the Explosive Waste Treatment Facility (EWTF) (Building 845). The following sections describe these operations: the generation, collection, and storage of radioactive, mixed, and hazardous waste. Treatment and storage capacities are presented in Table B.1.3–1.

Explosive Waste Treatment Facility

The EWTF, located in Building 845, was built to replace the Building 829 High Explosives Open Burn Treatment Facility (RCRA closure was completed in 1999). The EWTF consists of two open burn units (burn pan and burn cage) and one open detonation unit (gravel pad). After treatment, residual wastes are managed in two storage units (S1 and S2) with a permitted storage capacity of 275 gallons and 110 gallons, respectively. In 2002, the EWTF treated 2,735 pounds of explosive-related hazardous waste (LLNL 2003be). Treatment quantity limits are shown in Table B.1.4–1. Biological, radioactive, and mixed wastes are not permitted at the EWTF.

TABLE B.1.4–1.—*Explosive Waste Treatment Facility Treatment and Quantity Limits*

	Burn Pan	Burn Cage	Detonation Pad
Annual limit	100 open burns/yr	100 open burns/yr	100/yr
Daily limit	1 open burn/day	1 open burn/day	1/day
Gross weight limit	150 lb/event	260 lb/event	350 lb/event

Source: California EPA 1997.
lb = pounds; yr = year.

Explosive Waste Storage Facility

The EWSF consists of three earth-covered, concrete magazines; two earth-covered, corrugated-metal magazines; and one prefabricated metal building. The magazines are built in a semicircle in a knoll with their doors facing out from the knoll. The materials and methods of construction are designed to minimize sympathetic fires and explosions by maintaining a fairly consistent temperature and humidity within each structure. Compliance with explosive weight and distance limits also helps to ensure the safe operation of the EWSF.

Building 883—Hazardous Waste Storage Facility

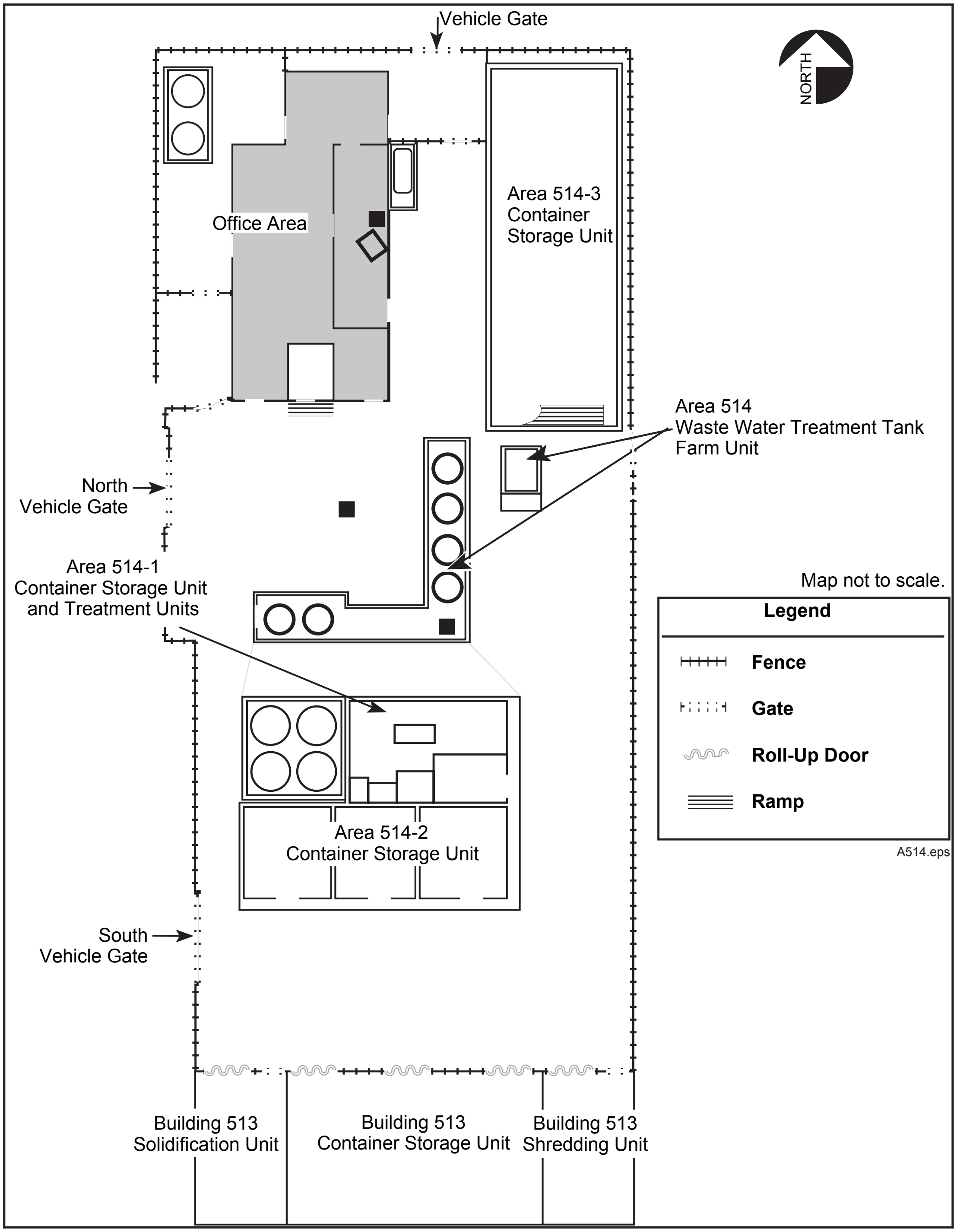
Building 883, the Hazardous Waste Storage Facility, consists of a roofed, rectangular structure 50 feet by 35 feet with a total inventory capacity of 3,300 gallons consisting of sixty 55-gallon drums or their equivalent. The facility is a RCRA Part B-permitted facility for storage of designated hazardous wastes. The floor area is surrounded by a berm for secondary containment and slopes to a sump in the southwest corner of the building. The facility is not used for the storage of radioactive wastes. Building 883 WAA can stage and stove low-level wastes before shipment to offsite disposal facilities. Building 804, a metal roof shed, is used for long term storage of gravel potentially contaminated with low-level radioactive materials.

B.1.5 Waste Management Facilities to be Shut Down and Closed

Three facilities at LLNL that are approved for waste management operations have been or will be shut down and closed. The Building 233 CSU has been shut down and all wastes removed. Building 280, although permitted for storage of hazardous waste, was never operated. Prior to FY2005, Building 514 operations will be transferred to the DWTF. Final closure plans for Building 233 and Area 514 were submitted to DTSC in May 2000. Since Area 514 will continue operations in the near term, descriptions of the waste management units in Area 514 are presented below. Treatment and storage capacities are presented in Table B.1.3–1.

Building 513

Building 513 houses a size reduction treatment unit (designed to operate with hand tools) and a radioactive and mixed waste container storage area. A solidification unit that was previously located in Building 513 has been relocated to Building 695 as part of the transition plan. This unit processes up to 8.32 cubic yards per day. Figure B.1.5–1 provides a footprint of Area 514. Area 514 is operated as a radiological facility.



Source: LLNL 2002ce.

FIGURE B.1.5–1.—*Area 514 Complex*

The storage area has a total storage capacity of 15,760 gallons, or approximately 286 55-gallon drums of regulated waste. Incompatible wastes (i.e., wastes that cause a potential hazard if mixed) have been stored on secondary containment pallets to contain leaks or spills.

Building 514

This building houses the wastewater filtration unit. As water is processed through the rotating drum vacuum filter, solids are filtered out by the diatomaceous earth, built up on the outside of the rotating drum, and continuously scraped off as the drum rotates during operation. The scraped material is collected for storage as a mixed waste. If the filtrate meets release limits, it is discharged to the sanitary sewer. If it does not meet the release criteria, the filtrate is reprocessed until the release limits are met.

Building 514 Wastewater Treatment Tank Farm and Storage Tanks

The wastewater treatment tank farm consists of six 1,850-gallon treatment tanks, and a quadruple tank unit (4-4,600 gallon storage tanks). The purpose of the tank farm is to treat wastewater that may be contaminated with hazardous constituents and/or radioactive isotopes. The purpose of the quadruple tank unit is to store, transfer, pump, bulk, and sample wastewater.

For the treatment tanks, the majority of liquid wastes arrive at the Building 514 Complex in portable tanks and are pumped into the 1,850-gallon tanks through a pump station. Wastes in containers such as 55-gallon drums and 5-gallon carboys are consolidated and transferred to the 1,850-gallon tanks via the bulking station. The treatment process may involve batch chemical treatments consisting of neutralization, flocculation, oxidation, reduction, precipitation, and separation. Filtration is accomplished by a diatomaceous earth-precoated vacuum filter located in Building 514.

For the quadruple tank unit, the tanks are filled through a pump station and can be pumped to any of the treatment tanks. The wastewater is stored until such time as treatment can be effectively performed. No treatment operations are performed in the quadruple tanks.

Storage Areas 514-1 and 514-2

These areas are designated for the storage and treatment of mixed wastes. They consist of epoxy-coated, covered concrete storage pads with sloped floors contained by 12-inch-high berms on three sides. Storage Area 514-1 contains a cold vapor evaporator. The cold vapor evaporator, which is used to remove greater than 85 percent of the water from a waste stream, will be removed from the facility in fiscal year (FY) 2004.

Storage Area 514-2 is subdivided into three areas by concrete berms in order to separate incompatible chemicals. The types of mixed waste stored in these areas include radioactive acid and alkaline solutions, dilute coolant with oil residue, and wastes containing low concentrations of metals including copper, beryllium, chromium, nickel, and/or zinc. Waste containers are stored on pallets.

Storage Area 514-3

This area is used as a portable tank and container storage area to store waste prior to treatment at the wastewater treatment tank farm. The types of waste stored in these areas include acid and

alkaline solutions, dilute coolant with oil residue, and wastes containing low concentrations of metals including copper, beryllium, chromium, nickel, and/or zinc. The majority of these wastes contain radioactive constituents and are consequently treated as mixed wastes. The area is also used to store solid waste generated by the wastewater filtration unit as well as empty tanks. The total storage capacity for the area is 22,050 gallons or approximately 400 55-gallon drums.

B.2 PURPOSE AND NEED

The NNSA needs to enhance the efficiency and safety of its current waste operations. NNSA proposes to meet its need by preparing a series of permit modifications, phasing out older facilities, and increasing operations to the design capabilities of the DWTF. The DWTF would continue to consolidate current waste operations, provide a facility to conduct hazardous operations, provide for the treatment and processing of stored wastes, improve waste minimization, and fully implement facility capabilities for waste treatment, storage, and processing. This centralized facility would concentrate like activities in one area, thus providing safer and more efficient working conditions. Other facilities (Area 612 Complex and Site 300 RHWM Facilities) would continue to treat, store, and process waste in support of LLNL programs and missions.

The proposed modifications are evaluated in this LLNL SW/SPEIS because of the integral nature of the radioactive and hazardous waste management operations to the overall LLNL mission. This appendix serves as the NEPA documentation for these modifications. One purpose of this appendix is to provide the NNSA decisionmaker, the DTSC, and the public with permit modification-specific information in one report, even though the impact analysis also appears under the individual environmental resources and issue areas of this LLNL SW/SPEIS.

B.3 DESCRIPTIONS OF THE NO ACTION ALTERNATIVE, PROPOSED ACTION, AND REDUCED OPERATION ALTERNATIVE FOR WASTE MANAGEMENT

CEQ regulations (40 CFR Parts 1500-1508) require that DOE and other Federal agencies use the review process established by NEPA, as amended (42 U.S.C. §4321 et seq.), and the DOE regulations implementing NEPA (10 CFR Part 1021) to evaluate not only the Proposed Action, but also to identify and review reasonable alternatives to the Proposed Action, as well as a No Action Alternative. This comprehensive review ensures that environmental information is available to public officials and citizens before decisions are made and before actions are taken.

NNSA developed the No Action Alternative, Proposed Action, and Reduced Operation Alternative to accomplish this action and to assess environmental impacts of waste management activities at LLNL. This appendix examines and compares the No Action Alternative, Proposed Action, and Reduced Operation Alternative. LLNL activity descriptions, by facility, are also provided. All of the activities discussed in this appendix were used in evaluating the impacts of each alternative presented in Chapter 3 of the LLNL SW/SPEIS. The alternatives are defined in the following sections:

- No Action Alternative (Section B.3.1)
- Proposed Action (Section B.3.2)
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These three alternatives represent the range of levels of operation necessary to carry out the NNSA missions, from the reduced levels of activity that maintain core capabilities (Reduced Operation Alternative) to the highest reasonable activity levels that could be supported by current facilities, closing facilities no longer needed (including Area 514) and the potential expansion and construction of new capabilities for specifically identified future actions (Proposed Action).

Under the No Action Alternative, ongoing NNSA programs and activities at LLNL would continue operating at planned levels as reflected in current NNSA management plans. In some cases, these planned levels would include increases over today's operating levels. The No Action Alternative would include any recent activities that have already been approved by the NNSA (including submitted permit modifications) and that have existing NEPA documentation.

Under the Proposed Action, NNSA programs and activities at LLNL would increase to the highest reasonable activity levels, as set forth in this LLNL SW/SPEIS, that could be supported by current facilities and by their potential expansion and modification for future actions specifically identified in the LLNL SW/SPEIS. The Proposed Action would continue to operate and enhance LLNL waste management facilities. The Proposed Action also provides new facilities that would generate wastes.

Under the Reduced Operation Alternative, NNSA would conduct operations at the minimum levels of activity required to maintain core capabilities. This includes a scale down of the Stockpile Stewardship Program by approximately 30 percent below the level analyzed under the No Action Alternative.

This appendix analyzes the environmental impacts of LLNL waste management activities associated with the No Action Alternative, Proposed Action, and Reduced Operation Alternative.

Table B.3–1 provides a brief summary of the waste management activity levels (DWTF and Area 612) evaluated in this appendix. Table B.3–2 provides a comparison of parameters used in analyzing the alternatives. Table B.3–3 provides planned permit and other activities by alternative. Table B.3–4 provides a brief summary of the waste management activity levels for Site 300 facilities evaluated in the appendix.

TABLE B.3–1.—*Activity Levels Used to Analyze Decontamination and Waste Treatment Facility and Area 612 Facilities Under the No Action, Proposed Action, and Reduced Operation Alternatives (Routine plus Nonroutine)*

Facility	Waste Type	FY2002	No Action	Proposed Action	Reduced Operation
DWTF and Area 612 Combined	TRU	39.2 m^3/yr	105 m^3/yr	110 m^3/yr	100 m^3/yr
	Mixed TRU	2.6 m^3/yr	1.7 m^3/yr	2.8 m^3/yr	0.7 m^3/yr
	LLW	650 m^3/yr	830 m^3/yr	1,040 m^3/yr	730 m^3/yr
	MLLW	111 m^3/yr	133 m^3/yr	169 m^3/yr	105 m^3/yr
	Total Hazardous	1,320 metric tons/yr	1,890 metric tons/yr	2,210 metric tons/yr	1,600 metric tons/yr

Source: TtNUS 2003.
DWTF = Decontamination and Waste Treatment Facility; LLW = low-level waste; m^3/yr = cubic meters per year; MLLW = mixed low-level waste; TRU = transuranic.

TABLE B.3–2.—*Comparison of Parameters Used to Analyze LLNL Waste Management Facilities Under the No Action, Proposed Action, and Reduced Operation Alternatives*

		FY2002	No Action	Proposed Action	Reduced Operation
	Units	Total LLNL	RHWM Facilities		
Land Use					
Total acreage	Acre	Livermore–821 Site 300–6,900	No changes	No changes	No changes
Class 3 permit modification	Acre	NA	Not part of this alternative	No changes Within existing footprints	Same as No Action
Waste storage facility modifications (Current Plans)	Acre	NA	No changes Within existing footprint	Same as No Action	Same as No Action
Class 1 Permit Modifications (Future Plans)	Acre	NA	No changes	No changes	No changes
Class 2 Permit Modifications (Future Plans)	Acre	NA	4 RCRA closures[d] (Buildings 233 CSU, 280, 513, and 514) less than 6 acres	Same as No Action[d]	Same as No Action[d]
Utilities and Energy					
Utilities (Annual Basis)					
5ESS Telecomm. Switch	Voice lines	18,973	520	556	479
Telecomm. Dist. System:					
Copper Trunk Cables (B256 to 13 nodes)	Pairs	20,330	556	596	514
Fiber Trunk Cables	Number	1,468	40	43	37

TABLE B.3–2.—*Comparison of Parameters Used to Analyze LLNL Waste Management Facilities Under the No Action, Proposed Action, and Reduced Operation Alternatives (continued)*

		FY2002	No Action	Proposed Action	Reduced Operation
	Units	**Total LLNL**	**RHWM Facilities**		
Utilities and Energy (cont.)					
Copper Distribution (Nodes to buildings)	Number	96,950	2,660	2,840	2,450
Network Speed to Desktop	Mbps	10	10	10	10
Electricity	MW	57	1.5	1.7	1.4
Natural Gas	therms/day	12,900	571	611	528
Domestic Water	GPD	210M	0.04M	0.04M	0.04M
Low Conductivity Cooling Water	MW	36.5	1	1	1
Demineralized Water	GPD	27,700	NA	NA	NA
Sanitary Sewer	GPD	216,400	8,000	9,000	7,800
Compressed Air	SCFM	2,400	74	79	68
Level of Activity	RHWM/ Workers	10,600	160/10,900	170/11,400	140/10,000
Geology and Soils					
Solid Waste Management Units	Number	800	Same as FY2002	Same as FY2002	Same as FY2002
RCRA Closures	Number	NA	4	Same as No Action	4 closures
Water Resources and Hydrology					
Domestic Water	GPD	1.4M	0.04M	0.04M	0.04M
Groundwater Quality	NA	Some MCL exceedance	No degradation	No cegradation	No degradation
Surface Water (stormwater)[a]	NA	NA	No changes	No changes	No changes
Biological and Ecological Resources					
Loss of Habitat	Acre	NA	No changes	No changes	No changes
Cultural Resources					
Cultural Resources Located in all Areas of Potential Effect	Acre	NA	No changes	No changes	No changes
Air Quality					
Permitted Emission Sources	Number	155	8	8	8
Nonradioactive Emissions Rates					
Precursor organic compounds	kg/day	19	0.3	0.3	0.3
Nitrogen oxides	kg/day	53	1.6	1.6	1.6

TABLE B.3–2.—*Comparison of Parameters Used to Analyze LLNL Waste Management Facilities Under the No Action, Proposed Action, and Reduced Operation Alternatives (continued)*

	Units	FY2002 Total LLNL	No Action	Proposed Action	Reduced Operation
			RHWM Facilities		
Air Quality (cont.)					
Carbon monoxide	kg/day	15	0.5	0.5	0.5
Particulates	kg/day	6	0.2	0.2	0.2
Sulfur oxides	kg/day	1	small	small	small
Radioactive Emissions (Dose)		<1 mrem	<1 mrem	<1 mrem	<1 mrem
Construction Related Carbon Monoxide Emissions					
New Construction	tons/yr	NA	0	0	0
Transportation (Normal Operations)					
Waste (Includes Hazardous and Radioactive, annual shipments)	Shipment/yr	88	240	310	200
Sanitary Waste (annual shipments)	Shipment/yr	359-518	370-534	395-570	341-492
TRU legacy waste shipment	Total shipments	0	24	24	24
LLW legacy waste shipment	Total shipments	1	64	64	64
MLLW legacy waste shipment	Total shipments	1	80	80	80
LBNL mixed TRU shipment	One time shipment	0	0	1	0
Mixed TSCA waste shipment	Total shipments	1	13	13	13
Workforce commuter Vehicles	Vehicles/day (Trips/day)	7,500-8,500 (15,000 - 17,000)	267 (534) 160 (320)	286 (572) 170 (340)	247 (494) 140 (280)
Waste Generation (Total, routine plus nonroutine)					
Radioactive Waste					
LLW	m^3/yr	650	830	1,040	730
MLLW	m^3/yr	110	130	170	110
TRU	m^3/yr	39	105	110	100
Mixed TRU Waste	m^3/yr	2.6	1.7	2.8	0.7
Chemical Waste					
RCRA Hazardous Waste	Metric Tons/yr	In total	730	860	610
TSCA (PCBs and Asbestos)	Metric Tons/yr	In total	430	490	360

TABLE B.3–2.—*Comparison of Parameters Used to Analyze LLNL Waste Management Facilities Under the No Action, Proposed Action, and Reduced Operation Alternatives (continued)*

	Units	FY2002 Total LLNL	No Action (RHWM Facilities)	Proposed Action (RHWM Facilities)	Reduced Operation (RHWM Facilities)
Waste Generation (cont.)					
Biohazardous	Metric Tons/yr	1.0	1.0	1.0	1.0
State-regulated Waste	Metric Tons/yr	In total	740	850	630
Total Hazardous	Metric Tons/yr	1,300	1,900	2,200	1,600
Sanitary Solid Waste	Metric Tons/yr	4,700	4,800	5,100	4,400
Class 1 Permit Modifications	Total Requests		75	100	50
Class 2 Permit Modifications	Total Requests		10	20	0
Class 3 Permit Modifications	Total Number	0	0	2	0
Number of RCRA Permits	Total Number	3	3	3	3
Permit Renewal	Total Number	0	1	1	1
RCRA Waste Management Facility Closures	Total Number	0	4	4	4
Noise					
LLNL Estimated Noise		CNEL L_d 7 am to 7 pm	CNEL L_d 7 am to 7 pm	CNEL L_d 7 am to 7 pm	CNEL L_d 7 am to 7 pm
Socioeconomics					
LLNL Workforce	Workforce	10,600	10,900	11,400	10,000
LLNL RHWM Workforce	Workforce	150	160	170	140
LLNL Operating Budget	Dollar/yr	1.5 billion[b]	1.5 billion[b]	1.7 billion[b]	1.4 billion[b]

Source: TtNUS 2003, LLNL 2002dm.

[a] Stormwater is collected, sampled, and dispositioned (may include treatment, discharge to sewer, or offsite disposal) at all RHWM facilities.

[b] Estimate based on 2002 dollars.

CNEL L_d = community noise equivalent-level-day; CSU = container storage unit; ER = environmental restoration; FY = fiscal year; GPD = gallons per day; kg/day = kilograms per day; LBNL = Lawrence Berkeley National Laboratory; LLW = low-level waste; M = million; m^3/yr = cubic meters per year; Mbps = million bits per second; MCL = maximum contaminant level; MLLW = mixed low-level waste; mrem = millirem; MW = megawatts; NA = not available; PCBs = polychlorinated biphenyls; RCRA = *Resource Conservation and Recovery Act;* RHWM = radioactive and hazardous waste management; SCFM = standard cubic feet per minute; TRU = transuranic; TPD = tons per day; TSCA = *Toxic Substances Control Act;* WM = waste management.

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TABLE B.3–3.—*Summary of Permit Actions and Other Waste Management Actions by Alternative*

Action	Description	No Action	Proposed Action	Reduced Operation
RCRA Closure Area 514 Treatment Units	Area 514 Storage and Treatment Quadruple Tank Unit	X	X	X
	Area 514 Waste Water Filtration Unit	X	X	X
	Area 514 Waste Water Treatment Tank Farm Unit	X	X	X
	Area 514 Bulking/Blending Unit	X	X	X
RCRA Closure Area 514 Storage Units	Building 513 CSU, Area 514-1 CSU, Area 514-2 CSU, and Area 514-3 CSU would undergo RCRA closure	X	X	X
RCRA Closures	Building 233 CSU and 280	X	X	X
Class 1 (DTSC several dates) modification	Implementation of 77 approved permit modifications	X	X	X
Class 2 (approved 12/23/2002) modification	Implementation of 3 approved permits modifications	X	X	X
Class 2 (submitted to DTSC in March 2003)	Replace drum rinsing station with a new, open-trough bulking station	X	X	X
	Remove room pre-filters from shredder/chopper ventilation systems	X	X	X
	Replace dry fire suppression system in the Reactive Waste Processing Area	X	X	X
Class 2 (submit to DTSC after 2003)	Permit Building 696 for Hazardous and Mixed Waste		X	
	Begin Storage of Hazardous and Mixed wastes in Building 696		X	
Building 695/696 Actions	Building 696 lab packing and waste verification would begin	X	X	X
	Relocation of rad-only Drum crusher to Building 696 from Building 612	X	X	X
	Relocation of Size Reduction Booth to Building 696 from Building 612		X	
	Install second evaporator for radioactive waste in Building 695	X	X	X
	Relocate Building 695 solification equipment and Building 513 encapsulation HEPA filter to Building 695 debris treatment room	X	X	X
	Add a glove-box into the small-scale treatment area, Building 695	X	X	X
	Relocate WAA into Building 696	X	X	X
Permit Renewal	Submit Permit Renewal	X	X	X
TRU Waste	Begin TRU Waste shipments to WIPP	X	X	X
	Receive a one-time Lawrence Berkeley National Laboratory TRU and mixed TRU waste shipment for storage and eventual shipment to WIPP	X	X	X
	Begin TRU Waste Legacy certification campaign	X	X	X
TSCA Waste	Begin TSCA-mixed waste treatment campaign with Oak Ridge, Tennessee, incinerator. Would include return of ash (residues) for storage prior to final disposal	X	X	X

Source: Original.

DTSC = California Department of Toxic Substances Control; RCRA = *Resource Conservation and Recovery Act;* TRU = transuranic; TSCA = *Toxic Substance Control Act*; WAA = Waste Accumulation Area; WIPP = Waste Isolation Pilot Plant.

TABLE B.3–4.—*Comparison of Activity Levels at Three Site 300 Facilities Under the No Action Alternative, Proposed Action, and Reduced Operation Alternative*

Facility	Primary Function	Activity Type or Material	Level of Activity	No Action	Proposed Action	Reduced Operation
EWTF	Waste management	Explosive waste, treatment and 1-year storage of treatment residues	LLW (kg/yr)	0	0	0
			MLLW (kg/yr)	0	0	0
			Total hazardous waste (lb/yr)	3,300	3,300	2,800
Building 883	Waste management	Collection, packaging, handling, and short-term storage of hazardous, radioactive, and mixed wastes	LLW (kg/yr)	0	0	0
			MLLW (kg/yr)	0	0	0
			Total hazardous waste (kg/yr)	12,000	13,000	11,000
EWSF	Waste management	Storage of explosive wastes	LLW (kg/yr)	0	0	0
			MLLW (kg/yr)	0	0	0
			Total hazardous waste (lb/yr)	6,500 (Gross)	7,200 (Gross)	6,200 (Gross)

Source: TtNUS 2003.
EWTF = Explosive Waste Treatment Facility; EWSF = Explosive Waste Storage Facility; kg/yr = kilograms per year, LLW = low-level waste; lb/yr = pounds per year; MLLW = mixed low-level waste.

In order to provide comprehensive existing conditions descriptions (in most cases the base period for data was 1992 through 2002) from which operational levels could be projected, the NNSA gathered the best available data. The following documents have been extensively used in this appendix and are not cited repeatedly:

- *Final Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrence Livermore National and Sandia National Laboratories* (1992 LLNL EIS/EIR) (LLNL 1992a)
- 1992 through 2001 routine and nonroutine waste generation data (LLNL 2001aq)
- 2001 and 2002 routine and nonroutine waste generation data in cubic meters and metric tons (LLNL 2002cc, LLNL 2002p)
- Waste minimization and pollution prevention data (LLNL 2002cc)
- Part B Permit application, including previous application data as referenced (LLNL 2002cd)
- Recently submitted Class 1 and Class 2 Permit modifications (Sandhu 1999, Sandhu 2001, LLNL 2003aj, LLNL 2002z, LLNL 2003b)
- Health risk assessments (LLNL 2001ar, LLNL 2000aa, LLNL 2003r)
- Site-Wide Environmental Impact Statement and Supporting Environmental Documentation Comparison of Parameters to be Used to Analyze LLNL Waste Management Facilities Under the No Action, Proposed Action, and Reduced Operation Alternatives (TtNUS 2003)

NNSA is not revisiting any programmatic decisions previously made in other NEPA documents, such as those addressing weapons complex, materials disposition, TRU waste shipments, or waste management and LLNL permit modification submittals. The LLNL SW/SPEIS includes these programmatic activities and permitting activities in order to provide the NNSA, California DTSC, and public with an overall understanding of the waste management activities at LLNL.

B.3.1 No Action Alternative

Under the No Action Alternative, ongoing NNSA and interagency programs and activities at LLNL would continue operating at planned levels as reflected in current DOE/NNSA management plans for 2004 through 2014 (e.g., recent Class 1 and Class 2 Permit modification submittals). The No Action Alternative includes the continuing and historical onsite waste management operations, continuing environmental protection and environmental restoration, continuing pollution prevention and waste minimization programs, and transportation of waste to offsite approved waste management facilities (includes a wide variety of DOE and commercial facilities). The DWTF use would increase by implementing planned permit modifications (see Table B.3.1–1). In some cases, projected waste generation levels would include increases over today's waste generation levels (e.g., National Ignition Facility [NIF] contributions). This would also include any recent activities that have already been approved by NNSA and have existing NEPA documentation. If these planned operations are implemented in the future, they could result in increased activity above present levels. Thus, the No Action Alternative forecasts, over

10 years, the level of activity for LLNL RHWM operations that would implement current management plans (e.g., RCRA closure of Building 514) for assigned programs.

TABLE B.3.1–1.—*Examples of Possible Permit Modifications Under the No Action Alternative*

Class 1	Class 2
Administrative and informational changes	Changes in frequency or content of inspection schedules
Correction of typographical errors	Changes to corrective action program
Equipment replacement or upgrading with functionally equivalent components	Changes to detection monitoring program
Changes in names, addresses, and phone numbers of emergency coordinators	Extensions of post-closure care period
Changes to waste sampling and analysis methods to comply with new regulations	Changes to facility training plan that affect the type or amount of employee training
Changes to analytical quality assurance and quality control plan to comply with new regulations	Changes in number, location, depth, or design of groundwater monitoring wells

Source: 40 CFR §270.42, EPA n.d.
Note: Permit modifications are classified in more detail in 40 CFR §270.42, Appendix I.

The CEQ's NEPA implementing regulations (40 CFR Parts 1500-1508) require analyzing the No Action Alternative to provide a benchmark against which the impacts of the activities presented in the other alternatives can be compared.

Other plans used to prepare the description of the No Action Alternative include the site development plans for LLNL, Programmatic Environmental Impact Statements (PEISs), Part B Permit modifications, and guidance. The activities reflected in this alternative include planned increases in some LLNL operations and activities over previous years' levels.

Over the next 10 years the following actions are planned for the No Action Alternative:

- Increase use of DWTF
- Transfer several Area 514 operations to Building 695 (Table B.3–3)
- Close Area 514 storage and treatment operations (Table B.3–3)
- Continue Class 1 (DTSC-approved, various dates) modifications (Table B.3.1–1)
- Fully implement approved Class 2 (DTSC-approved, December 2002) modifications (Table B.3.1–1)
- Fully implement March 2003 permit modification
- Add (radioactive waste-only) 600-ton per year Drum/Container Crusher to Building 696
- Begin lab packing and waste verification in Building 696
- Install second evaporator for radioactive waste in Building 695

- Relocate Building 695 modification equipment to Building 696
- Relocate Building 513 HEPA filter encapsulation to Building 695 debris treatment room
- Add a glovebox into Building 695
- Submit approximately 75 Class 1 permit modifications over the next 10 years (Table B.3.1–1)
- Submit approximately 5 to 10 Class 2 permit modifications over the next 10 years (Table B.3.1–1)
- Submit one permit renewal
- Begin TRU and mixed TRU waste shipments to WIPP
- Receive a one-time shipment of Lawrence Berkeley National Laboratory TRU and mixed TRU waste at LLNL for interim storage and eventual shipment to WIPP
- Begin TSCA-mixed waste treatment campaign with Oak Ridge, Tennessee, incinerator, including return of ash (residues) for storage prior to final disposal
- Begin closure of Buildings 233 CSU and 280
- Annually manage (routine) waste quantities presented in Table B.3.1–2

TABLE B.3.1–2.—*Routine and Nonroutine Operations Annual Waste Generation Quantities Under the No Action Alternative*

Waste Type	Annual Quantities	
	Routine	**Nonroutine**
LLW	200 m^3/yr	630 m^3/yr
MLLW	61 m^3/yr	72 m^3/yr
Total hazardous	390 metric tons/yr	1,500 metric tons/yr
TRU	50 m^3/yr	55 m^3/yr
Mixed TRU	1.7 m^3/yr	0
Sanitary solid	4,800 metric tons/yr	Included in Routine
Wastewater	310,000 gal/day	Included in Routine

Source: TtNUS 2003.

gal/day = gallons per day; LLW = low-level waste; m^3/yr = cubic meters per year; MLLW = mixed low-level waste; TRU = transuranic.

The following sections describe the activities that would occur at specific facilities because of implementing assignments under the No Action Alternative.

Radioactive and Hazardous Waste Management Facilities

The DWTF (Buildings 693, 695, and 696) would receive, treat, handle, package, store (short-term), and ship hazardous, radioactive, and nonhazardous chemical wastes. The facility is located in a fenced compound in the northeast corner of the Livermore Site. Except for Building 696, the DWTF is a RCRA, Part B-permitted facility that would support waste generators throughout LLNL. Activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. The facility would normally operate one shift.

Modifications to the existing facility to improve flexibility and operational efficiencies (see Table B.3.1–1) would be completed. Building 696 would continue to manage radioactive and nonhazardous wastes only. Quantities of total hazardous waste managed (see Table B.3–1) would be up to 1,890 metric tons per year. Quantities of MLLW managed (see Table B.3–1) would be up to 133 cubic meters per year. Quantities of TRU and mixed TRU wastes managed (see Table B.3–1) would be up to 107 cubic meters per year plus the legacy inventory of 106 cubic meters.

Building 694, the Operational Support Building, and Building 697, the Chemical Exchange Warehouse, are situated adjacent to the DWTF. While part of the waste management support operations at LLNL, these facilities do not currently receive, treat, handle, package, store (short-term), or ship hazardous and nonhazardous chemical wastes. Building 694 activities would be limited to office work. Building 697 would be used to prepare chemicals for reuse onsite as a method for avoiding disposal at licensed facilities, but could eventually house a WAA. These facilities would normally operate one shift. Modifications to the existing facilities to improve flexibility and operational efficiencies (see Table B.3.1–1) would be minor.

Area 612 Complex (Buildings 612, 614, 624, and 625) would receive, treat, handle, package, store (short-term), and ship hazardous, radioactive, and nonhazardous chemical wastes. The complex is located in a fenced compound in the southern part of the Livermore Site. The facility is a RCRA, Part B-permitted facility that would support waste generators throughout LLNL. Activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. The facility would normally operate one shift. Modifications to the existing facility to improve flexibility and operational efficiencies (see Table B.3.1–1) would be completed. Quantities of total hazardous waste managed (see Table B.3.1–2) would be up to 1,900 metric tons per year. Quantities of other wastes managed would be expected as presented in Table B.3–1.

The Area 514 Complex (Buildings 513 and 514) would receive, treat, handle, package, store (short-term), and ship hazardous and nonhazardous chemical wastes until RCRA closure would be initiated. The facility is located in a fenced compound in the southern part of the Livermore Site. The facility is a RCRA, interim-status facility that would support waste generators throughout LLNL. Activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. The facility would normally operate one shift until RCRA closure would be initiated. Treatment and storage operations would be transferred to the DWTF and the facility would undergo RCRA closure.

Although never made operational, Building 280 would also undergo RCRA closure. The building is located in the northwest quadrant of the Livermore Site. In 2001, LLNL notified the DTSC that the facility was no longer required to support waste generators throughout LLNL. The storage operation planned for Building 280 would be relocated to Building 696.

The Building 233 CSU would undergo RCRA closure. The facility is located in a fenced compound in the southwest quadrant of the Livermore Site. The facility is a RCRA, interim-status facility that prepared wastes for offsite transportation for recycling, treatment, or disposal at approved facilities. The facility does not currently store waste.

The EWTF treats and stores (short-term for treated debris only) hazardous (i.e., explosive) wastes. The facility is located in a fenced compound in the center of Site 300 and is RCRA, Part

B-permitted. This facility would support explosive waste generators throughout Site 300 and at the High Explosives Application Facility (HEAF) at the Livermore Site. The quantities of wastes treated (see Table B.3–4) would be up to 3,300 pounds per year.

The EWSF (M816, M2, M3, M4, and M5) receives, handles, packages (through B805), stores, and ships hazardous (i.e., explosive) wastes. The facility is located in a fenced compound in the southeast central portion of Site 300 and is RCRA Part B-permitted. This facility supports explosive waste generators throughout Site 300 and at the HEAF. Activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. The facility would operate one shift. The quantities of explosive waste managed (see Table B.3–4) would be up to 6,500 pounds (gross) per year. No mixed hazardous waste would be managed.

Building 883 would receive, handle, package, store (short-term), and ship hazardous and nonhazardous chemical wastes. The facility would not accept radioactive materials and explosives. Activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. Modifications to the existing facility to improve flexibility and operational efficiencies would be completed.

B.3.2 Proposed Action

The Proposed Action would include all operations and activities identified in the No Action Alternative. The Proposed Action would include the continuing and historical onsite waste management operations, continuing environmental protection and environmental restoration, continuing pollution prevention and waste minimization programs, and continuing transportation of waste to offsite approved waste management facilities (includes a wide variety of DOE and commercial facilities).

Under the Proposed Action, new missions would generate waste volumes currently not managed at Livermore Site or Site 300. In general, over 10 years, waste management activities would change and planned facility operations for the DWTF would increase in support of LLNL's assigned missions. Waste management changes would include implementing a series of recent permit modifications (see Table B.3–3), improving overall RHWM operations, beginning new projects, and routinely submitting additional permit modifications as required. This alternative addresses the same facilities described in Section 3.1 for the No Action Alternative.

This alternative differs from the No Action Alternative in that

- Permitted treatment and storage operations would be conducted in B696 in addition to radioactive and nonpermitted waste handling operations
- Annual waste generation at LLNL would increase 7 percent over the No Action Alternative site-wide over the next 10 years to quantities presented in Table B.3.2–2.
- The 600-ton per year drum/container crusher would be moved from Area 612 to Building 696
- A 250-ton per year size reduction unit operation would be relocated from Area 612 to Building 696

- Building 280 hazardous and mixed wastes storage capacity would be moved to Building 696
- Storage of hazardous and mixed wastes would begin in Building 696
- Approximately 100 Class 1 permit modification requests (which could include one or more items) would be submitted over the next 10 years (Table B.3.2–1)
- Approximately 20 Class 2 permit modification requests (which could include one or more items), would be submitted over the next 10 years (Table B.3.2–1)
- Two Class 3 permit modifications would be submitted over the next 10 years (Table B.3.2–1)
- Waste quantities presented in Table B.3.2–2 would be managed annually

TABLE B.3.2–1.—*Examples of Possible Permit Modifications Under the Proposed Action*

Class 1	Class 2	Class 3
Administrative and informational changes	Changes in frequency or content of inspection schedules	Addition of corrective action program
Correction of typographical errors	Changes to corrective action program	Creation of a new SWMU as part of closure
Equipment replacement or upgrading with functionally equivalent components	Changes to detection monitoring program	Modification or addition of tank units resulting in greater than 25% increase in the facility’s tank capacity
Changes in names, addresses, and phone numbers of emergency coordinators	Extensions of post-closure care period	Addition of compliance monitoring to groundwater monitoring program
Changes to waste sampling and analysis methods to comply with new regulations	Changes to facility training plan that affect the type or amount of employee training	Reduction in post-closure care period
Changes to analytical quality assurance and quality control plan to comply with new regulations	Changes in number, location, depth, or design of groundwater monitoring wells	Addition of temporary treatment unit for closure activities

Source: 40 CFR §270.42, EPA n.d.
Note: Permit modifications are classified in more detail in 40 CFR §270.42, Appendix I.
SWMU = solid waste management unit.

TABLE B.3.2–2.—*Routine and Nonroutine Operations Annual Waste Generation Quantities Under the Proposed Action*

Waste Type	Annual Quantities	
	Routine	**Nonroutine**
LLW	330 m^3/yr	710 m^3/yr
MLLW	88 m^3/yr	81 m^3/yr
Total Hazardous	510 metric tons	1,700 metric tons
TRU	50 m^3/yr	60 m^3/yr
Mixed TRU	2.8 m^3/yr	0
Sanitary Solid	5,100 metric tons/yr	Included in Routine
Wastewater	330,000 gal/day	Included in Routine

Source: TtNUS 2003.
gal/day = gallons per day; LLW = low-level waste; m^3/yr = cubic meters per year; MLLW = mixed low-level waste; TRU = transuranic.

The following sections summarize the activities that would be performed at each of the LLNL waste management facilities.

Radioactive and Hazardous Waste Management Facilities

The DWTF (Buildings 693, 695, and 696) would receive, treat, handle, package, store (short-term), and ship hazardous, radioactive and nonhazardous chemical wastes. The facility is located in a fenced compound in the northeast corner of the Livermore Site. After completing the modification for Building 696, the facility would be a RCRA Part B-permitted facility that would support waste generators throughout LLNL. Activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at approved facilities. The facility would normally operate one shift. Modifications (within the list of Proposed Actions) to the existing facility to improve flexibility and operational efficiencies (see Table B.3.2–1) would be completed. Building 696 would obtain permit status. Quantities of total hazardous waste managed (see Table B.3–1) would be up to 2,210 metric tons per year. Quantities of MLLW managed (see Table B.3–1) would be up to 169 cubic meters per year. For other wastes see Table B.3–1.

Building 694, the Operational Support Building, and Building 697, the Chemical Exchange Warehouse, would continue to support operations at LLNL. As with the No Action Alternative, these facilities would not receive, treat, handle, package, store (short-term), and ship hazardous and nonhazardous chemical wastes. Modifications (within the list of Proposed Actions) to the existing facilities to improve flexibility and operational efficiencies (Table B.3.2–1) would be minor.

Area 612 Complex (Buildings 612, 614, 624, and 625) would receive, treat, handle, package, store (short-term), and ship radioactive hazardous and nonhazardous chemical wastes. As with the No Action Alternative, activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities.

Modifications (within list of Proposed Action) to the existing facility to improve flexibility and operational efficiencies (see Table B.3.2–1) would be completed. Quantities of total hazardous waste managed (see Table B.3–1) would be up to 2,210 metric tons per year. For other wastes see Table B.3–1.

Area 514 Complex (Buildings 513 and 514) would receive, treat, handle, package, store (short-term), and ship hazardous, radioactive and nonhazardous chemical wastes. The facility is located in a fenced compound in the southern part of the Livermore Site. Prior to FY2005, Area 514 Complex operations would cease. The existing capabilities would be transferred to the DWTF. Once the operations are transferred, the Complex would undergo RCRA closure.

As with the No Action Alternative, Building 280 would undergo RCRA closure. The storage capacity planned for Building 280 would be relocated to Building 696.

As with the No Action Alternative, Building 233 CSU would undergo RCRA closure. The storage operation previously conducted in Building 233 CSU would be relocated to Building 696.

The EWTF would continue to treat and store (short-term for treated debris only) hazardous (explosive) wastes. The facility is located in a fenced compound in the center of Site 300 and is RCRA Part B-permitted. The facility would support explosives waste generators throughout Site 300 and at the HEAF at the Livermore Site. The quantities of wastes treated (see Table B.3–4) would be up to 3,300 pounds per year.

The EWSF (M816, M2, M3, M4, and M5) would continue to receive, handle, package (through B805), store, and ship hazardous (i.e., explosive) wastes. The facility is located in a fenced compound in the southeast central portion of Site 300 and is RCRA Part B-permitted. This facility would support explosive waste generators throughout Site 300 and at the HEAF. Activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. The facility would normally operate one shift. The quantities of explosive waste managed (see Table B.3–4) would be up to 7,200 pounds (gross) per year. No mixed hazardous waste would be managed.

Building 883 would receive, handle, package, store (short-term), and ship hazardous, toxic, and nonhazardous chemical wastes. The facility would not accept radioactive wastes and explosives. As with the No Action Alternative, activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. Modifications (within the list of Proposed Actions) to the existing facility to improve flexibility and operational efficiencies (see Table B.3.2–1) would be completed. Quantities of total hazardous waste managed would be up to 13 metric tons per year.

B.3.3 Reduced Operation Alternative

The Reduced Operation Alternative would reflect minimum levels of activity required to maintain waste management operations and activities assigned to support LLNL capabilities over the next 10 years consistent with a 30 percent reduction of the Stockpile Stewardship Program below the No Action Alternative. In some specific operations, waste management operations would increase over the base period. The operations are those that, during the base period, have not yet been operated (e.g., the NIF).

This alternative would not eliminate assigned missions or capabilities, but could entail not consolidating, enhancing, or upgrading operations. However, under this alternative, LLNL waste management operations would not be reduced beyond those required to maintain safety, permit requirements, or other agreements, such as the Site Treatment Plan.

Approximately 50 Class 1 permit modifications would be submitted. No Class 2 or Class 3 permit modifications would be submitted. No new construction would be included. All RCRA closures identified in the No Action Alternative would be completed. Building 696 would not obtain RCRA permit status. It should be noted that the Reduced Operation Alternative would allow only partial fulfillment of the RHWM mission by limiting future permit modifications and limiting Building 696 wastes operations, and it would not fully satisfy the purpose and need for agency action.

This alternative differs from the No Action Alternative in that (see Table B.3–3):

- Approximately 50 Class 1 permit modifications would be submitted over the next 10 years (Table B.3.3–1).
- No Class 2 and Class 3 permit modifications would be submitted over the next 10 years.
- Waste quantities presented in Table B.3.3–2 would be managed annually.

TABLE B.3.3–1.—*Examples of Possible Permit Modifications*

Class 1
Administrative and informational changes
Correction of typographical errors
Equipment replacement or upgrading with functionally equivalent components
Changes in names, addresses, and phone numbers of emergency coordinators
Changes to waste sampling and analysis methods to comply with new regulations
Changes to analytical quality assurance and quality control plan to comply with new regulations

Source: 40 CFR §270.42, EPA n.d.
Note: Permit modifications are classified in more detail in 40 CFR §270.42, Appendix I.

TABLE B.3.3–2.—*Routine Operations Annual Waste Generation Quantities Under the Reduced Operation Alternative*

Waste Type	Annual Quantities	
	Routine	Nonroutine
LLW	180 m^3/yr	550 m^3/yr
MLLW	42 m^3/yr	63 m^3/yr
Total Hazardous	300 metric tons/yr	1,300 metric tons/yr
TRU	45 m^3/yr	55 m^3/yr
Mixed TRU	0.7 m^3/yr	0
Sanitary Solid	4,400 metric tons/yr	Included in Routine
Wastewater	290,000 gal/day	Included in Routine

Source: TtNUS 2003.
gal/day = gallons per day; LLW = low-level waste; m^3/yr = cubic meters per year; MLLW = mixed low-level waste; TRU = transuranic.

This alternative addresses the same facilities described in Section B.3.1 for the No Action Alternative. This alternative differs from the No Action Alternative in that operations would decrease to the lowest reasonably foreseeable levels over the next 10 years. The following sections describe the activities that would occur at specific facilities because of implementing assignments under the Reduced Operation Alternative.

The DWTF (Buildings 693, 695, and 696) would receive, treat, handle, package, store (short-term), and ship hazardous, toxic, and nonhazardous chemical wastes. The facility is located in a fenced compound in the northeast corner of the Livermore Site. Except for Building 696, the DWTF is a RCRA Part B-permitted facility that would support waste generators throughout LLNL. Activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. The facility would normally operate one shift per day. Building 696 would not obtain permit status. Future modifications to the existing facility to improve flexibility and operational efficiencies would not be completed. Quantities of total hazardous waste managed (see Table B.3–1) would be up to 1,600 metric tons per year. Quantities of MLLW managed (see Table B.3–1) would be up to 105 cubic meters per year. For other wastes see Table B.3–1.

Area 612 Complex (Buildings 612, 614, 624, and 625) would receive, treat, handle, package, store (short-term), and ship hazardous, radioactive, toxic, and nonhazardous chemical wastes. As with the No Action Alternative, activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. Future modifications to the existing facility to improve flexibility and operational efficiencies would not be completed. For quantities of waste managed see Table B.3–1.

Area 514 Complex (Buildings 513 and 514) would receive, treat, handle, package, store (short-term), and ship hazardous, toxic, and nonhazardous chemical wastes. As with the No Action Alternative, activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities until RCRA closure would be completed.

Building 280 would undergo RCRA closure.

Building 233 CSU would undergo RCRA closure.

The EWTF would treat and store (short-term for treated debris only) hazardous (explosive) wastes. The facility is located in a fenced compound in the center of Site 300 and is RCRA Part B-permitted. The facility would support explosives waste generators throughout Site 300 and at the HEAF at the Livermore Site. The quantities of wastes treated (see Table B.3–4) would be up to 2,800 pounds per year.

The EWSF (M816, M2, M3, M4, and M5) would continue to receive, handle, package (through B805), store, and ship hazardous (i.e., explosive) wastes. The facility is located in a fenced compound in the southeast central portion of Site 300 and is RCRA, Part B-permitted. This facility would support explosive waste generators throughout Site 300 and at the HEAF. Activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. The facility would normally operate one shift. The quantities of explosive waste managed (see Table B.3–4) would be up to 6,200 pounds (gross) per year. No mixed hazardous waste would be managed.

Building 883 would receive, handle, package, store (short-term), and ship hazardous, toxic, and nonhazardous chemical wastes. As with the No Action Alternative, activities would include preparing wastes for offsite transportation for recycling, treatment, or disposal at licensed facilities. Future modifications to the existing facility to improve flexibility and operational efficiencies would not be completed.

B.3.4 Alternatives Eliminated from Detailed Review

The CEQ regulations implementing NEPA require that all reasonable alternatives be evaluated in an EIS (40 CFR §1502.14[a]). The term *reasonable* has been interpreted by the CEQ to include those alternatives that are practical or feasible from a common sense, technical, and economic standpoint. The range of reasonable alternatives is, therefore, limited to continued LLNL operations. NNSA mission line assignments to LLNL define the Administration's purpose and need for action, as discussed in Chapter 1 of the LLNL SW/SPEIS.

NNSA carefully considered public input and comments received during the pre-scoping and scoping processes. No additional alternatives were considered in detail in the LLNL SW/SPEIS because the range of alternatives were adequate for assessing impacts associated with the Administration's purpose and need.

B.4 DESCRIPTION OF THE AFFECTED ENVIRONMENT FOR WASTE MANAGEMENT

B.4.1 Environmental Setting/Existing Conditions

Understanding the environmental setting and existing conditions is necessary for understanding potential impacts from waste operations at LLNL. This section describes the existing conditions of the physical and natural environment for LLNL waste management facilities and operations, and the relationship of people with that environment. Descriptions of the affected environment provide a framework for understanding the direct, indirect, and cumulative effects of each of the No Action Alternative, Proposed Action, and Reduced Operation Alternative. The discussion is categorized by resource area to ensure that all relevant issues are included. This section is divided into the following 16 resource areas and topic groupings that support the impact assessment discussed in Section B.5:

- Land Use and Applicable Plans
- Socioeconomic Characteristics and Environmental Justice
- Community Services and Recreation
- Prehistoric and Historic Cultural Resources
- Aesthetic and Scenic Resources
- Meteorology
- Geological Resources and Hazards (including soils)
- Ecology
- Air Quality
- Water Resources and Hydrology
- Noise
- Minerals
- Traffic and Transportation

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- Ecology
- Air Quality
- Water Resources and Hydrology
- Noise
- Minerals
- Traffic and Transportation

- Materials and Waste Management
- Utilities and Energy
- Worker Safety and Human Health

The information in this appendix comes primarily from the comprehensive environmental monitoring and surveillance programs that DOE maintains at LLNL and web-based information. Data for 1992 through 2002 are also included where necessary to present trends. Other relevant information is summarized and incorporated by reference.

Detailed discussions of each environmental resource in the overall affected environment for LLNL is the same as would be discussed for RHWM facilities. Because overall LLNL operations and RHWM operations are interdependent and interconnected, the affected environment and impacts under the various alternatives may be discussed collectively (site-wide basis). As appropriate, each resource and topic area includes a discussion of the area that may be affected by RHWM activities. The discussion establishes the scope of analysis and in general focuses the appendix on relevant information specific to RHWM facilities. Because resources and topic areas are often interrelated, one section may refer to another.

Potential releases of materials from LLNL can reach the environment and people in a number of ways. The routes that materials follow from LLNL to reach the environment and subsequently people are called transport and exposure pathways. LLNL conducts environmental monitoring to determine whether radioactive and nonradioactive materials and wastes were released into the environment. Environmental monitoring also assesses the potential for people to encounter these materials and wastes by any route of exposure. Sampled media include air, vegetation, groundwater, stormwater runoff, and wastewater discharge. LLNL publishes an annual site environmental report that contains details on these sampling programs (SNL 1997, LLNL 1998b, LLNL 1999c, LLNL 2000g, LLNL 2001v, LLNL 2002cc, LLNL 2003l).

Pursuant to the management of hazardous, radioactive, mixed, and medical wastes generated, RHWM programs implement site-wide plans and operating practices to comply with regulatory requirements. Inspections and findings of the Livermore Site and Site 300 by external agencies in 2001 are listed in Table B.4.1–1. A summary of permitting activities is presented in Table B.4.1–2. Table B.4.1–3 contains summaries of major laws, regulations, and orders relevant to LLNL RHWM facilities.

TABLE B.4.1–1.—*Inspections and Findings of the Livermore Site and Site 300 by External Agencies in 2001*

Medium	Description	Agency	Date	Finding
Livermore Site				
Sanitary sewer	Annual compliance sampling	LWRP	October 2 October 8, 9	No violations
	Categorical sampling		October 15 October 31	No violations
Waste	Hazardous waste facilities	DTSC	June 20–22	Received an inspection report and final SOV on 11/6/01 with two minor violations and one violation categorized as "other violation." All violations were resolved by LLNL before the final SOV was received on 11/6/01.
	Medical waste	ACDEH	September 25	No violations
Storage tanks	Compliance with underground storage tank upgrade requirements and operating permits.	ACHCS	June 26 August 21 September 4, 17 October 17	No violations
HW transportation	Biennial terminal inspection	CHP	January 5	Three minor deficiencies (short mud flaps, two loose bolts) corrected during inspection.
Site 300				
Waste	Permitted hazardous waste facilities (EWTF, EWSF, B883 CSA), waste accumulation area B883 north, and generator areas.	DTSC	May 16–18	Three violations were issued. One violation was issued on 5/18 and two additional violations were issued in an amended inspection report which LLNL received on 8/15. All violations have been corrected.
			August 16, 17	No violations

Source: LLNL 2002cc.
ACDEH = Alameda County Department of Environmental Health; ACHCS = Alameda County Health Care Services; CHP = California Highway Patrol; CSA = Container Storage Area; DTSC = Department of Toxic Substances and Control; EWSF = Explosives Waste Storage Facility; EWTF = Explosives Waste Treatment Facility; HW = Hazardous Waste; LWRP = Livermore Water Reclamation Plant; SOV = Summary of Violations.

TABLE B.4.1–2.—*Summary of Permits Active in 2001 and 2002*

Type of Permit	Livermore Site	Site 300
Hazardous waste	EPA ID No. CA2890012584. Authorization to mix resin in Unit CE231-1 under conditional exemption tiered permitting. Final closure plan submitted to DTSC for the Building 419 interim status unit (February 2001).	EPA ID No. CA2890090002. Part B Permit—Container Storage Area (Building 883) and Explosives Waste Storage Facility (issued May 23, 1996).
	Authorizations to construct the permitted units of Building 280, Building 695, and additions to Building 693.	Part B Permit—Explosives Waste Treatment Facility (issued October 9, 1997).
	Authorization under hazardous waste permit to operate 18 waste storage units and 14 waste treatment units.	Docket HWCA 92/93-031. Closure and Post-Closure Plans for Landfill Pit 6 and the Building 829 Open Burn Facility.
	Continued authorization to operate seven waste storage units and eight waste treatment units under interim status. Final closure plans submitted to DTSC for the Building 233 CSU and Building 514 interim status units (May 2000). Notified DTSC on 3/31/01 that LLNL will not modify and operate Building 280 as a permitted unit as described in our hazardous waste facility permit.	Post-Closure Permit Application submitted for Building 829 Open Burn Facility (September 2000)[a]. Prepared a Notice of Deficiency (NOD) response document to be submitted to DTSC in February 2002.
Medical waste	One permit for large quantity medical waste generation and treatment covering the biology and biotechnology research program, Health Services Department, Forensic Science Center, Medical Photonics Lab, and Tissue Culture Lab.	Limited Quantity Hauling Exemption for small quantity medical waste generator.
Sanitary sewer	Discharge Permit No. 1250 (01/02) for discharges of wastewater to the sanitary sewer. Permit 1510G (01) for discharges of sewerable groundwater from CERCLA restoration activities.	
Storage tanks	Eight operating permits covering 11 underground petroleum product and hazardous waste storage tanks: 111-D1U2 Permit No. 6480; 113-D1U2 Permit No. 6482; 152-D1U2 Permit No. 6496; 271-D2U1 Permit No. 6501; 321-D1U2 Permit No. 6491; 322-R2U2 Permit No. 6504; 365-D1U2 Permit No. 6492; and 611-D1U1, 611-G1U1, 611-G2U1, and 611-O1U1 Permit No. 6505.	One operating permit covering five underground petroleum product tanks assigned individual permit numbers: 871-D1U2 Permit No. 008013; 875-D1U2 Permit No. 006549; 879-D1U1 Permit No. 006785; 879-G3U1 Permit No. 007967; and 882-D1U1 Permit No. 006530

Source: LLNL 2002cc, LLNL 2003l.
[a] On February 20, 2003, the DTSC issued a Post-Closure Permit for Building 829.
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; DTSC = Department of Toxic Substances and Control; HWCA = Hazardous Waste California.

TABLE B.4.1–3.—*Summary Of Major Laws, Regulations, and Orders*

Laws, Regulations, and Orders	Description
Solid Waste Disposal Act of 1976 (42 U.S.C. §6902)	This Act regulates the management of solid waste. Solid waste is broadly defined to include any garbage, refuse, sludge, or other discarded material including solid, liquid, semisolid, or contained gaseous materials resulting from requirements and controls for transport, test procedures, and administrative requirements. Schedules include industrial, commercial, mining, or agricultural activities. Specifically excluded as solid waste is source, special nuclear, or by product material as defined by the *Atomic Energy Act*.
Resource Conservation and Recovery Act of 1976 (42 U.S.C. §6901, et seq.)	This Act amends the *Solid Waste Disposal Act* and establishes requirements and procedures for the management of hazardous wastes. As amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA), RCRA defines hazardous wastes that are subject to regulation and sets standards for generation, treatment, storage, and disposal facilities. The HSWA emphasize reducing the volume and toxicity of hazardous waste. They also establish permitting and corrective action requirements for RCRA-regulated facilities. RCRA was also amended by the *Federal Facilities Compliance Act* (FFCA) in 1992. It requires the EPA, or a state with delegated authority, to issue an order for compliance. A Federal facilities compliance order was issued by the California EPA, requiring the DOE and LLNL to comply with the FFCA. Compliance with the order is achieved through Site Treatment Plans prepared by DOE.
Underground Storage Tanks (42 U.S.C. §6901, Subtitle I)	Underground storage tanks are regulated as a separate program under RCRA, which establishes regulatory requirements for underground storage tanks containing hazardous or petroleum materials. California EPA has been delegated authority for regulating LLNL.
Federal Facility Compliance Act of 1992 (42 U.S.C. §6961)	This 1992 Act waives sovereign immunity from fines and penalties for RCRA violations at Federal facilities. However, it postponed the waiver for three years for storage prohibition violations with regard to land disposal restrictions for the DOE's mixed wastes. It required DOE to prepare plans for developing the required treatment capacity for each site at which it stores or generates mixed waste. The state or EPA must approve each plan (referred to as a Site Treatment Plan) after consultation with other affected states, consideration of public comments, and issuance of an order by the regulatory agency requiring compliance with the plan. The Act further provides that DOE will not be subject to fines and penalties for storage prohibition violations for mixed waste as long as it complies with an existing agreement, order, or permit. The FFCA requires that Site Treatment Plans contain schedules for developing treatment capacity for mixed waste for which identified technologies exist. The DOE must provide schedules for identifying and developing technologies for mixed waste without an identified existing treatment technology. A Federal Facility Compliance Order was signed in 1997 to address treatment and disposal of mixed waste, as well as characterization and disposal of TRU waste.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as Amended (42 U.S.C. §9601, et seq.)	This Act, commonly referred to as the CERCLA, or Superfund, establishes liability standards and governmental response authorization to address the release of a hazardous substance or contaminant into the environment. The EPA is the regulating authority for the Act. CERCLA was amended by the *Superfund Amendments and Restoration Act* (SARA) in 1986. SARA Title III establishes additional requirements for emergency planning and reporting of hazardous substance releases. These requirements are also known as the *Emergency Planning and Community Right-to-Know Act* (EPCRA), which, due to its unique requirements is discussed separately below. SARA also created liability for damages to or loss of natural resources resulting from releases into the environment and required the designation of Federal and state officials to act as public trustees for natural resources. LLNL is subject to, and required to report releases to the environment under the notification requirements in 40 CFR Part 302 (Designation, Reportable Quantities, and Notification) and EPCRA, as applicable. Pursuant to CERCLA Section 120, DOE signed a Federal Facility Agreement for LLNL in 1989 and Site 300 in 1992.

TABLE B.4.1–3.—*Summary of Major Laws, Regulations, and Orders (continued)*

Laws, Regulations, and Orders	Description
Hazardous Waste Control Act (California Health and Safety Code § 25100 et seq.)	This Act is the state authorization to implement the state hazardous waste program pursuant of RCRA.
Hazardous Waste Reduction Act (California Health and Safety Code § 25244.12-24)	This Act expands the State of California hazardous waste source reduction activities to accelerate reduction in hazardous waste generation.
Pollution Prevention Act of 1990 (42 U.S.C. §13101)	This Act sets the national policy for waste management and pollution control that focuses first on source reduction, followed sequentially by environmentally safe recycling, treatment, and disposal. In response, the DOE committed to voluntary participation in EPA's 33/50 Pollution Prevention Program, as set forth in Section 313 of SARA.
Toxic Substances Control Act of 1977 (15 U.S.C. §2601, et seq.)	This Act, unlike other statutes that regulate chemicals and their risk after they have been introduced into the environment, was intended to require testing and risk assessment before a chemical is introduced into commerce. It also establishes record keeping and reporting requirements for new information regarding adverse health and environmental effects of chemicals. The Act governs the manufacture, use, storage, handling, and disposal of PCBs; sets standards for cleaning up PCB spills, and establishes standards and requirements for asbestos identification and abatement in schools. It is administered by the EPA. Because LLNL's R&D activities are not related to the manufacture of new chemicals, PCBs are LLNL's main concern under the Act. Activities at LLNL that involve PCBs include, but are not limited to, management and use of authorized PCB-containing equipment, such as transformers and capacitors, management and disposal of substances containing PCBs (dielectric fluids, contaminated solvents, oils, waste oils, heat transfer fluids, hydraulic fluids, paints, slurries, dredge spoils, and soils), and management and disposal of materials or equipment contaminated with PCBs as a result of spills. At LLNL, PCB-contaminated wastes are transported offsite for treatment and disposal unless they also have a radioactive component. Nonradioactive wastes containing PCBs are disposed of at an offsite facility that has been approved by the EPA for such disposal (provided that strict requirements are met with respect to notification, reporting, record-keeping, operating conditions, environmental monitoring, packaging, and types of wastes disposed). Radioactive PCB waste, typically known as TRU mixed waste or mixed waste, is currently stored at one of LLNL's hazardous waste storage facilities until the Waste Isolation Pilot Project, or other approved facility, accepts this waste for final disposal. LLNL conducts asbestos abatement projects in accordance with Occupational Health and Safety Administration (OSHA) requirements (29 CFR Part 1926), applicable requirements of the *Clean Air Act*, and the California Solid Waste Management Regulations.
Atomic Energy Act of 1954	This Act, makes the Federal government responsible for regulatory control of the production, possession, and use of three types of radioactive material: source, special nuclear, and byproduct (includes waste). Regulations promulgated by the U.S. Nuclear Regulatory Commission (NRC) under the *Atomic Energy Act* establish standards for the management of these radioactive materials (including waste).
40 CFR Part 260	The implementing regulations established by EPA governing hazardous wastes (RCRA).

TABLE B.4.1–3.—*Summary of Major Laws, Regulations, and Orders (continued)*

Laws, Regulations, and Orders	Description
Title 22 CCR Division 4.5	The implementing regulations established by California EPA for management of hazardous waste.
DOE Order 435.1, Radioactive Waste Management	DOE Order 435.1 establishes the policies, guidelines, and minimum requirements by which the DOE and its contractors manage radioactive waste, mixed waste, and contaminated facilities. This order establishes DOE policy that radioactive and mixed wastes be managed in a manner that ensures protection of the health and safety of the public, the DOE, contractor employees, and the environment. In addition, the generation, treatment, storage, transportation, and disposal of radioactive wastes, and the other pollutants or hazardous substances they contain, must be accomplished in a manner that minimizes the generation of such wastes across program office functions and complies with all applicable Federal, state, and local environmental, safety, and health laws and regulations and DOE requirements.

Source: LLNL 2002cc.

B.4.2 Land Uses and Applicable Plans

B.4.2.1 *Existing Land Uses*

B.4.2.1.1 *Livermore Site*

Onsite Land Uses

Onsite land uses at the 821-acre Livermore Site include offices, laboratory buildings, support facilities (e.g., cafeterias, storage areas, maintenance yards, and a fire station), roadways, parking areas, and landscaping. The site also includes internal utility and communication networks. See Chapter 2 and Appendix A for detailed descriptions of onsite land uses, facilities, and major programs. A 500-foot wide security buffer zone lies along the northern and western borders of the Livermore Site.

Surrounding Land Uses

The Livermore Site is bordered on the east by Greenville Road. The property east of Greenville Road is agricultural with a few scattered rural residences and is used primarily for grazing. A Western Area Power Administration electrical substation is on the southeast corner of Greenville Road and Patterson Pass Road. The South Bay Aqueduct, a branch of the California Aqueduct, traverses the land east of the Livermore Site in a north-south direction. The Patterson Reservoir and filtration plant for the South Bay Aqueduct are northeast of the Livermore Site along Patterson Pass Road.

Patterson Pass Road runs along the northern boundary of the Livermore Site. Across Patterson Pass Road to the north is a light-industrial park. This area also includes a Pacific Gas and Electric construction training center. Several new industrial park complexes have been completed in recent years. A Union Pacific Railroad line runs in an east-west direction along the northern boundary of the industrial park. Land uses farther north include vacant land, industrial uses, a Union Pacific Railroad line, and Interstate 580 (I-580). Land northeast of the site is agricultural and used primarily for grazing. Wind turbines are installed on the hills of the Altamont Pass, northeast of the site.

On the west, the Livermore Site is bordered by Vasco Road. A low-density, single-family residential subdivision begins at the southwest corner of Patterson Pass Road and Vasco Road and extends south and west. A new housing development of attached single-family residences is currently being completed directly west of the site (north of East Avenue). Medium-density residential areas, mainly apartment complexes, exist on the west side of this new development approximately 2,000 feet west of Vasco Road.

To the south, the Livermore Site is bordered by East Avenue. South of East Avenue is the Sandia National Laboratories, California (SNL/CA), which has land uses very similar to those in LLNL. The primary land uses to the east and west of SNL/CA are rural residential and agricultural (mainly grazing). A K-8 school, The Stivers Academy, is located to the west of SNL/CA on the east side of Vasco Road, between East Avenue and Tesla Road. Public access to the section of East Avenue common to the Livermore Site is administratively controlled beginning in 2003 (DOE 2002h). There is a small light-industrial park on the southwest corner of East Avenue and Vasco Road. South of this industrial park, a new single-family housing development is being built.

B.4.2.1.2 *Site 300*

Onsite Land Uses

Site 300 is on approximately 7,000 acres of largely undeveloped land. Site 300 is primarily a nonnuclear high explosives and other nonnuclear weapons component test facility. The site has three remote high explosive testing facilities supported by a chemistry processing area, a weapons test area, maintenance facilities, and a General Services Area (GSA) at the site entrance. One hundred and sixty acres have been developed as the "*Amsinckia grandiflora* Reserve" to protect this species' natural habitat.

Surrounding Land Uses

The majority of existing land uses surrounding Site 300 are agricultural, primarily for the grazing of cattle and sheep. Two other smaller, privately operated defense-related research and testing facilities are located near Site 300. The property east of and adjacent to Site 300 is now owned by Fireworks America and is currently being used to store pyrotechnics. A portion of the property is leased to Reynolds Initiator Systems, Inc., and is used to manufacture initiators (agents which cause a chemical reaction to commence). A facility, operated by SRI International, that conducts high explosives tests, is approximately 0.6 mile south of Site 300.

Corral Hollow Road borders Site 300 on the south. South of the western portion of Site 300 across Corral Hollow Road is the Carnegie State Vehicular Recreation Area, covering approximately 5,000 acres and operated by the California Department of Parks and Recreation Off-Highway Motor Vehicle Recreation Division for the exclusive use of off-highway vehicles. The nearest urban area is the city of Tracy, approximately 2 miles northeast of Site 300. Rural residences are located along Corral Hollow Road, west of Site 300 and the Carnegie State Vehicular Recreation Area. Power-generating wind turbines occupy the land northwest of the site.

B.4.2.2 *Land Use Plans and Programs*

Livermore Site

The city of Livermore and Alameda County do not have planning jurisdiction over the Livermore Site because it is a Federal facility owned by DOE. However, for purposes of providing a complete description to the public and decision makers of the existing and potentially affected environment, local land use planning in the vicinity of the Livermore Site is presented in this section.

Alameda County General Plan: East County Area Plan

The East County Area Plan replaces the Livermore-Amador Valley Planning Unit General Plan. The East County Area Plan was adopted by the Alameda County Board of Supervisors on May 5, 1994, and was amended most recently in May 2000 (Alameda County 1994). The Livermore Site lies within Alameda County and most of it is zoned “M-P” for industrial-park use. The Alameda County Zoning Code specifies “laboratory, including research, commercial, testing, developmental, experimental or other types” as a permitted use within the M-P Zone. The remaining portions of the Livermore Site lie within the city of Livermore and are not subject to county zoning.

The Livermore Site is designated as being outside the urban growth area for the city of Livermore. Areas north and west of the Livermore Site are designated as lands within the Livermore city limits and are within the urban growth boundary. The area to the south, including SNL/CA, is also within the urban growth boundary. Policy 144 of the East County Plan states that “The County shall ensure that all new uses approved near the Lawrence Livermore National Laboratories in East Livermore are compatible with Laboratory operations.” The county’s land use designations in and near the Livermore Site include industrial, large parcel agricultural, residential, and other open space.

The portion of the Livermore Site within Alameda County is designated industrial. SNL/CA south of East Avenue is also designated industrial. The areas adjacent to SNL/CA on the east, west, and south are designated limited agriculture. The areas directly east of LLNL, across Greenville Road is designated large parcel agricultural. To the west are residential areas.

There are other designated open space areas in east Alameda County in the general vicinity of the Livermore Site: one is 4 miles south and the other 3 miles north of the Livermore Site. Approximately 3 miles northeast of the Livermore Site is a Wind Resource Area. Running northeast to southwest approximately 100 yards west of the site is a canal, the South Bay Aqueduct, which is designated as Water Management.

Livermore Community General Plan, 1976–2000

The Livermore Community General Plan, 1976–2000, was adopted by the Livermore City Council on March 8, 1976, and updated in August 1998 (City of Livermore 1975). Most of the Livermore Site is designated low intensity industrial, with the northern 500-foot perimeter area designated high intensity industrial. The Livermore Community General Plan designates the areas north of the Livermore Site as high intensity industrial. Areas west of the Livermore Site are designated as urban low-medium residential to urban high residential. Small areas within the residential areas are designated as open space parks, which include parks, trailways, recreation corridors, and protected areas. Areas south and east of the Livermore Site and SNL/CA are designated low-intensity industrial and the area farther west up to Greenville Road is designated as limited agricultural with a 20-acre minimum lot requirement.

City of Livermore Zoning

The northern perimeter area of the Livermore Site is zoned I-3 for heavy industrial use, and the western perimeter area is zoned I-2 for light industrial use (City of Livermore 2002a). These are the areas within the city of Livermore boundaries. The Livermore Zoning Ordinance provides for manufacturing, warehousing and distribution facilities, research and development facilities; professional and administrative offices, restaurants, wholesale certified recycler and recycle processor, and off-street parking as principal permitted uses within the I-2 zones. In addition to those uses in the I-2 zone, the I-3 zone permits contractor storage yards, truck terminals, or other open storage uses and recycle processor uses (City of Livermore 2002b).

The surrounding areas north of the Livermore Site are designated I-3. Areas west of the Livermore Site are designated as PD for planned development, PDR for planned development residential, RS-3 for residential use with a maximum density of three dwelling units per acre, RG-10 for suburban multiple-residential use (approximately 10 dwelling units per acre), RS-5 for residential use with a maximum density of five dwelling units per acre, and RL-6 for low-density residential with a minimum lot size of 6,000 square feet.

Site 300

Most of Site 300 is in San Joaquin County, with a small portion in Alameda County. The city of Tracy is located approximately 2 miles northeast of the site. Planning programs of these three government entities are addressed below to provide a basis for evaluating Site 300's compatibility with future surrounding land uses. San Joaquin and Alameda Counties and the city of Tracy do not have planning jurisdiction over Site 300 because it is a Federal facility, owned by DOE.

San Joaquin County General Plan

The San Joaquin County General Plan was adopted by the San Joaquin County Board of Supervisors on June 29, 1992 (San Joaquin County 1992). The land use/circulation element of the General Plan contains goals, objectives, and principles for land use development and circulation and transportation within San Joaquin County.

The portion of Site 300 in San Joaquin County is designated public and quasi-public. Areas north and east of Site 300 are designated general agricultural. Areas south of Site 300, along Corral Hollow Road, are designated as recreation and conservation areas. Areas to the north and west are designated as general agriculture.

San Joaquin County Zoning

The portion of Site 300 in San Joaquin County is zoned AG-160 for general agriculture with a 160-acre minimum parcel size. The agricultural zone was established to preserve agricultural lands for the continuation of commercial agricultural enterprises. In addition, hazardous industrial operations using explosives are permitted within the agricultural zone, subject to use permits (San Joaquin County 1992).

Alameda County General Plan: East County Area Plan

The East County Area Plan designates this portion of Site 300 as major public. The East County Area Plan Policy 138 states that "the County shall allow development and expansion of major public facilities (e.g., hospitals, research facilities, landfill sites, jails, etc.) in appropriate locations inside and outside the Urban Growth Boundary consistent with the policies and Land Use Diagram of the East County Area Plan."

Alameda County Zoning

The portion of Site 300 in Alameda County is zoned A for agricultural use. The Alameda County Ordinance Code specifies "remote testing facilities" as a conditional use within the A district, subject to approval by the zoning administrator for Alameda County (Sections 8-94.0 and 8-25.0).

City of Tracy General Plan

Site 300 is approximately 2 miles southwest of the city of Tracy. The Site 300 area is designated on the city of Tracy Community Areas Map as Federal Reserve/Open Space (FR/O) (City of Tracy 1993). Site 300 borders the city of Tracy's sphere of influence, which is designated as the Tracy Hills area. The Tracy Hills planning area includes both Tracy sphere of influence lands in San Joaquin County and an area southwest of I-580 recently annexed by the city of Tracy. The area adjacent to Site 300 in Tracy's sphere of influence has been designated Open Space Habitat. The Tracy Hills area within the city limits of Tracy has been zoned as low and medium-density residential. A residential development project is proposed for the Tracy Hills area.

B.4.3 Socioeconomic Characteristics and Environmental Justice

B.4.3.1 *Socioeconomic Characteristics*

Employment characteristics of the communities in the region surrounding the Livermore Site and Site 300 are presented in this section by relevant county and city. Approximately 93 percent of the LLNL workforce reside within Alameda, San Joaquin, Contra Costa, and Stanislaus counties. As of September 2002, approximately 10,600 persons comprised the workforce at LLNL (LLNL 2002dm). This appendix bounds the analysis by estimating the total waste management work force at 150 people.

Alameda County

The California Employment Development Department (EDD) reported a 2001 total employed labor force of 721,000 persons in Alameda County (Table B.4.3.1–1). This represented a 13.3 percent increase over the 1991 annual average of 636,300. The average annual unemployment rate for 2001 was 4.5 percent (33,900 persons), which was lower than the statewide average of 5.3 percent for the same year (EDD 2002a).

TABLE B.4.3.1–1.—*Employment and Income Profile in the Four-County Region*

	Alameda	San Joaquin	Contra Costa	Stanislaus	Region
Number of workers (2001 average)	754,900	264,700	509,800	210,300	1,739,700
Employed	721,000	241,600	493,100	188,800	1,644,500
Unemployed	33,900	23,100	16,700	21,500	95,200
Percent unemployed	4.5	8.7	3.3	10.2	5.5
LLNL Workforce (September 2002)					
Number of workers	4,919	1,636	1,132	533	8,220
Percent of 2001 workforce	0.7	0.6	0.2	0.3	0.5
Personal Income (2000 Average)					
Total personal income ($1,000)	55,972,377	13,208,972	39,194,448	10,302,276	108,375,797
Per capita ($)	38,624	23,242	41,110	22,889	36,479

Source: BEA 2002, EDD 2002a, LLNL 2002b.

San Joaquin County

The EDD reported a 2001 total employed labor force of 241,600 persons in San Joaquin County (Table B.4.3.1–1). This represented a 18.5 percent increase over the 1991 annual average of 203,900. The average 2001 unemployment rate was 8.7 percent (23,100 persons), which is substantially higher than the statewide average for that year (5.3 percent). Agricultural areas, such as San Joaquin County, tend to have greater seasonal variations in employment and higher unemployment rates. Robust job growth is expected through 2006, with services, retail trade, and government experiencing the greatest percentage increase (EDD 2002b).

Contra Costa County

The EDD reported a 2001 total employed labor force of 493,100 persons in Contra Costa County (Table B.4.3.1–1). This represented a 19.9 percent increase over the 1991 annual average of 411,400. The average annual unemployment rate for 2001 was 3.3 percent (16,700 persons), which was significantly lower than the statewide average of 5.3 percent for the same year (EDD 2002a).

Contra Costa County's varied economic base is dominated by the services industry, which accounts for 32 percent of total employment. The job growth forecast to 2006 indicates services jobs will grow at the greatest pace, followed by government and retail trade (EDD 2002b).

Stanislaus County

The EDD reported a 2001 total employed labor force of 188,800 persons in Stanislaus County (Table B.4.3.1–1). This represented a 20.6 percent increase over the 1991 annual average of 156,500. The average annual unemployment rate for 2001 was 10.2 percent (21,500 persons), which was significantly higher than the statewide average of 5.3 percent for the same year (EDD 2002a). Agricultural areas, such as Stanislaus County, tend to have greater seasonal variations in employment and higher unemployment rates.

While agriculture has traditionally been the basis of Stanislaus County's economy, other economic sectors are expanding dramatically. Growth is expected through 2006 in all major industries, with services, manufacturing, and retail trade experiencing the greatest percentage increases (EDD 2002b).

LLNL Workers by County and Major City

The majority of LLNL personnel reside in the Alameda County (see Table B.4.3.1–2), with the largest concentration (approximately 3,270 workers) residing in the city of Livermore. Recent shifts in population have led workers east, making the city of Tracy the second largest concentration of LLNL workers (approximately 720). The city of Pleasanton is home to 550 LLNL employees, while 420 reside in Manteca (LLNL 2002b).

In 2000, the population of Alameda County was 1,443,741. Of that total, 166,972 people lived within the communities of Livermore, Pleasanton, and Dublin, near the Livermore Site. In 2000, the population of San Joaquin County was 563,598. In 2000, the population of Contra Costa County was 948,816. In 2000, the population of Stanislaus County was 446,997 (Census 2002b).

LLNL is the largest employer in the city of Livermore, followed by the Livermore Valley Joint Unified School District (Table B.4.3.1–3).

TABLE B.4.3.1–2.—*Geographic Distribution of LLNL Workers by County and Major City*

County	Livermore Site	Site 300	Total
Alameda	4,871	48	4,919
San Joaquin	1,528	108	1,636
Contra Costa	1,108	24	1,132
Stanislaus	485	48	533
Other	622	11	633
Total	8,614	239	8,853
City			
Livermore	3,239	35	3,274
Tracy	674	48	722
Pleasanton	541	6	547
Manteca	390	32	422
Castro Valley	353	3	356
Modesto	251	28	279
Brentwood	231	8	239
San Ramon	235	1	236
Stockton	218	14	232
Dublin	188	2	190
Oakland	188	0	188

Source: LLNL 2002b.

TABLE B.4.3.1–3.—*City of Livermore Major Employers*

Employers	Description	Number of Employees
LLNL	Government Research and Development	8,000
Livermore Valley Joint Unified School District	Public school system	1,170
Sandia National Laboratories, California	Government research and development	950
Triad Systems Corporation	Computer systems	900
Valley Care Health System	Hospital	850
City of Livermore	City government	490
KLA-Tencor	Semiconductor inspection equipment manufacture	400
Bank of America	Warehouse and distribution	300
Wente Vineyards	Winery	320
Kaiser Permanente Regional Distribution Center	Warehouse and distribution	275
WalMart Stores	Retail	275
Trans Western Polymers, Inc.	Manufacturing	250
Form Factor	Electronic contact	230
Johnson Controls, Inc.	Manufacturing	200
Hexcel	Manufacturing	170
Costco Wholesale	Retail	164
Livermore Area Recreation and Park District	Government	170
Circuit City	Retail warehouse and distribution	150
Codiroli Motors	Retail	139
Dayton Hudson Corp/Target	Retail	130

Source: City of Livermore n.d.

Housing by County

The Alameda County housing stock (all units) totaled 546,735 units as of January 2002. The vacancy rate in the county was 3.0 percent, indicating a low percentage of available housing (DOF 2002).

The San Joaquin County housing stock (all units) totaled 197,279 units as of January 2002. The vacancy rate in the county was 3.9 percent, indicating a moderate percentage of available housing (DOF 2002).

The Contra Costa County housing stock (all units) totaled 361,748 units as of January 2002. The vacancy rate in the county was 2.9 percent, indicating a low percentage of available housing (DOF 2002).

The Stanislaus County housing stock (all units) totaled 156,515 units as of January 2002. The vacancy rate in the county was 3.7 percent, indicating a moderate percentage of available housing (DOF 2002). Table B.4.3.1–4 compares housing units and vacancy rates within the four-county Region of Influence (ROI) and selected cities for 1997 to 2002.

TABLE B.4.3.1–4.—*Housing Units and Vacancy Rates Within the Four-County Region of Influence and Selected Cities, 1997-2002*

	1997			2002			
County	**Housing Units**	**Occupied**	**% Vacant**	**Housing Units**	**Occupied**	**% Vacant**	**Housing Unit Growth (1997-2002)**
Alameda	521,101	495,598	4.9	546,735	530,115	3.0	4.7
San Joaquin	182,444	173,439	4.9	197,279	189,512	3.9	7.5
Contra Costa	342,980	325,659	5.1	361,748	351,134	2.9	5.2
Stanislaus	147,088	139,688	5.0	156,515	150,649	3.7	6.0
City							
Livermore	24,524	23,558	3.9	27,357	26,856	1.8	10.4
Tracy	15,953	14,687	7.9	20,571	20,040	2.6	22.4
Pleasanton	22,085	21,090	4.5	24,517	23,845	2.7	9.9
Manteca	15,616	15,011	3.9	18,649	18,023	3.4	16.3
Modesto	65,693	62,542	4.8	69,848	67,540	3.3	5.9
Brentwood	4,874	4,590	5.8	9,784	9,419	3.7	50.2
San Ramon	16,087	15,272	5.1	17,917	17,296	3.5	10.2
Stockton	79,420	75,333	5.1	84,266	80,722	4.2	5.8
Dublin	7,949	7,731	2.7	11,107	10,496	5.5	28.4
Oakland	154,640	144,285	6.7	158,607	151,843	4.3	2.5

Source: DOF 2002.

Economic Factors by County Including LLNL

Alameda and Contra Costa counties had a total of 69,993 business establishments in 2001, with a combined annual payroll of $38.7 billion (including LLNL) (Table B.4.3.1–5). The services industry was the largest source of revenue, with a $15-billion total payroll (EDD 2002c).

A total of 12,920 business establishments were located in San Joaquin County in 2001. Payroll for these companies totaled $5.0 billion during the year (Table B.4.3.1–5). The services industry was the largest source of revenue, with a $1.5-billion total payroll (EDD 2002c).

A total of 11,276 business establishments were located in Stanislaus County in 2001. Payroll for these companies totaled $4.1 billion during 2001 (Table B.4.3.1–5). The services industry was the largest source of revenue, with a $1.4 billion total payroll (EDD 2002c).

LLNL had an overall budget of $1.5 billion in FY2002. LLNL has a monthly payroll of approximately $59 million. LLNL payroll originates entirely from the Livermore Site in Alameda County, even though some personnel are located at Site 300 in San Joaquin County. As of FY2002, the total annual LLNL payroll was approximately $668 million, representing 1.7 percent of the total combined payroll generated by all business establishments in Alameda County. The RHWM would represent 3 percent of the overall LLNL effect.

LLNL contributes considerably to the economy in direct purchases; it purchased a total of $568 million in goods and services in FY2002. Of that total, $348 million was for purchases in California and $142 million was for purchases in Alameda County.

TABLE B.4.3.1–5.—*Annualized 2001 Payroll for Four-County Area by Industry Sector, 2001 ($1,000)*

Industry	Alameda/Contra Costa [a]	San Joaquin	Stanislaus
Agriculture	102,860	346,260	272,492
Mining	350,836	10,740	776
Utilities	222,976	65,700	11,764
Construction	3,493,652	511,460	384,844
Manufacturing	6,194,008	830,308	893,384
Wholesale Trade	2,898,288	281,700	212,284
Retail Trade	3,356,488	588,760	505,948
Transportation & Warehousing	1,484,200	409,728	120,728
Information	2,536,288	138,344	70,676
Finance & Insurance	2,260,504	235,992	151,368
Real Estate Rental & Leasing	655,652	66,392	40,804
Services	15,115,788	1,489,472	1,410,480
Total	**38,671,540**	**4,974,856**	**4,075,548**

Source: EDD 2002c.
[a] Combined Oakland Metropolitan Statistical Area.

B.4.3.2 *Environmental Justice*

Environmental justice has been defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (EPA 2002a). Concern that minority and/or low-income populations might be bearing a disproportionate share of adverse health and environmental impacts led President Clinton to issue an Executive Order (EO) in 1994 to address these issues; EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," directs Federal agencies to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. When conducting NEPA evaluations, the NNSA incorporates environmental justice considerations into both its technical analyses and its public involvement program in accordance with the U.S. Environmental Protection Agency (EPA) and the CEQ regulations (CEQ 1997).

The NNSA selected an area of influence within a 50-mile radius of the Livermore Site and Site 300 for analysis, an area that encompasses all or portions of 19 counties. This area of influence was selected to be consistent with possible effects evaluated as part of the air impacts and accident consequence analyses.

Identifying Minority and Low-Income Populations

For this analysis, minority populations are considered to be all *people of color*, which includes all ethnic and racial groups except non-Hispanic whites. For California, the minority population is 53.3 percent. Chapter 4, Figure 4.3.5–1, of this LLNL SW/SPEIS shows the location of census block groups within the 50-mile area of influence where the minority population is greater than 53.3 percent.

For this analysis, low-income populations are those individuals living below the poverty threshold, as defined by the 2000 Census. This threshold varies from a household income of $8,259 to $38,138, depending on the number and age of household members. For California, the percent of the population living in poverty is 14.2 percent. Chapter 4, Figure 4.3.5–2 of this LLNL SW/SPEIS shows the location of census block groups within the 50-mile area of influence where the low-income population is greater than 14.2 percent.

Livermore Site

Minority Populations

A total population of 7,256,274 resides within a 50-mile radius of the Livermore Site. Of these, 3,743,027, or 51.6 percent, are minorities. This percentage is less than the minority percentage in the State of California as a whole. There are no block groups within a 5-mile radius that are categorized as minority. An area of Alameda County approximately 10 miles west of the Livermore Site is categorized as minority. Within 20 miles, higher concentrations of minorities are found within portions of western Alameda County and San Joaquin County in the Central Valley.

Low-Income Populations

Of the total population of 7,256,274 within the 50-mile area of influence, 711,571, or 9.8 percent, are low income. This percentage is less than the low-income percentage in the State of California as a whole. There are no block groups within a 10-mile radius of the Livermore Site that have percentages of low-income populations greater than the state average. Within 20 miles, some higher concentrations of low-income populations are located in the eastern portion of Contra Costa County, San Joaquin County, the southwestern portion of Alameda County, and the northern portion of Santa Clara County.

Site 300

Minority Populations

A total population of 6,406,704 resides within a 50-mile radius of Site 300. Of these, 3,343,660, or 52.2 percent, are minorities. This percentage is less than the minority percentage in the State of California as a whole. There are no block groups within a 5-mile radius that are categorized as minority. Several areas of San Joaquin County approximately 9 miles north and northeast of Site 300 are categorized as minority. Within 20 miles, higher concentrations of minorities are found within western portions of San Joaquin and Stanislaus counties in the Central Valley.

Low-Income Populations

Of the total population of 6,406,704 within the 50-mile area of influence, 654,156, or 10.2 percent, are low income. This percentage is less than the low-income percentage in the State of California as a whole. There are no block groups within a 5-mile radius of Site 300 that have percentages of low-income populations greater than the state average. Within 10 miles, two areas of western San Joaquin County to the north and northeast of Site 300 are categorized as low income. Within 20 miles, some higher concentrations of low-income populations are located in the western portions of San Joaquin and Stanislaus counties, and the northern portion of Santa Clara County.

B.4.4 Community Services

This section describes the existing demands on fire protection and emergency services, police protection and security services, school services, and nonhazardous solid waste disposal from the operation of LLNL.

B.4.4.1 *Fire Protection and Emergency Services*

The Fire Safety Division at the Livermore Site occupies two facilities: a fire station at Building 323 (Fire Station No. 1) and an emergency dispatch center at Building 313. All Livermore Site health and safety alarms are received by the emergency dispatch center through the site-wide alarm system. In addition to monitoring the Livermore Site alarms and dispatching personnel, the emergency dispatch center serves as the Mutual Aid Dispatch Center for Twin Valley and Alameda County, as appropriate.

There are about 62 fire protection and emergency services personnel at LLNL in the following categories: fire protection engineering and fire prevention, training, emergency dispatch, and emergency operations. A minimum staff of eight is on duty at Fire Station No. 1. LLNL Fire Station No. 1 equipment consists of four large-capacity pumpers (1,500 to 1,000 gallons per minute) including one ladder truck and one four-wheel drive, one smaller capacity (325 gallons per minute) four-wheel drive pumper, a special services unit with hazardous material containment equipment, two ambulances, and three command vehicles.

The average LLNL Livermore Site Fire Department response time onsite is 3.5 minutes. One vehicle and four personnel will initially respond to a call onsite. Additional equipment and personnel will respond as needed. Table B.4.4.1–1 provides a summary of the numbers and types of onsite emergency calls to which the LLNL fire safety division responded in 1999, 2000, 2001, and 2002.

Table B.4.4.1–1.—*Summary of Emergency Response Calls for 1999 through 2002*

Type of Incident	Number of Incidents							
	1999		2000		2001		2002	
	Livermore Site	Site 300[a]	Livermore Site	Site 300[a]	Livermore Site	Site 300[a]	Livermore Site	Site 300[a]
Ambulance	141		120		142		196	
Fire	466		319		341		394	
Hazardous materials	74		66		69		61	
Mutual/automatic aid[b]	683		668		1,079[c]		885[c]	
Total	**1,364**	**59**	**1,173**	**68**	**1,631**	**59**	**1,536**	**65**

Source: LLNL 2003b.
[a] Site 300 emergency response calls are not categorized by incident type.
[b] Includes responses under agreements with offsite agencies.
[c] Increase from previous years primarily due to expansion of service area and calls on and after September 11, 2001.

At the Livermore Site, the ambulances transport patients to a medical facility that offers care commensurate with the severity of the injury (based on evaluation using emergency medical service protocols). These facilities include the onsite Health Services Department, Valley Care Medical Center (Pleasanton), or Eden Medical Center (Castro Valley).

The LLNL Fire Safety Division participates in several automatic and mutual aid agreements with various offsite agencies. Automatic aid is dispatched without request on a first alarm. Mutual aid assistance is specifically requested after local agency resources have been depleted. LLNL participates in automatic and mutual aid agreements with the city of Livermore Fire Department and the Alameda County Fire Patrol, respectively. LLNL participates in a mutual aid network that extends throughout the State of California.

The LLNL Fire Department responds to approximately 300 of the Livermore/Pleasanton Fire Department's total annual calls. Conversely, the Livermore/Pleasanton Fire Department responds to 3 of the Livermore Site's total annual calls. LLNL responds to an average of 300 Alameda County Fire Patrol calls per year; the Alameda County Fire Patrol typically is not called on to respond to LLNL calls. The California Department of Forestry, which provides mutual aid to Site 300, does not respond to mutual aid requests at the Livermore Site because it does not maintain structural fire equipment. The Livermore Site fire station assists with approximately three wildland fires per year within the California Department of Forestry's jurisdiction. This constitutes less than 1 percent of the California Department of Forestry's total annual calls (LLNL 2003b).

LLNL Fire Station No. 2 is located in Building 890 at Site 300. This facility is part of the overall Fire Safety Division of LLNL and is operated under the direction of the LLNL Fire Chief. The minimum staff level at Fire Station No. 2 is four personnel. LLNL Fire Station No. 2’s equipment consists of two large (1,250 and 1,000 gallons per minute) pumpers (the smaller of which is four-wheel drive), one four-wheel-drive pumper (325 gallons per minute), and one ambulance.

The average Site 300 fire station response time onsite is 4.5 minutes. One vehicle and four personnel respond from the Site 300 fire station. In addition, a vehicle from the Livermore Site responds as a “cover” in case an additional fire breaks out. The response time to the Site 300 main gate from the Livermore Site is approximately 15 minutes. Table B.4.4.1–1 provides the number of onsite emergency calls to which the Site 300 Fire Department responded in 1999, 2000, and 2001.

At Site 300, the ambulance transports patients to a medical facility that offers care commensurate with the severity of the injury (based on evaluation using emergency medical service protocols). These facilities include the Sutter Hospital in the city of Tracy or the nearest trauma center.

The LLNL Fire Safety Division maintains mutual aid agreements with several agencies, including the city of Tracy and the California Department of Forestry that could serve Site 300.

The city of Tracy Fire Department and the Site 300 fire station typically do not request aid from each other. The Site 300 fire station has not historically responded to calls within the Tracy Rural County Fire Protection District's jurisdiction. Conversely, the Tracy Rural County Fire Protection District typically receives one call annually from Site 300. The State of California

Department of Forestry and the Site 300 fire station respond to an average of less than three of each other's calls per year (LLNL 2003b).

B.4.4.2 *Police and Security Services*

Police and security services at LLNL are provided by the Protective Force Division of the Safeguards and Security Department. It is the function of the Protective Force Division to provide protection of LLNL personnel and assets (including RHWM staff and facilities). This protection is provided through several elements, including access control, fixed access and surveillance points, random vehicle and foot patrols, response elements, and special response team elements.

The Protective Force Division provides emergency response service to the Livermore Site and Site 300 and has contingency plans to cover credible emergencies, including work stoppages, bomb threats, natural disasters, site-wide evacuations, callout procedures, satellite command center activation procedures, executive protection, alarm response procedures, and civil disorders.

LLNL participates in emergency response agreements with the city of Livermore Police Department, the Alameda County Sheriff's Department, the San Joaquin County Sheriffs Department, the State of California Highway Patrol (CHP), and the Federal Bureau of Investigation (FBI). Offsite agencies generally provide first alarm response to LLNL offsite leased properties (LLNL 2002bz).

The city of Livermore Police Department is rarely requested to respond to calls at the Livermore Site through its emergency response agreement. The Alameda County Sheriff's Department responds to an average of six calls at the Livermore Site per year, which is less than 1 percent of the agency's total annual calls. Site 300 is within Patrol District 8 of the San Joaquin County Sheriff's Department. LLNL did not request assistance from the Sheriff's Department within the past year. The CHP responds to calls from the LLNL Safeguards and Security Department during large-scale demonstrations that have the potential to block Vasco Road and Greenville Road. The CHP responds to calls for crowd control from the LLNL Safeguards and Security Department on an average of once per year. There is occasional interaction with the FBI for criminal and security investigations (LLNL 2002bz).

B.4.4.3 *School Services*

In 2001–2002, student enrollment totaled 606,967 in the region (Table B.4.4.3–1). The local school district is the Livermore Valley Joint Unified School District and includes schools from kindergarten through high school. The local school district serves over 10,000 students from a 240-square mile area that includes the city of Livermore. There is no available information on the number of children of LLNL employees that attend district schools.

TABLE B.4.4.3–1.—*Education in the Region of Influence*

	Alameda	San Joaquin	Contra Costa	Stanislaus	ROI
School Enrollment	217,591	127,354	161,742	100,280	606,967

Source: California Department of Education 2003.

B.4.4.4 *Nonhazardous and Nonradioactive Solid Waste Disposal*

Nonhazardous solid waste generated at the Livermore Site is transported to the Altamont Landfill for disposal. The landfill is estimated to have sufficient capacity to receive waste until the year 2038 (Hurst 2003). The current total daily permitted throughput at the Altamont Landfill is 11,150 tons per day (SWIS 2002).

During 2002, approximately 5,650 metric tons of solid sanitary waste were collected and transported to the Altamont Landfill from the Livermore Site (LLNL 2003bd). Construction wastes make up approximately two-thirds of this total generation, and the remaining one-third consists of plastics, glass, other organics, and other wastes. This waste is stored in 222 onsite containers with average volume capacities of 4 cubic yards each. Waste from 178 of the containers is collected and disposed of daily at the Altamont Landfill by LLNL workers. Waste from the other 31 containers is collected and disposed of twice weekly (remaining containers less frequently) by the same method. In addition, approximately 63.5 tons of landscape clippings (chips, mulch, street sweepings) are composted each month (SWIS 2002, LLNL 2003bd). There are no plans to expand the Livermore Site nonhazardous solid waste storage facilities or to modify nonhazardous waste disposal methods.

In 2002, LLNL diverted almost 60 percent of the 15,300 metric tons of its nonhazardous waste for recycling and reuse. A portion of the nonhazardous waste generated annually is sold for recycling or reuse. Additionally, soil is reused at the Livermore Site and at the landfill for daily cover (LLNL 2002cc). Approximately 560 tons of landscape clippings were composted in 2002 (LLNL 2003bd).

Site 300 wastes are transported to the city of Tracy Material Recovery and Solid Waste Transfer station prior to final disposal. Site 300 represents approximately 3 percent of the LLNL total.

B.4.5 Prehistoric and Historic Cultural Resources

Livermore Site

Records searches conducted prior to and for the 1992 LLNL EIS/EIR did not reveal the presence of prehistoric resources on the Livermore Site (LLNL 1992a). Field surveys conducted by Holman & Associates in the undeveloped western and northern perimeter areas, including a 500-foot wide buffer and undeveloped area survey conducted in 1991, did not reveal the presence of prehistoric resources (LLNL 1992a). Because most of the Livermore Site is developed, the likelihood of finding unrecorded and undisturbed prehistoric sites is low; however, there is still the possibility that undisturbed prehistoric sites lay buried under the modern landscaping.

The Livermore Site has a number of buildings associated with historic events or significant LLNL achievements. Some of the buildings and facilities, or groups of them at the Livermore Site, may be eligible for listing in the National Register of Historic Places (NRHP). To facilitate evaluation of the properties, an historic context is being developed and analysis of specific individual properties is in progress (LLNL 2002bj). To date, DOE and the State Historic Preservation Officer (SHPO) have evaluated and concurred that 50 buildings are not eligible for listing on the NRHP. The negative or not eligible determinations include the following buildings: 177, 222, 251, 317, 328A, 412, 431, 490, 592, 593, 1253, 1477, 1478, 1482, 1601, 1602, 1631, 1734, 1877, 2512, 2527, 2529, 2530, 2629, 2685, 2687, 2626, 2801, 2802, 2808, 3629, 3703, 3751, 3777, 3903, 3904, 3905, 3907, 3982, 4107, 4180, 4302, 4377, 4378, 4383, 4384, 4387, 4388, 4440, 4442, 8011, and 8806 (LLNL 2003ca).

Site 300

Site 300 has been surveyed for both prehistoric and historic cultural resources and a number of potentially significant prehistoric and historic sites have been identified (LLNL 1992a). The resources include rock shelters and other areas used for the making of stone tools, and the historic Town Site of Carnegie. No formal subsurface testing program has occurred and formal NRHP eligibility determinations are incomplete. Further investigation and delineation of the known resources has resulted in the formation of four archaeological sensitivity areas (LLNL 2002bj). Projects in Sensitive Areas II, III, and IV require that the LLNL archaeologist be contacted. Projects in Sensitive Area I do not require this. Development or ground disturbing activities have not been permitted in or within 300 feet of the delineated areas unless the activity was approved or monitored by LLNL archaeologists (LLNL 2002bj). The EWSF and Building 883 are located in Sensitive Area I. The EWTF is located in Sensitive Area II and requires a LLNL archaeologist be contacted on any projects, including permit modifications.

B.4.6 Aesthetics and Scenic Resources

The Landscape Architecture Master Plan for LLNL provides guidance for development at LLNL (LLNL 2002d). Because there are no strict standards at LLNL for matching exterior building color or style, the landscape architecture planning process is the only means of creating cohesiveness in image. The Landscape Architecture Master Plan is intended to ensure that all site improvements are architecturally compatible with their immediate surroundings and that other aesthetic qualities, such as temperature, wind, and glare are enhanced.

The Livermore Site is within Alameda County. In addition, the western 1,100 feet of the Livermore Site is within the city of Livermore. Most of Site 300 is within San Joaquin County, with a small portion in Alameda County. Because LLNL is a Federal facility owned by DOE, the surrounding cities and counties have no planning jurisdiction for the site. Nevertheless, LLNL does consider local planning policies, to the extent practicable, in its land decisions as a good neighbor policy.

B.4.6.1 *Visual Character of the Project Area*

Regional Character

The Livermore Valley of eastern Alameda County, where the Livermore Site is located, is ringed by hills and mountains that define the regional view shed and provide open space around the development on the valley floor. The terrain in the vicinity of the sites ranges from relatively flat land to gently rolling hills. The hills east and south of the Livermore Site gradually become steeper as they trend eastward to form the Altamont Hills of the Diablo Range. Wind turbines north and south of the Altamont Pass punctuate the eastern horizon and have become part of the eastern valley landscape identity.

Site 300 is located in the Altamont Hills of the Diablo Range. This area is largely grasslands and low shrubs in areas ranging in topography from gently rolling hills to steeply sloping ridges and drainages. View sheds in the area around Site 300 are severely constrained by topography.

Livermore Site

The Livermore Site has a campus-like or business park-like setting with buildings, internal roadways, pathways, and open space. Portions of the site along the western and northern boundaries remain largely undeveloped and serve as security buffer zones. A row of eucalyptus and poplar trees surrounds much of the developed portion of the Livermore Site and screens most ground-level views of the facility. Onsite buildings range in height from 10 feet to approximately 110 feet. A 9-foot chain-link and barbed-wire security fence surrounds the Livermore Site. The most prominent buildings in the public view shed are the administrative building off of East Avenue in the southwest corner of the site and the NIF in the northeast corner. Both of these buildings are visible from locations along adjacent roads.

The area surrounding the Livermore Site is a mixture of rural and pastoral uses and urban development. SNL/CA is located immediately south of the Livermore Site. Rural residences and grazing land are the primary visual features to the east. The area west of the Livermore Site is occupied by detached residences giving the area a suburban character. A small area of commercial use occupies lands immediately southwest of LLNL. The commercial area is surrounded by a mixture of vineyards and residential uses, although residential development is currently underway and the visual character of the area is shifting from pastoral to suburban. The area north of the Livermore Site to I-580 is industrial, primarily one- and two-story industrial buildings, business parks, and the Union Pacific railroad line that traverses the area. This area is visually similar with the research, business, and industrial character of the Livermore Site.

Site 300

The main gate and GSA of Site 300, including a number of buildings, roads, and infrastructure, are foreground and middle-ground features in view from Corral Hollow Road, which forms the southern boundary of Site 300. Vegetative screening and topography partially obscure many of the features associated with the GSA. The majority of Site 300 is obscured from view by topography.

The surrounding area is primarily undeveloped open space or rural, with some exceptions. Fireworks America is adjacent to and northeast of Site 300. Although the sign at the entrance to the facility is visible from Corral Hollow Road, structures associated with this facility are obscured by topography. The SRI International Testing Facility is approximately 0.6 mile south of Site 300 and is not visible from Corral Hollow Road.

Carnegie State Vehicular Recreation Area, located south of the western portion of Site 300, is used for off-road vehicle use. The park includes dirt trails on the surrounding hillsides and a ranger station, picnic areas, and several contoured riding areas in the valley floor adjacent to Corral Hollow Road. These features are all visible from Corral Hollow Road. The high degree of modification is substantially out of character with the surrounding open space and rural features of the area.

B.4.6.2 *Sensitive Views in the Surrounding Area*

Locations of visual sensitivity are defined in general terms as areas where high concentrations of people may be present or areas that are readily accessible to large numbers of people. No visually sensitive locations are defined on the Livermore Site or Site 300. The visual sensitivity of areas surrounding the Livermore Site and Site 300 are described below.

Livermore Site

Sensitive views around the Livermore Site include residential areas and scenic routes or visual amenities designated by the city of Livermore or Alameda County.

The Livermore Site is not visible from several designated scenic resource areas (e.g., Wente and Concannon wineries, Tesla historical town site, Altamont Pass Road, Cross Road, and Mines Road) and is only minimally visible from several other designated scenic resource areas as a result of distance or intermittent topography. The Livermore Site is relatively distant from I-580 (approximately 1.5 miles) and views are obstructed by vegetation and development. Only the tallest onsite building on the Livermore Site is intermittently visible from this highway. The Livermore Site is not visible from most of Flynn Road but does occupy the middle-ground views from the western end of Flynn Road. As a result of distance, the facilities are visually indistinct and are consistent with surrounding development. The view of the Livermore Site from Tesla Road is almost completely obstructed by intervening topography.

The Livermore Site is prominently visible from residences near and motorists traveling along Vasco Road. Vegetation that surrounds the Livermore Site obstructs or partially screens most views of the facilities from this area. The buffer zone also provides visual separation between the Livermore Site and surrounding viewers.

The Livermore Site is also visible from residences and vineyards to the southwest, and to motorists traveling north on Vasco Road. Security buffer area and vegetation provide partial screening of the Livermore Site from this view. In addition, residential and vineyard development in this area is currently taking place and will further screen views of the facilities.

The Livermore Site is prominent in views from most of Greenville Road. Although Greenville Road follows the eastern boundary of the Livermore Site, views from this portion of the road are heavily screened by vegetation. Views from Greenville Road south of the Livermore Site are more panoramic due to the elevated viewing perspective, but are partially screened by the rolling topography. The Livermore Site is visually distinct in the foreground and middle ground, but is visually consistent with the overall pattern of development in the view shed.

The Livermore Site is prominent in views from the western portions of Patterson Pass Road from Vasco Road to Flynn Road. Views from Patterson Pass Road adjacent to the Livermore Site, similar to those described for Vasco Road, are largely screened by vegetation and are separated from viewers by a security buffer area. Views toward the west from the lower reaches of Patterson Pass Road are similarly obstructed by vegetation. Views of the facilities from the higher reaches of Patterson Pass Road are obstructed by topography.

Site 300

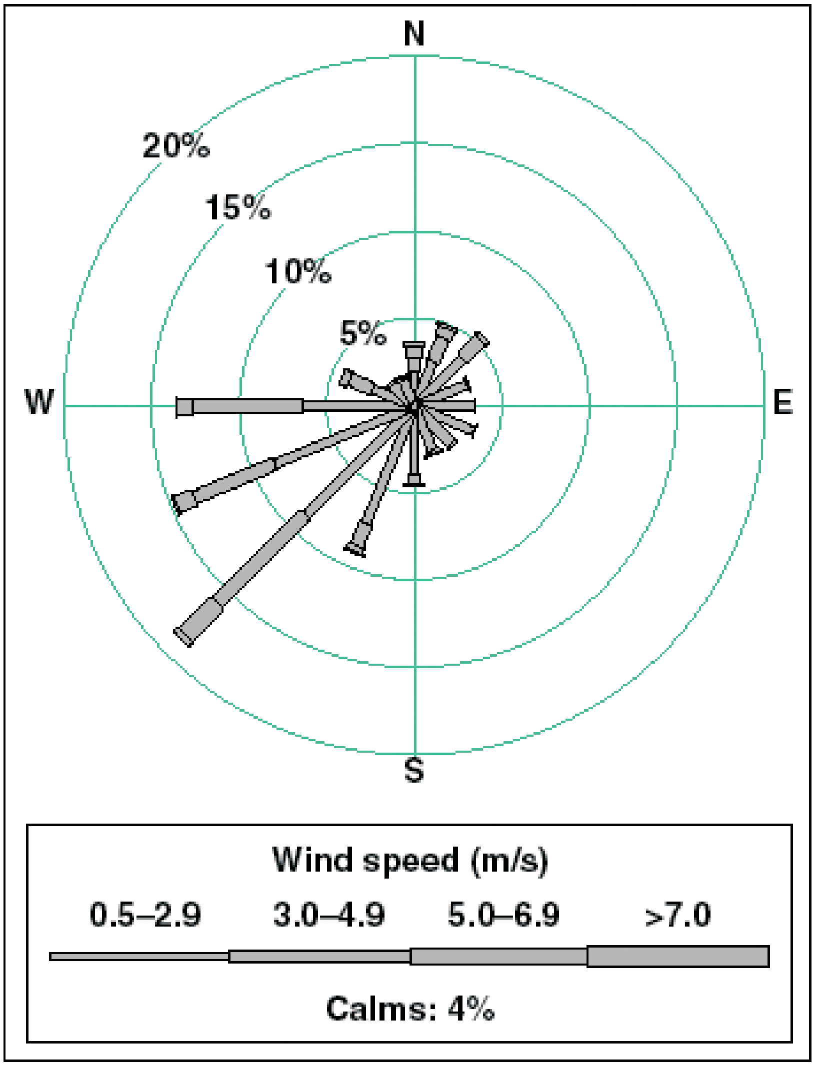
Sensitive views around Site 300 include the Carnegie State Vehicular Recreation Area and scenic routes designated by Alameda County or San Joaquin County.

Site 300 is not within the view shed of any of designated scenic corridors except for a very short section of Tesla Road at the eastern end of Alameda County. Tesla Road becomes Corral Hollow Road in San Joaquin County. Corral Hollow Road follows the southern boundary of Site 300 and affords views of the site, but is not designated as a scenic corridor. Corral Hollow Road, which is adjacent to and south of Site 300, is the nearest public roadway with a view of the site. The view of Site 300 from Corral Hollow Road is of parking areas and several single-story structures in the GSA. The remainder of the view of Site 300 from Corral Hollow Road consists of rolling hillsides and a few scattered small structures on the hilltops. Other than the GSA, the facilities of Site 300 are not apparent in landscape views from publicly accessible viewpoints; however, a 3-foot-high wire fence surrounding Site 300 is visible from Corral Hollow Road, along the site's southern boundary.

Site 300 can be seen from the Carnegie State Vehicular Recreation Area, which lies directly south. One single-story structure (Building 899) and its surrounding light posts are visible from the recreation area. From the picnic area near the park entrance, the view of Site 300 consists primarily of undeveloped hillsides.

B.4.7 Meteorology

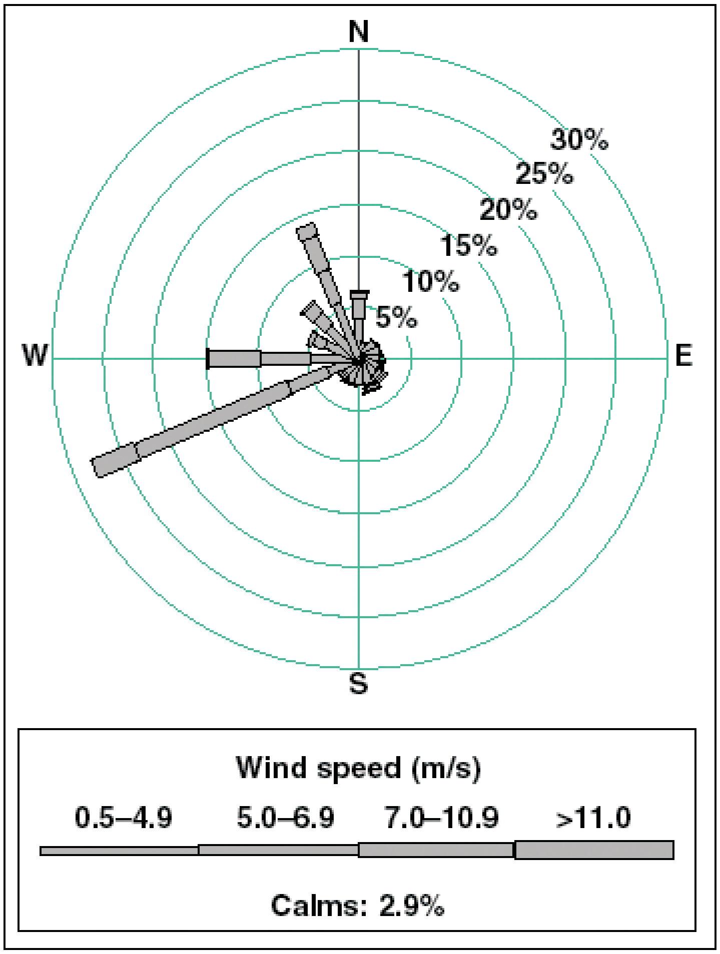
Meteorological data (including wind speed, wind direction, rainfall, humidity, solar radiation, and air temperature) are continuously gathered at both the Livermore Site and Site 300. Mild, rainy winters and warm, dry summers characterize the climate. The mean annual temperature for the Livermore Site in 2001 was 58.5°F. The mean annual temperature for Site 300 in 2001 was 59°F. Temperatures range from 23°F during some predawn winter mornings to 104°F during some summer afternoons. Both rainfall and wind exhibit strong seasonal patterns. These wind patterns tend to be dominated by the thermal draw of the warm San Joaquin Valley that results in wind blowing from the cool ocean toward the warm valley, increasing in intensity as the valley heats up. The wind blows from the northeast primarily during the winter storm season. Most precipitation occurs between October and April, with very little rainfall during the warmer months. Annual wind data for the Livermore Site are given in Figure B.4.7–1. These data show that about 50 percent of the wind comes from the southwest to westerly direction. This prevailing pattern occurs primarily during the summer. During the winter, the wind often blows from the northeast. Based on a 10-year record, the highest and lowest annual rainfalls were 21 and 7.2 inches, respectively and the average annual rainfall was 14 inches. In 2001, the Livermore Site received 13.4 inches of rain.



Source: LLNL 2002bx, LLNL 2002ci.

FIGURE B.4.7–1.—*Wind Rose Showing the Frequency of Occurrence for Wind Speed and Direction at the Livermore Site, 2001*

The meteorological conditions at Site 300, while generally similar to those at the Livermore Site, are modified by higher elevation and more pronounced topological relief. The complex topography of the site significantly influences local wind and temperature patterns. Annual wind data are presented in Figure B.4.7–2. The data show that winds are more consistently from one wind direction, the west-southwest, and reach greater speeds than at the Livermore Site. Rainfall for 2001 was 9.7 inches at Site 300. As in the case for the Livermore Site, precipitation is seasonal, with most rainfall occurring between October and April.



Source: LLNL 2002bx, LLNL 2002ci.

FIGURE B.4.7–2.—*Wind Rose Showing the Frequency of Occurrence for Wind Speed and Direction at Site 300, 2001*

B.4.8 Geological Resources and Hazards

This section provides a summary of the affected physical environment, including discussions of the local and regional geological setting, stratigraphy, soils, structural geology, and geographic hazards (including seismicity) for both the Livermore Site and Site 300 relative to the RHWM facilities.

B.4.8.1 *Livermore Site Geological Setting Overview*

The Livermore Valley is an east-west trending synclinal structure composed primarily of gently deformed alluvial deposits overlying complexly deformed Cenozoic and Mesozoic rocks. Most of the faults in the region are right-lateral strike-slip faults associated with the San Andreas Fault system. The Livermore Valley is bordered by the Calaveras Fault to the west, the Greenville Fault to the east, the Tassajara Hills and Mount Diablo to the north, and the Diablo Range to the south.

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

Stratigraphy—Radioactive and Hazardous Waste Management Facilities

The sediments beneath the Livermore Site are late Tertiary and Quaternary alluvial sediments known as the Livermore Formation. The maximum thickness of the Livermore Formation is thought to be approximately 4,000 feet. This formation has been divided into Upper and Lower Members. The Upper Member of the Livermore Formation is characterized by massive gravel beds mixed with sand, silt, and clay. The Lower Member of the Livermore Formation is dominated by greenish- to bluish-grey silt and clay, with lenses of gravel and sand (DOE 2001a).

Structure—Radioactive and Hazardous Waste Management Facilities

The Livermore Site is located near the boundary between the North American and Pacific tectonic plates, and the area is characterized by the San Andreas Fault system that trends northwest. The Diablo Range, which includes the Altamont Hills, is part of the northwest-trending Coast Ranges, and parallels three major faults in the area: the San Andreas Fault system, the Sur-Nacimiento Fault, and the Coast Range thrust fault system (the Sur-Nacimiento Fault and the Coast Range thrust). These faults can generally be considered to define three different lithologic blocks. The westernmost block is the Salinian Block, consists primarily of metamorphic and granitic rock. To the east of the Salinian Block is the Franciscan Assemblage, lying between the San Andreas and the Coast Range thrust fault zones. It is composed of marine sedimentary and volcanic rocks. The next block positioned above the Coast Range thrust fault zone consists of late Mesozoic through late Tertiary marine sedimentary rocks overlying complex ancient oceanic and continental crust rocks. This block lies primarily along the eastern margin of the Coast Range Province. Structural relationships along the Coast Range thrust are complex due to later reactivation of the thrust by high-angle normal and strike-slip faults.

The Hayward Fault, which is part of the San Andreas Fault system (see Figure B.4.8.1–1), forms the western boundary of the East Bay Hills and is located about 17 miles west of the Livermore Site. Another branch of the San Andreas Fault system, the Calaveras Fault zone, trends northwest through the San Ramon Valley, which borders the Livermore Valley to the west. A major structural feature north of the Livermore Valley is the Mount Diablo Complex. This complex consists of folded and thrust-faulted rock in the vicinity of Mount Diablo and the surrounding hills. This complex is bordered on the northeastern edge by the Green Valley-Clayton Fault system. The Suisun Bay is to the north and the Livermore Valley to the southeast flank of the Diablo Complex. The two regional northwest-southeast trending fault zones located closest to the Livermore Site waste management facilities are the Greenville Fault zone and the Tesla-Las Positas Fault zones.

None of the Livermore Site waste management facilities, including the DWTF, are located within 200 feet of an active fault. The north branch of the Las Positas Fault is the closest fault to Livermore Site waste management facilities. The Las Positas Fault is approximately 2,700 feet south of the DWTF. The DWTF is approximately 3,500 feet west of the nearest potentially active fault strands in the Greenville Fault zone (LLNL 2002da).

Soils—Radioactive and Hazardous Waste Management Facilities

The soils beneath the Livermore Site are formed primarily upon sediments deposited by local streams. Four soils cover most of the Livermore Site vicinity. In order of decreasing extent these soils are Rincon loam (Areas 612 and 514 and Buildings 280 and 233 CSU), Zamora silty clay loam, San Ysidio loam, Yollo gravelly loam, and Rincon clay loam (DWTF). These soils are primarily Alfisols, or moderately developed soils, and grade into Mollisols, which are grassland soils (LLNL 2001af).

Seismicity—Radioactive and Hazardous Waste Management Facilities

Three principal components of the San Andreas Fault system in the San Francisco Bay Area, the San Andreas, Hayward, and Calaveras faults, have produced the majority of significant historical earthquakes in the Bay Area. These three faults also accommodate the majority of slip along the Pacific and North American plate boundary and they would likely continue to generate moderate to large earthquakes more frequently than other faults in the region. The potential for local, damaging earthquakes was highlighted by the January 1980 Livermore earthquake sequence on the Greenville fault, which produced two earthquakes of magnitudes 5.5 and 5.6 on the Richter Scale. The earthquake caused structural and nonstructural damage to the LLNL facilities. In most cases, earthquakes in the Livermore Valley region have occurred on strike-slip faults, generally indicating north-south-oriented compression. The fault segment nearest LLNL may be capable of generating a magnitude 6 to 6.5 earthquake (LLNL 2002da). A recent U.S. Geological Survey study of the likelihood of major earthquakes in the San Francisco Bay Area has determined that there is a 62 percent probability of one or more earthquakes with a magnitude of 6.7 or greater occurring with 30 years (USGS 2003). The study concluded that the probability of these earthquakes occurring along the Calaveras, Greenville, and Mt. Diablo Thrust faults within the next 30 years was 11 percent, 3 percent, and 3 percent, respectively. The study calculated that there was a 50 percent chance of the Livermore area exceeding a ground shaking of Modified Mercalli (MM) intensity VII to VIII.

The existing waste management facilities were built to the seismic criteria required at the time of their construction. Any structural modifications to these buildings are done in accordance to the Uniform Building Code (UBC) standards in place at the time of modification. All new construction at the Livermore Site is in accordance with the criteria specified in DOE O 6430.1A and current UBC standards. LLNL follows the criteria of the Seismic Safety Program of the *Health and Safety Manual*.

Buildings 612, 614, and 625 have been seismically reviewed and have received a performance rating of "Good," which indicates that during a major seismic disturbance some structural and nonstructural damage and falling hazards may result, but that these would not significantly jeopardize life.

Building 693, built in 1987, was constructed to meet the 1985 UBC seismic standards, which were the standards in effect at that time. Building 280 meets the 1994 and all previous UBC seismic standards. DWTF has been designed to meet 1994 UBC seismic standards.

B.4.8.2 *Site 300 Geologic Setting Overview*

Site 300 occupies approximately 7,000 acres of steep ridges that decrease in elevation toward the southeast. The lowest elevation onsite, where Corral Hollow Creek follows the southern Site 300 southern boundary, is approximately 500 feet above mean sea level. The principal faults in the vicinity of Site 300 are the Corral Hollow-Carnegie, Black Butte, and Midway faults. These faults are discussed in detail in Appendix H. The active Carnegie Fault of the Corral Hollow-Carnegie Fault zone crosses the southern portion of the site. The Elk Ravine Fault, a complex structure composed of pre-Holocene strike-slip faults, reverse faults, normal faults, and local folds, crosses Site 300 from the northwest corner to the southeast corner (Dibblee 1980d). Site 300 soils have developed on marine shales and sandstones, uplifted river terraces, and fluvial deposits. They are classified as loamy Entisols. Entisols are young soils that have little or no horizon development. Clay-rich soils, known as Vertisols, are also present and have been mapped as the Alo-Vaquero Complex. Vertisols are mineral soils characterized by high clay content that display shrink/swell capability. The remaining soil types identified at Site 300 occur only in limited areas. These units are mixtures of soils described and are not readily separable, including grassland Mollisols, or are poorly developed Inceptisols (USDA 1966, 1990).

Stratigraphy—Site 300 Radioactive and Hazardous Waste Management Facilities

The Building 883 area is underlain by unconsolidated Quaternary alluvial and terrace deposits associated with old and present-day stream channels of Corral Hollow Creek. These deposits consist of brown clay, silt, sand, and gravel lenses. Quaternary alluvial deposits predominate in the near Building 883. The Quaternary terrace remnants represent deposits of ancestral Corral Hollow drainage systems. The units are essentially flat-lying in the area and unconformably overlie the late Miocene Neroly and Cierbo Formations. In general, the Neroly Formation in the GSA and vicinity is composed of poorly consolidated, blue-weathering volcaniclastic sandstone and siltstone with interbedded claystone and rare conglomerate. Neroly Formation beds dip generally from 80° to 18° southwesterly.

All three regional stratigraphic members that comprise the Neroly Formation have been encountered in wells drilled in the area: upper blue sandstone member, middle claystone member, and lower blue sandstone. The uppermost, locally recognized, stratigraphic member of the Neroly Formation, upper siltstone and claystone, is not present in the Building 883 area. Its absence may reflect either nondeposition or erosion prior to deposition of the latest overlying Tertiary deposits. The blue-gray sandstone underlies areas east and west of Site 300 and is exposed to the east.

Structure—Site 300 Radioactive and Hazardous Waste Management Facilities

The EWTF located near the center of Site 300 is underlain by interbedded sandstones, claystones, and conglomerates that comprise the lower portions of the late Miocene Neroly formation. This formation underlies most of Site 300. Groundwater underlies the EWTF at depths that vary from 80 to 130 feet (LLNL 1997i).

The nearest fault mapped in the vicinity of the EWTF is the Elk Ravine Fault that passes about 1,000 feet to the northeast. Repeated studies of various strands of this fault have shown no evidence of Holocene activity (LLNL 1997i).

The EWTF is located in the south central portion of Site 300. Available geological mapping studies indicate that the storage magazines are excavated into Quaternary terrace gravels and underlain by dense, semilithified clays, silts, and silty sands correlated with the Pliocene nonmarine sequence of Dibblee. The Neroly Formation underlies the area at greater depths and probably is host to the regional water table (LLNL 1997i).

The nearest mapped fault to the EWTF is the unnamed fault identified in 1982 during early geologic mapping studies. In the northeastern portion of Site 300, this fault appears to offset the contact between the Neroly Formation and the Pliocene nonmarine sequence about 50 feet vertically. No detailed studies are available (LLNL 1997i).

The principal faults mapped in the vicinity of Building 883 include the Corral Hollow-Carnegie Fault system. The Carnegie Fault trends northwest-southeast in the southwest part of Site 300 and merges with the Corral Hollow Fault southwest of the Building 883. This fault system is considered to be active. Within the area, a reverse fault with approximately 8 feet of apparent slip is exposed in the cut slope north of Building 874. Other faults are postulated in the subsurface of the area based on cross sections constructed using seismic data, geophysical logs, and lithologic logs. Fault interpretations are also supported by locally steep gradients on potentiometric surface maps and pump test information. Insufficient information is available at this time to determine the orientation and extent of these faults in the subsurface or of the fault exposed north of Building 874. Nine abundant joints and fractures are present in the Neroly Formation in the GSA and vicinity. Mineral coatings of manganese and iron oxides have been found on fractures in drill core indicating the fractures are a natural phenomenon and not the result of drilling activities. Most fractures observed in drill core occur subparallel to bedding planes in brittle claystone and siltstone and as subvertical joints in resistant, locally cemented sandstone beds. These observations suggest that the more brittle, finer-grained strata may be more responsive to stress. Fossil plants and leaves, typically coated with manganese oxide and lesser iron oxide, may also weaken bedding planes. At deep monitor well W-25N-04, fractures may transport most, if not all, groundwater produced.

Soils—Site 300 Radioactive and Hazardous Waste Management Facilities

Within the Building 883 area, soils consist primarily of the Alo Vaquero complex with the northeast and northwest portion of the area covered by the Wisflat-Arburua-San Timoteo complex. The Alo-Vaquero complex is comprised of clay to silty clay, which is calcareous below 10 inches, typically grading to shale and sandstone at 20 to 40 inches. These soils are well-drained with relatively low permeability and low water-holding capacity. Runoff from Alo-Vaquero soils is medium to rapid, and erosion hazards are moderate to severe. Excessive shrinking and swelling of these soils may occur. The Wisflat-Arburua-San Timoteo complex soils consist of well- to very well-drained sandy to clayey loam with moderate to moderately high permeability and low to very low water-holding capacity. Runoff from these soils is high, and the erosion hazard is severe.

Seismicity—Site 300 Radioactive and Hazardous Waste Management Facilities

Site 300 is located near the eastern edge of the Coast Range Province, which is characterized by northwest trending, strike-slip faults of the San Andreas Fault system. The boundary between the Coast Ranges and the San Joaquin Valley lies immediately east of Site 300 and is characterized by east-northeast compression, resulting in reverse and thrust faulting and folding. The principal faults in the vicinity of Site 300 are the Corral Hollow-Carnegie, Black Butte, and Midway faults. These faults are further described in Appendix H. The active Carnegie Fault of the Corral Hollow-Carnegie Fault zone crosses the southern portion of the site. No significant recorded earthquakes have occurred on any of the local faults.

B.4.9 Ecology

B.4.9.1 *Vegetation*

The Livermore Site RHWM facilities cover less than 5 percent of the 821-acre site. The vegetation at this site was initially altered in the 1800s when livestock grazing began on a large scale in the Central Valley and surrounding areas of California.

The plant communities at the Livermore Site were further degraded and destroyed when the U.S. Navy acquired the land in 1942 and covered the site with concrete runways, roads, and buildings. In addition, Arroyo Las Positas, which flowed through the site, was channelized and now traverses part of the eastern boundary and flows through the northern part of the site.

A survey was conducted in June 2002, which confirmed that site conditions and species composition have changed relatively little during the past 10 years. The developed areas at the Livermore Site, including areas near Buildings 233 CSU and 280, DWTF, and Areas 514 and 612, are planted with ornamental vegetation and lawns. There are also small areas of disturbed ground with early successional plant species. The undeveloped land in the security zone (located north of DWTF) is the introduced grassland plant community dominated by nonnative grasses such as wild oat, brome grasses, foxtail barley, curly dock, and wild radish years (Jones and Stokes 2002a).

Plant species along Arroyo Las Positas (located north of the DWTF) were observed to be essentially those found during a 1997 survey. Common species in the annual grassland along the upper channel bank of the arroyo include wild oats, brome grasses, alkali mallow, and yellow star-thistle (Jones and Stokes 2002a, 2002c).

Site 300 covers approximately 7,000 acres of land in eastern Alameda County and western San Joaquin County. The northern portion is characterized by rolling hills while the southern part consists of steep, deep canyons. The site was acquired in 1953 and, since then, no grazing or farming has taken place. A relatively small part (approximately 5 percent) has been developed for all LLNL activities (less than one percent are waste management-related); the remainder is undisturbed, except for controlled burning. Controlled burning takes place every year on approximately 2,000 acres of land, including areas surrounding the EWTF. Approximately 620 acres of formerly designated California red-legged frog habitat is located in the southwestern half of Site 300. Both the EWSF and Building 883 are located in this area. A 385-acre area including formerly designated as Alameda whipsnake critical habitat is located in the southwestern quarter of Site 300. None of the Site 300 waste management facilities are located in the area (Jones and Stokes 2001, USFWS 2002a).

Several site-wide vegetation surveys have been conducted at Site 300. These surveys have identified a total of 406 plant species at this site (Jones and Stokes 2002a).

B.4.9.2 *Fish and Wildlife*

A total of 4 species of fish, 6 species of amphibians and reptiles, 52 species of birds, and 10 species of mammals were reported observed at the Livermore Site during the biological survey for the 1992 LLNL EIS/EIR or in subsequent documentation (LLNL 1992a, USFWS 1998, LLNL 2003bz).

Wildlife includes species that live in the undeveloped grassland and species that live in the developed areas or along the arroyo (north of DWTF). Representative species observed in the undeveloped grassland areas include the fence lizard, the black-tailed hare, the California ground squirrel, the red fox, and the western meadowlark. Nesting birds include the American crow, American robin, house finch, mockingbird, and house sparrow. These species nest in the planted trees onsite (in the vicinity of all waste management facilities). A raven's nest was observed among some pipes at the Livermore Site.

Recent studies have provided new information about raptor activity at the Livermore Site. In 1996, the red-shouldered hawk, not previously known to occur on LLNL property, nested at the Livermore Site (LLNL 1997e). In 1999, 3 pairs of nesting white-tailed kites, a state-protected bird of prey, successfully fledged 18 young at the Livermore Site. The kites were marked with aluminum leg bands to initiate long-term studies of the species in a semi-urban edge habitat (DOE 2001a, LLNL 2001v).

Site 300, with large areas of undisturbed vegetation, interspersion of various plant community types, and availability of water at springs, provides habitat for a diversity of wildlife. A total of 20 amphibian and reptile species have been observed at Site 300. The scarcity of permanent water limits the potential of Site 300 to support more than a few species of amphibians. Aquatic habitat is available at the sewage lagoon (located east of Building 883) and some of the drainages contain aquatic vegetation supported by underground springs and seeps. Two species of salamanders were observed: the California slender salamander and the California tiger salamander. The latter species was observed during 1986 biological surveys, but not during 1991 surveys. Frog and toad species known to occur onsite are the western toad, Pacific treefrog, and California red-legged frog.

Conditions are far more favorable for reptiles than for amphibians at Site 300. Grassland provides ideal habitat for racers and gopher snakes. Rock sites provide suitable habitat for such species as the western fence lizard, western skink, common kingsnake, and the western rattlesnake. Seeps and springs provide excellent habitat for the northern alligator lizard. Side-blotched lizards and California horned lizards frequent areas with more open vegetation and sandy soils.

A total of 90 bird species have been observed at Site 300 in 2002 (LLNL 2003by). Although grasslands normally support a limited resident bird population, the Site 300 interspersion of several different plant community types and an abundance of seeds and insects provide good habitat for a variety of birds. The western meadowlark, horned lark, and savannah sparrow were the most common small birds seen throughout the open grassland areas. Vegetation at springs and seeps provides nesting habitat for the red-winged blackbird. These permanent water sources attract a greater number of birds than normally found in the adjacent grasslands. For example, mourning dove, cliff and barn swallow, and California quail all require daily water. Oak woodland and a few cottonwood provide nesting habitat for the western kingbird, northern oriole, loggerhead shrike, and American goldfinch. Coastal sage scrub supports scrub jay, Anna's hummingbird, rufous-crowned sparrow, and white-crowned sparrow. Ecotones (boundary areas between two habitats) of sage scrub and grassland provide ideal habitat for mourning dove, California quail, lazuli bunting, and lark sparrow. Rocky outcrops and cliffs provide breeding sites for white-throated swift, cliff swallow, Say's phoebe, and rock wren. Site 300 supports a population of nesting raptors. A report is in progress to provide the current status of foraging and nesting activities of such raptors as the great horned owl, barn owl, golden eagle, prairie falcon, red-tailed hawk, northern harrier, and short-eared owl.

A total of 30 mammal species have previously been observed onsite. Mammals were recorded during threatened and endangered species surveys that included ground surveys over the entire site, night spotlighting, establishment of scent stations in 1986 and 1991, and small-mammal trapping in 1986 (LLNL 1992a). An inventory was recently conducted on small mammals at Site 300, and 10 small mammal species were identified (Jones and Stokes 2002b).

Productive and diverse grasslands on Site 300 support an abundance of rodents and lagomorphs (rabbits and hares). Conditions are ideal for California ground squirrels in the northern portion of Site 300 where the terrain is less rugged. Other common rodents include the house mouse, deer mouse, brush mouse, western harvest mouse, California vole, Heermann's kangaroo rat, San Joaquin pocket mouse, California pocket mouse, and valley pocket gopher (Jones and Stokes 2002b). Lagomorphs such as black-tailed hares and desert cottontails are also widespread and abundant, with the latter tending to occupy areas with more cover.

B.4.9.3 *Threatened and Endangered Species*

Detailed studies for threatened, endangered, and other species of concern (referred to as sensitive species in this section) were conducted at the Livermore Site and Site 300. Other species of concern refer to Federal candidate species and State of California species of special concern. The biological assessment currently under regulatory agency informal consultation includes a list of potential sensitive species that may occur at the sites. As a result of recent surveys and previous consultations, six federally listed species and two state-listed species have been identified at or near Site 300.

No sensitive plants, invertebrates, reptiles, or mammals were observed during the 1992 or recent biological surveys at the Livermore Site (LLNL 1992a, USFWS 2002a). The California red-legged frog, a federally listed threatened species and a State species of special concern occurs at the Livermore Site.

Although the U.S. Fish and Wildlife Service (USFWS) established critical habitat for the species in March 2001 (66 FR 14626), the critical habitat was later rescinded by a court order. At the Livermore Site, formerly designated critical habitat for the California red-legged frog is present in the North Buffer Zone, just north of the DWTF (LLNL 2002cc). It is possible that the USFWS will later re-establish the critical habitat.

Although the California tiger salamander, a federally proposed threatened species and state species of special concern, is not presently found at the Livermore Site, it has been observed in land near the installation (LLNL 1992a, LLNL 2002cc). The DWTF and Areas 514 and 612 are located adjacent to formerly designated critical habitat for the California red-legged frog.

The loggerhead shrike, a Federal species of concern and a State species of special concern, has recently been reported nesting in developed areas at SNL/CA (NNSA 2003a).

The only federally protected plant species known to occur at Site 300 is the large-flowered fiddleneck (a federally listed and state-listed endangered species). A portion of Site 300 has been designated as critical habitat for the plant (Jones and Stokes 2002c). None of the RHWM facilities are located in this area.

B.4.9.4 *Wetlands*

Wetlands, although very limited at the Livermore Site, do occur along Arroyo Las Positas at the northern perimeter of the site, adjacent to the DWTF. In 1992, 0.36 acre was determined to qualify as jurisdiction wetland. The wetland was dominated by salt grass, and cattails occurred on one-third of the wetland (LLNL 1992a, Jones and Stokes 2002c).

Since 1992, wetlands along Arroyo Las Positas have increased due to the release of water associated with environmental restoration activities at the Livermore Site. In 1997, an additional wetland delineation study was performed along Arroyo Las Positas. That study determined that the size of jurisdictional wetlands had expanded to approximately 1.96 acres and involved three different wetland plant communities. Approximately 1.22 acres of ruderal wetland was identified dominated by tall flatsedge, bristly ox-tongue, bearded sprangletop, Bermuda grass, and barnyard grass (Jones and Stokes 2002c).

Approximately 0.65 acre of freshwater marsh was delineated dominated by cattails and bullrushes. Finally 0.09 acre of riparian scrub was observed dominated by willows and a small stand of cottonwoods (Jones and Stokes 2002c).

A study for the EIS for previous site-wide operations delineated 6.76 acres of wetlands at Site 300 (LLNL 1992a). In August 2001, another wetland delineation study was conducted identifying 46 wetlands and determining that the total size of wetlands had increased to 8.61 acres. Approximately 4.39 acres were found to meet criteria for jurisdictional wetlands. These wetlands are small in nature and include freshwater seeps, runoff from some of the buildings, vernal pools, and seasonal ponds (Jones and Stokes 2002c). Many of the wetlands occur at springs in the bottom of deep canyons in the southern half of the site. RHWM facilities are associated with wetlands at either the Livermore Site or Site 300.

B.4.10 Air Quality

Radiological air quality is discussed below. The section provides radionuclide emission estimates as well as dose calculations for maximally exposed receptors and the populace. Dose estimates are also compared to EPA standards designed to protect members of the public.

Section B.4.10.2 details LLNL's air pollutant sources and emissions. While both LLNL sites are discussed, focus is weighted more heavily on the Livermore Site because it is significantly larger in terms of the number of sources, permitted equipment, emission rates, and employee traffic.

B.4.10.1 *Radiological Air Emissions*

LLNL uses and manages a variety of radioisotopes, including uranium, TRUs, biomedical tracers, tritium, and mixed-fission products and waste, for research purposes. The major radionuclide released to the atmosphere from the Livermore Site is tritium. In addition to effluent sampling for tritium, a number of facilities at the Livermore Site (including the DWTF and Building 514) have air effluent samplers to detect the release of uranium and TRU aerosols. LLNL also monitors diffuse, or nonpoint, sources to fulfill the National Emission Standard for Hazardous Air Pollutants (NESHAP) requirements. Summary data from several point and diffuse sources can be found below. Assessment of air effluent emissions and resulting dose to the public is performed by monitoring emissions and/or evaluating potential emissions. Radiological emissions from LLNL RHWM facilities, LLNL operational facilities, and other sources and subsequent exposure to members of the public are considered minor (LLNL 2002bb).

For the Livermore Site, the dose calculated for the site-wide maximally exposed individual (MEI) from diffuse emissions in 2001 totaled 0.011 millirem. The dose due to point sources was 0.0056 millirem. When combined, the total annual dose was 0.017 millirem, 66 percent from diffuse and 34 percent from point sources. The total dose to the Site 300 site-wide MEI from operations in 2001 was 0.054 millirem. Point source emissions from firing table explosives experiments accounted for 0.050 millirem, or 93 percent, of this total, while 0.0037 millirem, or about 7 percent, was contributed by diffuse sources containing low levels of depleted uranium, representing resuspension by wind of soil throughout the site.

Tritium accounted for more than three-quarters of the Livermore Site's calculated dose, while at Site 300, practically the entire calculated dose was due to the isotopes uranium-238, uranium-235, and uranium-234 in depleted uranium. LLNL doses from air immersion and ground irradiation are negligible for both tritium and uranium.

Table B.4.10.1–1 shows the facilities or sources (four of the eight are RHWM facilities) that accounted for more than 90 percent of the doses to the site-wide MEI for the Livermore Site and Site 300 in the year 2001. Although LLNL has nearly 200 sources releasing radioactive material to the air, most are very minor; nearly the entire radiological dose to the public comes from fewer than a dozen sources. The trends in dose to the site-wide MEI from emissions at the Livermore Site and Site 300 over the last 12 years are shown in Table B.4.10.1–2. The general pattern, particularly over the last decade, shows year-to-year fluctuations around a quite low dose level, staying at or below about 1 percent of the Federal standard.

The site-wide MEI dose estimates are intentionally conservative, predicting potential doses that are generally higher than would actually be experienced by any member of the public.

TABLE B.4.10.1–1.—*List of Facilities or Sources Whose Emissions Accounted for More Than 90 Percent of the Site-wide Maximally Exposed Individual Doses for the Livermore Site and Site 300 in 2001*

Facility (source category)	CAP88-PC dose in mrem/y[a]	CAP88-PC percentage contribution to total dose
	Livermore Site	
Building 612 Yard (diffuse source) [b]	0.0082[a]	48
Building 331 Stacks (point source)	0.043[a]	25
Building 514 Tank Farm (diffuse source)[b, c]	0.0013	8
Southeast Quadrant (diffuse source)	0.00088	5
Building 612, (point source) [b]	0.00062	4
Building 514 Evaporator (point source) [b, c]	0.00058	3
	Site 300	
Building 851 Firing Table (point source)	0.05	93
Soil resuspension (diffuse source)	0.0037	7

Source: LLNL 2002cc.
[a] One mrem equals 10 microsievert.
[b] RHWM facility.
[c] This source moves to the DWTF prior to FY2005.
DWTF = Decontamination and Waste Treatment Facility; RHWM = radioactive and hazardous waste management.

TABLE B.4.10.1–2.—*Doses Calculated for the Site-wide Maximally Exposed Individual for the Livermore Site and Site 300, 1990 to 2001*

Year	Total dose (mrem)[a]	Point source dose (mrem)[a]	Diffuse source dose (mrem)[a]
Livermore Site			
2002	0.23 [b]	0.10 [b]	0.13
2001	0.017 [b]	0.0057[b]	0.011
2000	0.038 [b]	0.017 [b]	0.021
1999	0.12 [b]	0.094 [b]	0.028
1998	0.055 [b]	0.031 [b]	0.024
1997	0.097	0.078	0.019
1996	0.093	0.048	0.045
1995	0.041	0.019	0.022
1994	0.065	0.042	0.023
1993	0.066	0.04	0.026
1992	0.079	0.69	0.01
1991	0.234	(c)	(c)
1990	0.24	(c)	(c)
Site 300			
2002	0.021	0.018	0.0033
2001	0.054	0.05	0.0037
2000	0.019	0.015	0.0037
1999	0.035	0.034	0.0012
1998	0.024	0.019	0.005
1997	0.02	0.011	0.0088
1996	0.033	0.033	0.00045
1995	0.023	0.02	0.003
1994	0.081	0.049	0.032
1993	0.037	0.011	0.026
1992	0.021	0.021	(d)
1991	0.044	0.044	(d)
1990	0.057	0.057	(d)

Source: LLNL 2003l.
[a] One mrem equals 10 microsievert (μSv).
[b] The dose includes modeling tritium emissions as directed by EPA Region IX. EPA Region IX acknowledges that such modeling results in a conservative overestimation of the dose. This methodology is used for purposes of compliance.
[c] Diffuse source doses were NR separately from the total dose for the Livermore Site for 1990 and 1991.
[d] No diffuse emissions were reported at Site 300 before 1993.

Common Radiological Effect Terminology

Dose: the energy imparted to matter by ionizing radiation; the unit of absorbed dose is the rad, equal to 0.01 joules per kilogram for irradiated material in any medium.

Diffuse source: any unconfined area (e.g., entire building or yard, ground, large tank, or evaporator).

Effective dose equivalent (EDE): an estimate of the total risk of potential effects from radiation exposure, it is the summation of the products of the dose equivalent and weighting factor for each tissue. The weighting factor is the decimal fraction of the risk arising from irradiation of a selected tissue to the total risk when the whole body is irradiated uniformly to the same dose equivalent. These factors permit dose equivalents from non-uniform exposure of the body to be expressed in terms of an effective dose equivalent (EDE) that is numerically equal to the dose from a uniform exposure of the whole body that entails the same risk as the internal exposure (ICRP 1990). The EDE includes the committed EDE from internal deposition of radionuclides and the EDE caused by penetrating radiation from sources external to the body, and is expressed in units of rem (or sievert).

Maximally exposed individual (MEI): a hypothetical member of the public at a fixed location who, over an entire year, receives the maximum EDE (summed over all pathways) from a given source of radionuclide releases to air. Generally, the MEI is different for each source at a site.

Point source: any confined and discrete conveyance (e.g., pipe, ditch, well, or stack).

Rem: a unit of radiation dose equivalent and EDE describing the effectiveness of a type of radiation to produce biological effects; coined from the phrase "roentgen equivalent man," and the product of the absorbed dose (rad), a quality factor (Q), a distribution factor, and other necessary modifying factors. One rem equals 0.01 sievert.

Sievert (Sv): the international unit of radiation dose equivalent and EDE, that is the product of the absorbed dose (gray), quality factor (Q), distribution factor, and other necessary modifying factors. 1 Sv equals 100 rem.

Site-Wide Maximally Exposed Individual (MEI): a hypothetical person for each LLNL location (Livermore Site and Site 300) who receives, at the location of a given publicly accessible facility (such as a church, school, business, or residence), the greatest LLNL-induced EDE (summed over all pathways) from all sources of radionuclide releases to air at a site. Doses at this receptor location caused by each emission source are summed, and yield a larger value than for the location of any other similar public facility. This individual is assumed to continuously reside at this location 24 hours per day, 365 days per year.

B.4.10.2 *Nonradiological Air Emissions*

All LLNL activities with the potential to produce air pollutant emissions are evaluated to determine the need for air permits and assess continued compliance. Sources that have been determined to be exempt from permit requirements are monitored to substantiate that each source operates in agreement with exemption specifications (e.g., throughput remains within the limits of a specified exempt quantity).

In 2002, LLNL operated 199 air emission sources for the Livermore Site and 44 air emission sources for Site 300. Air emission source permits are listed in the RCRA Part B Permit and include waste operations in Building 612, Building 514 and the EWTF. A general listing of air permits is provided in Table B.4.10.2–1.

TABLE B.4.10.2–1.—*Summary of Air Permits Active in 2002*

Category	Permitted Units	
	Livermore Site	**Site 300**
Coating, printing, and adhesives	Paint spray booths Adhesives operations Optic coating operations Printing press operations Silk-screening operations Silk-screen washers	Paint spray booth
Combustion	Boilers Emergency generators Diesel air-compressor engines	Boilers Emergency generators
Explosives testing	Fire test cells and firing tanks	Contained Firing Facility
Gasoline dispensing	Gasoline dispensing operation	Gasoline dispensing operation
Machining	Metal machining and finishing operations	-
Ovens	Ovens	Drying ovens
Remediation	Groundwater air strippers/dryers	Groundwater air strippers Soil vapor extraction units
Materials handling	Drum crusher Paper-pulverizer system	Woodworking cyclone (exhaust system control device)
Solvent cleaning	Cold cleaners Manual wipe-cleaning operations	-
Miscellaneous	Oil and water separator Sewer diversion system Storage tanks with VOCs in excess of 1.0% Semiconductor operations Material-handling equipment	Explosive waste treatment units
Total Permitted Units	**199**	**44**

Source: LLNL 2003l.
RHWM = radioactive and hazardous waste management; VOC = volatile organic compound.

Site-wide criteria pollutant emission rates for LLNL are provided in Table B.4.10.2–2. The Livermore Site currently emits approximately 90 kilograms per day of criteria air pollutants from both permitted and exempt sources. The largest sources of criteria pollutants from the Livermore Site are surface coating operations, internal combustion engines, solvent operations, and oil and natural gas-fired boilers. The largest sources at Site 300 are internal combustion engines, boilers, a gasoline-dispensing operation, open burning of brush for fire hazard management, paint spray booths, drying ovens, and soil vapor extraction operations (LLNL 2002cc).

Finally, a separate Federal listing of approximately 200 compounds is evaluated to confirm applicability under NESHAP. Emission rates at both LLNL sites are less than one-half of the thresholds of 7 tons per year for a single hazardous air pollutant (HAP) or 15 tons per year for a combination of HAPs (LLNL 2002e).

TABLE B.4.10.2–2.—*Criteria Air Pollutant Emission Rates*

	Estimated Releases (kilograms per day) [a]									
	Livermore Site					Site 300				
Pollutant	1998	1999	2000	2001	2002	1998	1999	2000	2001	2002
Precursor organic compounds	25	24	20	19	16	0.90	1.2	0.4	0.1	0.23
Nitrogen oxides	56	81	54	52	67	2.1	3.2	2.3	0.9	1.1
Carbon monoxide [b]	11	24	14	14	17	0.48	0.71	0.5	1.1	1.0
Particulates (PM_{10})	5.7	8.6	5.5	5.5	6.1	0.53	0.33	0.2	0.3	0.09
Oxides of sulfur	0.72	0.98	0.6	0.6	2.8	0.15	0.28	0.2	0.1	0.07

Source: LLNL 2002cc, LLNL 2001v, LLNL 2000g, LLNL 1999c, LLNL 2003l.
[a] One kilogram equals 2.2 pounds.
[b] In 1999, the emission factor used to calculate carbon monoxide was 0.035 pounds per 1,000 cubic feet for large boilers and 0.021 pounds per cubic foot for small boilers. In previous years the emission factor used was 0.017 pounds per cubic foot for both large and small boilers. This resulted in a significant change in carbon monoxide emissions reported for 1999.
PM_{10} = particulate matter less than 10 microns diameter.

Based on previous assessments, the Bay Area Air Quality Management District and the San Joaquin Valley Unified Air Pollutant Control District have ranked LLNL as a low-risk facility for nonradiological air emissions.

B.4.11 Water Resources and Hydrology

Surface Water

Surface drainage and natural surface infiltration at the Livermore Site are generally good, but drainage decreases locally with increasing clay content in surface soils. Surface flow may occur intermittently from October to April, during the valley's wet season. The two major intermittent streams associated with the Livermore Site are the Arroyo Seco and Arroyo Las Positas; the latter is located north and adjacent to the DWTF. When surface flow occurs in these channels, water infiltrates into the underlying alluvium and eventually percolates to the aquifers.

Arroyo Seco cuts across the southwestern corner of the site, flowing to the northeast; discharge to this stream is primarily storm runoff. Arroyo Las Positas is an intermittent stream that drains from the hills directly east of the Livermore Site. This channel enters the Livermore Site from the east, is diverted along a storm ditch around the northern edge of the site, and exits the site at the northwest corner.

Nearly all surface water runoff at the Livermore Site is discharged into Arroyo Las Positas; only surface runoff along the southern boundary and storm drains in the southwest corner of the Livermore Site drain into Arroyo Seco.

Surface water at Site 300 consists of seasonal runoff, springs, and natural and manmade ponds. There are no perennial streams at or near Site 300. The canyons that dissect the hills and ridges at Site 300 drain into intermittent streams. Naturally occurring springs show both the presence of flowing water or wet soils where the water table at that point is close to the surface, and the presence of distinct hydrophytic vegetation (cattails, willow). There are at least 23 springs at Site 300, 19 that are perennial and 4 that are intermittent. Most of the springs have very low flow rates and are recognized only by small marshy areas, pools of water, or vegetation.

Numerous artificial surface water bodies are present at Site 300. Several areas of surface water discharge are present onsite near cooling towers or other process runoff areas. These artificial runoff areas have the same characteristics as natural springs because they contain running water and support hydrophytic vegetation (LLNL 2002k).

Surface Water-Radioactive and Hazardous Waste Management Facilities

For waste management areas that are not completely enclosed, accumulated precipitation must be removed from the secondary containment systems as required to prevent overflow. (Note: Puddles of rainwater that do not exceed a depth of a half-inch do not interfere with operations, do not compromise secondary containment capacity, are not removed, and are allowed to evaporate.) In general, the accumulated liquids are managed based on volume accumulated and analytical results when samples are required to be collected. The accumulation points (i.e., sumps and trenches) are typically visually inspected to determine if liquids are present. If liquids are observed or detected, the source (e.g., precipitation) of the liquids is determined. If analytical results are within the discharge limitations, the accumulated liquids are discharged. If the analytical data indicate that the accumulated liquid does not meet sanitary sewer discharge criteria, the liquids are removed using a wet-dry vacuum, portable pump, or similar collection device and transferred into appropriate containers. The contaminated liquids are then managed as a waste.

In one area of the Area 612 yard, gravity drain lines are used to drain the accumulated rainwater directly into the sanitary sewer. A normally closed and locked isolation valve is located on the drain line to prevent unauthorized discharges.

Discharges to the Sanitary Sewer

Prior to any discharge to the sanitary sewer, wastewater must be tested and found to meet or fall below internal discharge limits. Further treatment of the wastewater is conducted as necessary to meet discharge requirements. Once the wastewater meets these requirements, the RHWM then discharges the wastewater through the discharge ports at the Area 612 facility or the DWTF, which are kept locked and to which only selected personnel have custody of the key. A record of the discharges is kept.

Groundwater

Within the Livermore Valley, uppermost saturated sediments are commonly unconfined. Interbeds and interlenses of low-conductivity sediments within the saturated zone act as local aquitards, which tend to confine the deeper water-bearing zones. The two most important formations that contain groundwater are Quaternary alluvial deposits and the Plio-Pleistocene Livermore Formation. The Livermore Formation is generally of lower permeability than the overlying deposits, but it commonly contains significant water-bearing zones.

In general, groundwater flows toward the east-west longitudinal axis of the Livermore Valley and then in a westward direction to the gravel pit mines and the municipal water supply wells near Livermore and Pleasanton. Vertical movement of water between the lower member of the Livermore Formation and the overlying alluvial sediments is restricted by permeability differences and by internal stratification within these sedimentary units. At the Livermore Site, the upper 15 to 60 feet of the lower member of the Livermore Formation is known to act as an aquitard. Under the Livermore Site, the contact between distinctively colored units in the lower member of the Livermore Formation generally dips to the west and is found between approximately 25 and 400 feet below ground surface.

The Livermore Valley has been divided into several groundwater subbasins. The Livermore Site is located within the Spring and Mocho I subbasins. Groundwater leaves the Spring-Mocho I sub-basin through surface discharge at the Las Positas Spring located near Interstate Highway 580 and State Highway 84 (1.5 miles northwest of LLNL) and via westward subsurface flow into the Mocho II subbasin. The Las Positas Fault Zone forms the southern boundary of the Spring-Mocho I subbasin. South of the Livermore Site, the water levels on the south side of the Las Positas Fault Zone have been more than 80 feet higher than those on the north side of the fault. This water level differential indicates that the Las Positas Fault Zone forms a significant barrier to groundwater flow.

Groundwater ranges from excellent to poor quality and has been used for industrial, agricultural, and domestic purposes. A Federal Facility Agreement for the Livermore Site was signed in November 1988 prohibits LLNL from using the underlying groundwater for drinking water. The LLNL area groundwater locally recharges by percolation through the valley alluvium and by infiltration via Arroyo Seco and Arroyo Las Positas as well as from unlined drainage ditches. A recharge basin (located south of the Livermore Site) is a significant source of groundwater recharge. The basin receives treated groundwater from the southwest portion of the Livermore Site. A manmade drainage retention basin (located near the center of the Livermore Site) has been lined to prevent the infiltration of stormwater and treated groundwater from proposed groundwater extraction well locations.

The depth to the water table beneath the Livermore Site currently ranges from approximately 30 feet to 135 feet. Periodic water table changes and mounds have been observed due to groundwater recharge near the Arroyo Seco, the Arroyo Las Positas, and the central drainage retention basin.

Water level fluctuations in monitoring wells near the Area 612 facility, the DWTF complex, and the Building 280 facility have been observed since 1985 and 1997. Some seasonal fluctuations can be observed. A rather steep water table gradient is observed near the DWTF complex. This steep gradient may be due to the abundance of low-permeability sediments in this area and to local recharge adjacent to the Arroyo Las Positas.

At Site 300, two regional aquifers or major water-bearing zones have been identified: an upper water table aquifer in the sandstones and conglomerates of the Neroly Formation and a deeper confined aquifer located in Neroly sandstones just above the Neroly/Cierbo contact. Both aquifers have permeable zones layered with lower permeability claystones, siltstones, or tuffs. Many of the sandstones are fine-grained and silty and contain fractures. Groundwater flow is both intergranular and fracture flow. In addition to the two regional aquifers, several perched aquifers have been identified, some of which give rise to springs. Extensive perched aquifers are present beneath the northwestern portion of the site and in the southeastern portion of the site. In addition, shallow Quaternary alluvium and undifferentiated Tertiary nonmarine sediments are locally water bearing such as the GSA. These local aquifers are generally unconfined or water table aquifers.

Investigation and remediation of contaminated groundwater beneath the Livermore Site and Site 300 is ongoing. Volatile organic compounds (VOCs) and other contaminants of concern are present in groundwater. Areas of past releases of contaminants to the environment, some dating from the 1940s, have been identified and groundwater contamination is being treated. Concentrations of contaminants have been significantly reduced as a result of extracting and treating millions of gallons of water.

A total of 862 solid waste management units at LLNL are identified and delineated in the EPA RCRA Facility Assessment, Visual Site Inspection Report. Investigation and resolution of groundwater contamination at the Livermore Site is being addressed according to the schedules and details specified in the Federal Facility Agreement. Investigation and resolution of groundwater contamination at Site 300 is being addressed as eight operable units. None of the storage or treatment units in this appendix are expected to impact the groundwater under the Livermore Site.

A wide range of analytes is monitored to assess the impact, if any, of current LLNL operations on local groundwater resources. Because surveillance monitoring is geared to detecting substances at very low concentrations in groundwater, it can detect contamination before it significantly impacts groundwater resources. Wells at the Livermore Site, in the Livermore Valley, and at Site 300 in the Altamont Hills are included in LLNL's surveillance monitoring plan. Initial releases of hazardous materials occurred at the Livermore Site in the mid-to-late 1940s when the site was the Livermore Naval Air Station. There is also evidence that localized spills, leaking tanks and impoundments, and landfills contributed VOCs, fuel hydrocarbons, lead, chromium, and tritium to the groundwater and unsaturated sediment in the post-Navy era. Historically, the surveillance and compliance monitoring programs have detected relatively elevated concentrations of various metals, nitrate, perchlorate, and depleted uranium (uranium-238) in groundwater at Site 300. Subsequent *Comprehensive Environmental Resources, Compensation, and Liability Act* (CERCLA) studies have linked several of these contaminants, including uranium-238, to past operations, while other contaminants are the objects of continuing study. Present-day administrative, engineering, and maintenance controls at both LLNL sites are specifically tailored to prevent accidental releases of chemicals to the environment.

Floodplains

All waste management units are located outside the predicted 100-year floodplain areas. The 100-year floodplains are adjacent to Arroyo Seco and Arroyo Las Positas, which are approximately 52 feet from the nearest waste management unit. LLNL stormwater is channeled through storm drains designed to accommodate a 10-year flow. At RHWM facilities, rainwater is collected, sampled, and disposed of according to the chemical analysis. Open ditches are used in underdeveloped areas of the Livermore Site. The Arroyo Seco crosses the Livermore Site at the southwest corner. The Arroyo Las Positas originally crossed the northeast section of the Livermore Site. However, in 1965, as part of an erosion control program, the Arroyo Las Positas was channeled north to the northeast corner of the Livermore Site, and then west along the north perimeter to an outlet near the northwest corner. This outlet, which also constitutes the main pathway for the Livermore Site surface drainage (storm and irrigation), runs north to the Western Pacific tracks, then west where it joins Arroyo Seco.

There are no floodplains on Site 300 as the 100-year base flood event is contained within all channels.

B.4.12 Noise

The noise generated at LLNL is typical of an R&D facility. Ambient noise sources include onsite vehicular traffic and stationary noise sources such as generators, cooling systems, transformers, engines, pumps, fans, etc. Construction activities also contribute to ambient background noise levels.

EPA guidelines for environmental noise protection recommend an average day-night sound level of 55 A-weighted decibels (dBA) as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas. Land-use compatibility guidelines adopted by the Federal Aviation Administration (FAA) and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses, and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (14 CFR Part 150).

LLNL is not subject to environmental noise regulation by state or local agencies. Alameda County has noise standards for the unincorporated areas of the county, which are applicable to areas northeast, east, south (beyond SNL/CA), and southeast of the Livermore Site. The standards correlate types of land use with minutes of exposure to various dB(A) levels by time of day. Noise sources associated with construction are exempt from the noise standards, provided the construction activities do not take place before 7 a.m. or after 7 p.m., Monday through Friday, or before 8 a.m. or after 5 p.m., Saturday or Sunday. Table B.4.12–1 presents the Alameda County noise level standards.

TABLE B.4.12–1.—*Alameda County Noise Level Standards*

Cumulative Number of Minutes in any 1-Hour Time Period	Noise Level Standard (dBA)			
	7 a.m. to 10 p.m.		10 p.m. to 7 a.m.	
	Noise Sensitive[a]	Commercial	Noise Sensitive[a]	Commercial
30	50	65	45	60
15	55	70	50	65
5	60	75	55	70
1	65	80	60	75
0	70	85	65	80

Source: NNSA 2003a.
[a] Noise-sensitive land uses include residences, schools, hospitals, churches, and public libraries.
dBA = A-weighted decibels.

The city of Livermore follows the Noise element of the Livermore General Plan. These guidelines are applicable to areas within the city that are west and northwest of the Livermore Site.

LLNL is subject to occupational noise exposure standards established in a Hearing Conservation Program that incorporates the requirements identified in DOE O 440.1A, “Worker Protection Management for DOE Federal and Contractor Employees,” and 29 CFR §1910.95, “Occupational Noise Exposure.” The program also incorporates the threshold limit values established by the American Conference of Governmental Industrial Hygienists. Under the Hearing Conservation Program, hearing protection is provided to workers to attenuate exposure to an 8-hour time-weighted average of no more than 85 dBA.

A field survey was conducted in January 2003 to characterize typical daily maximum noise levels in the vicinity of the Livermore Site. Measurements were taken for 1-hour periods using standard sound-level meters during the heart of the morning and evening commute. The monitors were placed at eight locations surrounding and just outside the Livermore Site perimeter and in regions of maximum activity (intersections and site entrance and exit locations), shown in Figure B.4.12–1. Results of the survey, shown in Table B.4.12–2, found that, as expected, vehicular traffic was the dominant noise source at most monitored locations. Rail operations and light aircraft overflights were minor contributors. The only recognizable noise sources from site activities within the site were some heavy equipment backup warning beepers, which were detectable during low traffic intervals at the monitoring sites on Patterson Pass Road. All levels were within the acceptable range established by the city of Livermore and county of Alameda.

The noise generated at Site 300 is typical of an R&D facility with two special considerations: a live firing range and occasional open detonation events (including at the EWTF). Ambient noise sources include onsite vehicular traffic and stationary noise sources such as generators, cooling systems, transformers, engines, pumps, and fans. Construction activities also contribute to ambient background noise levels. Like the Livermore Site, Site 300 is not subject to environmental noise regulation by state or local agencies. Because Site 300 is part of LLNL operations, the occupational noise protection procedures are the same for identifying, handling, protecting, reducing, and controlling noise. The potential for a noise pulse event exists as the EWTF conducts open burns and open detonation to treat explosive wastes. Table B.1.2–1 provides quantity limits at the EWTF.

A less extensive field survey, consisting of five perimeter locations and 10- to 15-minute collection periods, was conducted in the vicinity of Site 300 in 1991, to document weekday ambient noise levels. The study showed that the ambient noise levels along Corral Hollow Road/Tesla Road ranging from 56 to 66 dBA equivalent-continuous sound level (L_{eq}), which is typical of traffic noises associated with suburban-street to near-freeway traffic (Table B.4.12–3).

At the time of the survey, no noticeable noise was being generated at the Site 300 firing range or the Carnegie State Vehicular Recreational Area. Higher ambient noise levels would be expected at the monitoring sites along Corral Hollow Road/Tesla Road during weekend periods when the Carnegie State Vehicular Recreational Area has the greatest off-highway vehicle activity. This survey was performed in 1991.

TABLE B.4.12–2.—*Results of Ambient Noise Measurements*[a]

	Locations [b]	Date	Start and End Times [c]		1-Hour L_{eq} [d]
1	Patterson Pass Rd: 16 feet from near traffic lane	Jan. 9, 2003	7:00 -	8:00 AM	70.5
			4:30 -	5:30 PM	68.5
2	Patterson Pass Rd: 19 feet from near traffic lane	Jan. 9, 2003	7:00 -	8:00 AM	68.1
			4:30 -	5:30 PM	63.7
3	Greenville Rd: 6.8 feet from near traffic lane	Jan. 7, 2003	7:15 -	8:15 AM	73.0
			4:30 -	5:30 PM	74.0
4	South Vasco Rd: 17 feet from near traffic lane	Jan. 8, 2003	7:00 -	8:00 AM	70.2
			4:30 -	5:30 PM	68.6
		Jan. 9, 2003[e]	7:00 -	8:00 AM	70.2
5	South Vasco Rd: 32 feet from near traffic lane	Jan. 10, 2003	7:15 -	8:15 AM	73.2
			4:30 -	5:30 PM	66.5
6	South Vasco Rd: 43 feet from near traffic lane	Jan. 10, 2003	7:15 -	8:15 AM	73.4
			4:30 -	5:30 PM	69.3
7	Greenville Rd: 21 feet from near traffic lane	Jan. 7, 2003	7:00 -	8:00 AM	72.2
			4:30 -	5:30 PM	73.5
8	Greenville Rd: 11 feet from near traffic lane	Jan. 8, 2003	7:00 -	8:00 AM	72.3
			4:30 -	5:30 PM	72.6

Source: Sculley 2003.

[a] Monitoring was conducted using Larson-Davis Model 820 Type I sound level meters mounted on tripods, about 4 to 5 feet aboveground level. Instruments have a 110-dB dynamic range with a noise floor of about 20 dB(A). Meters were programmed for slow response (8 samples per second, 1 second averaging), A-weighted setting. Weather protection for the body of the meter was provided as necessary using plastic bags or vinyl pouches.

[b] Locations are shown on Figure B.4.12–1.

[c] Meters were started and stopped manually, with 1-minute time histories and 15-minute interval histories collected; interval histories were synchronized to clock hours.

[d] Leq is an energy-averaged noise level for the indicated time period.

[e] Morning noise monitoring at Station # 4 was repeated on January 9, 2003.

dB(A) = A-weighted decibels.

Table B.4.12–3.— *Site 300 Offsite Ambient Noise Measurement Results*

Location	Time	L_{eq} (dB[A])[a]	Description
Along eastern Site 300 boundary	11:15 - 11:30 AM	59	No dominant noise sources
Next to Corral Hollow Road approximately 0.75 mile west of I-580	9:05 - 9:20 AM	60	Ambient noise dominated by earth-moving equipment operating at Corral Hollow landfill (0.5 mile from monitoring site)
Next to Corral Hollow Road approximately 2 miles east of I-580	9:35 - 9:50 AM	56	Ambient noise dominated by overflying hawk
Next to Corral Hollow Road across from Carnegie State Vehicular Recreational Area	12:50 - 1:05 PM	66	Ambient noise dominated by wind and a few vehicles on roadway
Next to Tesla Road approximately 0.5 mile west of Alameda/San Joaquin County Line	1:15 - 1:30 PM	64	Ambient noise dominated by wind and a few vehicles on roadway

Source: LLNL 1992a.

[a] L_{eq} is an energy-averaged noise level for the indicated time period.

B.4.13 Minerals

The potential stone and aggregate resources of the eastern Livermore Valley and western San Joaquin County were assessed in 1987 and 1988. Zones have been established that identify sand, gravel, and stone source areas. The Livermore Site and Site 300 are located in a Mineral Resource Zone 1. Zone 1 is defined as an area where adequate information indicates that no significant mineral deposits are present or that the likelihood of their presence is rare. Within the eastern Livermore Valley, several deposits have been identified as recoverable and marketable resources (LLNL 1992a). According to a report developed by the California Department of Conservation, Division of Mines and Geology, an estimated 3.8 billion tons of aggregate reserves are available within the southern San Francisco Bay region, and the total aggregate reserves available within the Livermore Valley area amount to 676 million tons; however, much of the area is currently developed for other land uses (TtNUS 2003).

Several occurrences of other potentially economically valuable mineral deposits are within a 10-mile radius of the Livermore Site. These include deposits of manganese, chromium, clay, gemstones, pyrite, dimension stone, sand and gravel, and natural gas.

Petroleum and Natural Gas Production

The Livermore oil field just east (10 miles) of the Livermore Site was discovered in 1967 and, to date, is the only oil field in the Livermore-San Ramon Valley area. The Livermore oil field was originally operated by the Hershey Corporation and consisted of 10 producing wells. These wells are located northeast of Livermore Site. Production is primarily from Miocene Cierbo Formation sandstones at depths of 900 to 2,000 feet. In 1992, the Livermore oil field was operated by the American Exploration Corporation. Of the original 10 wells, 5 were producing an average of 7 barrels of oil per day, 1 well was plugged and abandoned, 3 wells were shut in, and 1 well was used for saltwater injection. Reserves were thought to be approximately 132,000 barrels and production was declining (LLNL 1992a). In 2002, the XL Operating Company operated the Livermore oil field. In February 2002, only three wells were producing. No oil or gas exploration is currently being conducted or proposed for the Livermore Valley or in the hills to the east toward Site 300 (CADC 2002).

While Alameda County has no active natural gas wells, the closest field is located approximately 7 miles southwest of the city of Livermore. Contra Costa and San Joaquin counties have 26 and 63 producing gas wells, respectively. The closest gas field is located approximately 15 miles east of the Livermore Site, near the city of Tracy (CADC 2002).

B.4.14 Traffic and Transportation

This section describes current regional and local transportation activities, including descriptions of any highway, rail, air, or marine transportation infrastructure that DOE uses to support waste movements at LLNL.

LLNL’s transportation system consists of paved and unpaved roads, pedestrian malls, paved service areas, and paved parking areas. The Livermore Site has 20 miles of roads and Site 300 has 25 miles of paved roads. Site 300 also has approximately 85 miles of unpaved fire trails.

Onsite vehicular traffic is comprised of light trucks, gasoline and electric carts, medium-duty trucks, forklifts, cranes, and other equipment. Delivery trucks are generally routed only to shipping and receiving facilities. Vehicles owned by organizations performing work (such as construction) for the Livermore Site are permitted around the site when necessary for the performance of the work. At Site 300, private vehicles are restricted to the entrance area.

Entrances to the Livermore Site are situated along Vasco Road, East Avenue, and Greenville Road. The primary routes to East Avenue are Vasco Road and Greenville Road. All regional traffic to and from the Livermore Site is via I-580, exiting onto Vasco Road or Greenville Road. The Site 300 entrance is situated on Corral Hollow Road.

The regional transportation network includes the San Francisco Bay Area. Traffic congestion is a growing concern in the Bay Area. The major transportation arteries near LLNL are I-580 and I-680. Major road projects are underway, including an upgrade to the I-580/I-680 interchange in Pleasanton and the addition of high-occupancy-vehicle (HOV) lanes to I-680 south of Pleasanton. Daily traffic volumes average 30,000 vehicles per day between I-580 and Las Positas Road, 26,200 vehicles per day between Las Positas Road and Patterson Pass Road, and 16,600 vehicles per day between Patterson Pass Road and East Avenue along Vasco Road border of the Livermore Site. Based on the Parking Master Plan and Parking Policy, in 2002, LLNL had 7,500 to 8,500 commuter vehicles (15,000 to 17,000 trips) each business day (LLNL 2002bv).

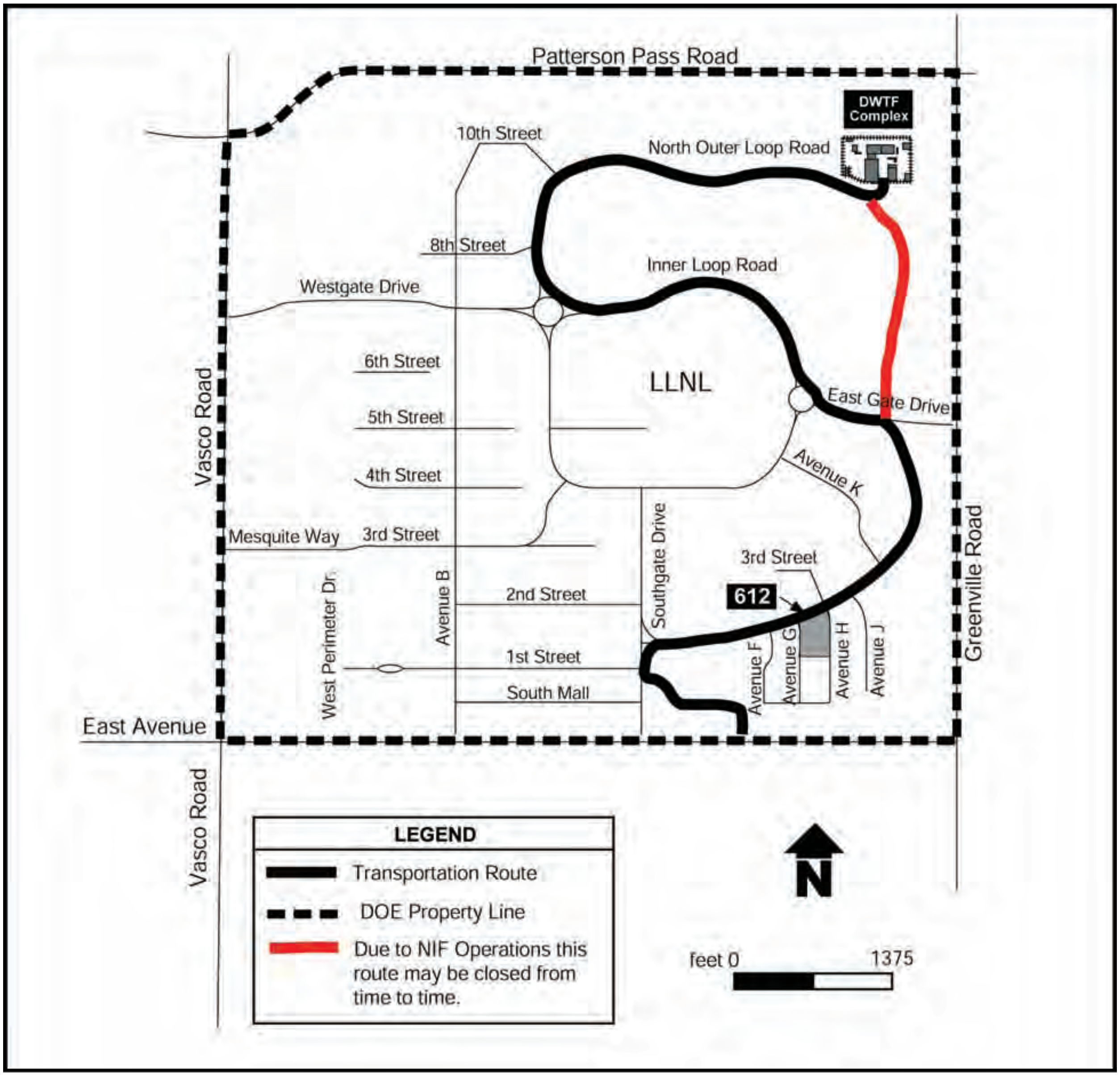
In 2003, LLNL and SNL/CA closed East Avenue as a public street between South Vasco Road and Greenville Road. The closure was prompted by the need for heightened security at the Nation's government facilities. The East Avenue segment is now under administrative control with security checkpoints at both ends of the segment. A truck inspection station is being built west of the Greenville Road intersection.

The East Avenue Gate is used for material and waste shipments. The public closure of East Avenue has not changed the existing transportation route. Figure B.4.14–1 shows the expected onsite waste transportation routes to Area 612 and the DWTF.

The closest airport to the Livermore Site is the Livermore Municipal Airport. This airport is not used for commercial passenger traffic; however, in the past, DOE personnel have flown into this airport using a small government jet. Other small airports in the area are in the cities of Tracy and Byron.

The Livermore Site is served by three international airports for commercial passenger and airfreight services. These airports are San Francisco (approximately 50 miles west), Oakland (approximately 33 miles west), and San Jose (approximately 32 miles southwest).

For Site 300, Tesla Road is an east-west arterial highway located one mile south of the Livermore Site. It is later called Corral Hollow Road at the boundary between Alameda County and San Joaquin County near the western end of Site 300. The access for Site 300 is located on Corral Hollow Road, about 9.3 miles east of Greenville Road. Between Site 300 and Greenville Road, the daily traffic on Tesla Road averages approximately 4,500 vehicles per day. In this area, Tesla Road is a winding two-lane roadway with no paved shoulders; the terrain is rolling. The Livermore Site does not receive any direct traffic by rail although some employees do commute by train, stopping at Vasco Road, approximately 1.5 miles north of the site. LLNL receives no direct traffic by ship.



Source: Original.

FIGURE B.4.14–1.—*Representative Waste Transportation Route Between Area 612 and the DWTF Complex*

Prevailing speeds are about 40 miles per hour. To the east of the Site 300 access, Corral Hollow Road continues as a two-lane winding roadway 6.8 miles to an interchange with I-580 south of the city of Tracy.

B.4.14.1 *Material Shipments*

From 270 to 300 shipments arrive at LLNL per year from offsite vendors (Table B.4.14.1–1). The shipment sizes vary with the frequency and urgency of the need for a particular shipment.

TABLE B.4.14.1–1.—*LLNL Current Annual Material Transportation Activities*

Activity	No. of Shipments
Material (annual shipments of radioactive, chemical, and explosives)	470 shipments[a]
Waste (annual shipments includes hazardous and radioactive)	88 shipments[b]
Annual sanitary waste shipments	518 shipments[c] (7 to 10 per week)

Source: TtNUS 2003.
[a] Based on 2002 data.
[b] Based on 1993 to 2002 generation rates and 2000 to 2002 shipment reports data.
[c] Estimate based on 4,666 metric tons (FY2001) and an average 9 to 13 metric tons per truck.

The Central Stores, Building 411, is located in the southeast quadrant of the Livermore Site. This 69,505-gross-square-foot building is managed by the Procurement and Material Department and handles all onsite receiving and temporary storage and offsite shipment of materials to Site 300. Material deliveries (nonhazardous, hazardous, and radioactive) are received here and sorted and are forwarded to the requesting program. Only standard (nonhazardous) supply items are placed in the storage area in Building 411, and program representatives can obtain needed material from Central Stores.

For Site 300, no central storage facility is currently in operation. Materials are shipped from the Livermore Site directly to the user facility at Site 300.

B.4.14.2 *Hazardous Waste Shipments*

In Calendar Year (CY) 2002, a total of 119 hazardous waste shipments were made. Table B.4.14.2–1 breaks down the CY2002 shipments by treatment and disposal facilities. The shipment sizes vary with the urgency and required treatment/disposal options for a particular shipment. Most offsite shipments of hazardous waste are loaded at Area 612 and the DWTF complex. For Site 300, offsite waste shipments originate from Building 883.

TABLE B.4.14.2–1.—*Combined Livermore Site and Site 300 Hazardous Waste Shipments[a] in CY2002*

Treatment/Disposal Site	State	Number of shipments	Waste Types
Safety-Kleen Inc.	CA	34	RCRA hazardous, state-regulated, and nonregulated waste
Altamont Landfill	CA	14	Asbestos and nonregulated waste
Lawrence Livermore National Laboratory[b]	CA	9	RCRA hazardous, state-regulated, and nonregulated waste
Envirosafe Services of Idaho, Inc.	ID	8	Hazardous and TSCA (PCB-related) wastes
Heritage Environmental Services, LLC	AZ	7	RCRA hazardous and nonregulated waste
Twenty First Century EMI	NV	6	RCRA hazardous and nonregulated waste
ENSCO West Inc.	CA	5	RCRA hazardous and nonregulated waste
Sub Total		83	
Other sites[c] (including Site 300[d])	Various	36	Various, including explosive wastes
Total		**119**	

Source: LLNL 2003ax.
[a] Hazardous waste shipments include RCRA hazardous waste, state-regulated, TSCA waste, wastes shipped for recycle, and nonregulated wastes (wastes not specifically regulated by RCRA; TSCA or the State of California that may contain materials of concern and are treated and disposed as if the wastes were regulated. [e.g., wastes containing PCBs less than 50 parts per million]).
[b] Site 300 routinely ships wastes to the Livermore Site.
[c] LLNL uses nearly 50 commercial treatment, storage, and disposal facilities (TSDFs). Due to the wide-range of wastes, including recyclable materials, a large number of TSDFs is needed. These TSDFs include incinerators, liquid treatment facilities, landfills, and recyclers. Capabilities at these TSDFs include fuel blending, solvent recovery, mercury processing, asbestos disposal, battery reclamation, and other special waste handlers including radioactive waste TSDFs.
[d] The Livermore Site ships explosive-related waste to Site 300 for treatment.

Note: Site 300 ships hazardous, radioactive, and mixed wastes to Livermore Site for storage, treatment, and preparation for final offsite disposal, as appropriate.

B.4.14.3 *All Other Waste Shipments*

A summary of all other waste shipments is presented in Table B.4.14.2–1.

B.4.15 Materials and Waste Management

B.4.15.1 *Materials*

LLNL maintains an inventory of radioactive, chemical, and explosive materials used in laboratory R&D in a wide variety of scientific, engineering, and weapon-related fields.

To safely control these materials, LLNL employs an integrated safety management system (ISMS) to manage the use of hazardous materials. The ISMS process includes project planning, hazard assessment, identification, and implementation of measures to perform work in a safe manner.

LLNL tracks and manages hazardous materials from receipt through transfer, storage, use, and final disposition (this may include disposal; however, for example, empty gas cylinders are returned to the vendor for reuse). Different inventory systems are used for radioactive, chemical, and explosive materials, which track materials for inventory and waste control.

Radioactive Material

Radioactive material has the property of spontaneously emitting alpha, beta, or gamma rays during the disintegration of an atom's nucleus. Radioactive material is found in nature or can be man-made. All radioactive material, used in activities at LLNL and present in quantities sufficient to be deemed hazardous, is controlled to protect LLNL workers, the public, and the environment. LLNL manages special nuclear material, source material, other nuclear material, and miscellaneous radioactive material.

Special nuclear material includes plutonium or highly enriched uranium (HEU). The majority of the plutonium and HEU is in the form of metal sealed in containers. The inventory consists mostly of heat sources, components (a part or piece of a larger system), targets, and calibration sources. LLNL does not produce plutonium.

Source material includes uranium and thorium. LLNL's inventory of natural, low enriched, or depleted uranium is either stored in specially designed containers or in large, sealed assemblies to minimize the probability of a release. The majority of the source material inventory at LLNL is in the form of metal sealed in containers. The inventory consists mostly of targets, shielding, components, and calibration sources. LLNL does not produce these materials.

Other nuclear material includes americium, californium, tritium, and lithium. These materials are used at LLNL for national defense research purposes. LLNL does not produce these materials.

Miscellaneous radioactive materials include strontium, cobalt, and cesium. These materials are used at LLNL for both nondefense and defense research purposes. LLNL does not produce or process these materials.

Table B.4.15.1–1 is a listing of facility inventories (or administrative limits) for radioactive materials at LLNL. The table shows typical quantities rather than maximum limits.

TABLE B.4.15.1–1.— *Facilities Managing Radionuclides[a] at LLNL*

Building Number	Radionuclide	Approximate[c] Quantity or Limit (kg, lb, or Ci)	Status[d]
Building 131 High Bay	Natural thorium Depleted uranium	0.5 kg 7,700 kg Inventory maintained below Category 3 thresholds	Radiological facility
Building 132N	Natural uranium Depleted uranium Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 132S	Natural uranium Depleted uranium Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 151	15 radionuclides	Inventory maintained below Category 3 thresholds. Ratio approximately 0.633[b]	Radiological facility
Building 152	Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 154	Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 190	Tritium Cobalt-60 Americium-241 Plutonium-238 Plutonium-239	20.0 Ci 1.43×10^{-4} Ci 1.11×10^{-5} Ci 0.027 Ci 1.50 Ci	Radiological facility
Building 191	Depleted uranium	0.008 Ci	Radiological facility
Building 194	Uranium-235 Plutonium-239 Sealed sources	0.192 kg 0.003 kg Inventory maintained below Category 3 thresholds	Radiological facility
Building 231	Natural thorium Natural uranium Depleted uranium Rhenium	0.5 kg 9.5 kg 3,000 kg 60 kg	Radiological facility
Building 231 vault	Natural thorium Uranium-235 Uranium-238	11 kg 3.4 kg 1,700 kg	Radiological facility
Building 232 Fenced Area and 233 Vault	Thorium Low enriched uranium Natural or depleted uranium	150 kg 0.3 kg 4,000 kg	Radiological facility
Building 239	Plutonium, fuel grade equivalent[e] Highly enriched uranium[e] Depleted uranium Tritium	6 kg 25kg/50 kg[f] 500 kg 0.02 kg	Varies; resident inventory maintained below Category 3 thresholds

TABLE B.4.15.1–1.— *Facilities Managing Radionuclides[a] at LLNL (continued)*

Building Number	Radionuclide	Approximate[c] Quantity or Limit (kg, lb, or Ci)	Status[d]
Building 241	Depleted uranium	2,650 kg	Radiological facility
	5 radionuclides	Inventory maintained below Category 3 thresholds	
Building 251	42-Category 2 radionuclides	Inventory maintained below Category 2 thresholds	Category 2 facility
Building 255E	Sealed sources	Inventory maintained below Category 3 thresholds	Radiological facility
Building 261/262	16 Radionuclides	Inventory maintained below Category 3 thresholds	Radiological facility
	Thorium	100 lbs (Metal)	
	Natural uranium	100 lb	
	Depleted uranium	300 lb	
Building 322	Depleted uranium	30 kg	Radiological facility
Building 327	Depleted uranium	95 kg	Radiological facility
Building 331[g]	Tritium[e]	0.030kg/0.035 kg[f]	Inventory is distributed between two segments; small quantities of other radionuclides may be present but the facility will remain a Category 3 facility
	Plutonium-239	900 g	
	Plutonium, fuel-grade equivalent	260 g	
	Uranium-235	700 g	
	HEU	5 kg	
Building 332	Plutonium[e]	700kg/1,400 kg[f]	Category 2 facility
	Enriched uranium[e]	500 kg	
	Depleted or natural - uranium[e]	3,000 kg	
Building 334 [g]	Plutonium, fuel grade equivalent[e]	18 kg	Category 3 facility
	Enriched uranium	100 kg	
	Depleted uranium	500 kg	
	Tritium	0.0001 kg	
Building 361	Phosphorus-32	0.027 Ci	Radiological facility
	Sulphur-35	0.008 Ci	
	Carbon-14	0.131 Ci	
	Tritium	0.29 Ci	
Building 362	Carbon-14	0.036 Ci	Radiological facility
	Tritium	0.006 Ci	
Building 363	Carbon-14	0.002Ci	Radiological facility
	Tritium	0.001 Ci	
Building 364	Cesium-137 (sealed source)	3.5×10^3 Ci	Radiological facility
Building 366	Phosphorus-32	0.007 Ci	Radiological facility
Building 378	20 radionuclides (Sealed sources)	Inventory maintained below Category 3 thresholds	Radiological facility
Building 379	20 radionuclides (Sealed sources)	Inventory maintained below Category 3 thresholds	Radiological facility
Building 381	Tritium	8.5 Ci (storage limit – 20 Ci)	Radiological facility
	Sealed sources	Inventory maintained below Category 3 thresholds	

TABLE B.4.15.1–1.— *Facilities Managing Radionuclides[a] at LLNL (continued)*

Building Number	Radionuclide	Approximate[c] Quantity or Limit (kg, lb, or Ci)	Status[d]
RHWM Facilities (Area 514)	Miscellaneous radionuclides	Inventory maintained below Cat 3 thresholds	Radiological facility
RHWM Facilities (Area 612)	Cat 2 radionuclides	See Appendix B for inventory limits	Category 2 facility
DWTF Buildings 695/696S	Cat 3 radionuclides	See Appendix B for inventory limits	Category 3 facility
DWTF Building 693/ 696RWSA	Cat 2 radionuclides	See Appendix B for inventory limits	Category 2 facility
Cargo Container Testing facility (planned)	Depleted or natural uranium	50 kg	Radiological facility
	Uranium-235		
	Plutonium-239	1.0 kg (metal), 0.2 kg (oxide)	
	Sealed sources	0.40 kg	
		Inventory maintained below Category 3 thresholds	

Source: LLNL 1999b, g; LLNL 2000d, k, l, o, p; LLNL 2001b,e, f, aw; LLNL 2002ar, cq, co.
[a]Summary information, additional radionuclides may be present in these facilities
[b]Ratio of activity to Category 3 threshold must be below 0.8 in order for a radiological accident analysis to not be required in a hazard analysis report.
[c]Inventories are snapshots in time. The information is provided to give the reader a degree of scale and is not (unless otherwise stated) a limit.
[d]Category 2 – Hazard analysis shows the potential for significant onsite consequences. Category 3 – Hazard analysis shows the potential for only significant localized consequences. Radiological–Facilities that do not meet or exceed Category 3 threshold criteria but still possess some amount of radioactive material. Category 2 and Category 3 thresholds are defined in DOE Standard DOE-STD-1027-92 (DOE 1997d).
[e]Administrative limit.
[f]Values are included for No Action Alternative and the Proposed Action, respectively.
[g]Materials in Buildings 331 and 334 are within the Superblock Administrative Limits for plutonium and uranium.
Ci = curies; DWTF = Decontamination and Waste Treatment Facility; kg = kilograms; RHWM = radioactive and hazardous waste management; RWSA = radioactive waste storage area.

Chemicals

Because of the wide variety of research activities performed at LLNL, the amounts and concentrations of chemicals maintained at LLNL vary at any given time and from facility to facility. Most research operations use small quantities of a wide variety of chemicals; however, in some operations, chemicals are used in large quantities. In general, the following chemical types are used and stored at LLNL: corrosives (acids and bases); toxics (poisonous chemicals); flammables and combustibles (solids, liquids, and gases); reactives (materials that are inherently readily capable of detonation or becoming flammable at normal temperatures and pressures); asphyxiates (physical asphyxiates are materials capable of physically displacing the volume of air in a given space; chemical asphyxiates are materials that are poisonous when breathed); and carcinogens (materials capable of inducing cancer).

In 2001, more than 166,000 chemical containers, ranging from 55-gallon drums to gram-quantity vials, were in use or stored at LLNL (LLNL 2002cc). Table B.4.15.1–2 presents a list for FY2001 – FY2002 of hazardous chemicals at the Livermore Site. The values are estimated maximum values for a single facility or average values over several facilities. Table B.4.15.1–3 presents a list of FY2001 – FY2002 of hazardous chemicals at Site 300. Table B.4.15.1–4 presents a list of hazardous chemicals at waste management facilities.

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002*

Material	Maximum/ Average Quantity[a]	Location[b]
1,1,1,2-Tetrafluoroethane (Refrigerant 134A)	1,600/500 lb	132N, 132S, 404, 511, 5207
1,1,1-Trichloroethane	220/70 gal	131, 132N, 151, 153, 165, 191, 243, 253, 281, 292, 298, 335, 391, 697
Acetic acid	500/100 gal	Located in more than 30 buildings.
Acetone	1,200/740 gal	Located in more than 70 buildings.
Acetonitrile	200/55 gal	132N, 132S, 151, 153, 154, 191, 197, 241, 253, 281, 298, 361, 363, 364, 432, 435, 691
Acetylene	83,000/60,000 ft^3	Located in more than 50 buildings.
Acoustical Tile Adhesive	200/55 gal	261, 418, 433, 511, 512, 523, 525, 531
Actrel 4493L Cleaner	170/165 gal	697
Aero Melamine	3,500/1,100 lb	132N, 191, 231, 281, 363
Air, Compressed	85,000/68,000 ft^3	131,132N, 151, 241, 281, 324, 391, 432, 435, 518, 5475, 5477
Aluminum hydroxide	1,600/530 lb	
Aluminum oxide (Alumina)	2,500/840 lb	Located in more than 30 buildings.
Ammonia, anhydrous	Combined with Ammonium hydroxide	132N, 132S, 151, 153, 191, 197, 292, 362, 391, 5207
Ammonium hydroxide	3,600/200 gal	Located in more than 30 buildings.
Ammonium nitrate	2,000/500 lb	132N, 151, 191, 197, 231, 241, 243, 281, 298, 322, 361, 377, 378, 446
Antifreeze, coolant	260/80 gal	131, 132N, 132S, 141, 176, 191, 197, 198, 231, 241, 253, 298, 321C, 322, 323, 332, 361, 366, 377, 391, 418, 490, 511, 519, 697
AQUA POWER, Cleaner/Degreaser	150/55 gal	291, 418, 511, 519, 6203
Argon, compressed	25,000,000/ 160,000 ft^3	Located in more than 60 buildings.
Asbestos-Free Roof Cement	165/55 gal	515
Asphalt Emulsion-seasonal product do not delete	1,100/55 gal	515
Barrett SN	300/230 gal	292, 321A, 322
Belsperse 161, Dispersant	6,500/3,000 lb	438
Beryllium	1,600/1,000 lb	131, 194
Beryllium oxide	500/350 lb	131, 321
Boron	2,600/500 lb	121, 132N, 132S, 151, 162, 182, 191, 231, 235, 697
Bright Plating solution	1,30/55 gal	322
Brulin MP 1793	200/100 gal	231, 321, 321C, 391
BSP Captor Solution	170/55 gal	291

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Bulls Eye 1-2-3 Primer/Sealer	750/55 gal	131, 335, 418, 6297
Butyl alcohol (n-Butanol)	510/55 gal	121, 132N, 151, 153, 154, 191, 231, 235, 241, 253, 281, 292, 298, 324, 328, 361, 362, 363, 364, 366, 391, 446, 697
Calcium chloride	3,200/500 lb	132N, 132S, 151, 154, 162, 191, 231, 235, 241, 243, 281, 292, 298, 322, 332, 361, 362, 363, 364, 366, 377, 378, 435, 436, 446, 612, 697
Calcium sulfate	1,300/500 lb	Located in more than 40 buildings.
Carbon, activated	800/500 lb	132N, 141, 151, 153, 154, 162, 190, 191, 235, 241, 261, 281, 292, 2925, 294, 298, 3203, 322, 361, 363, 381, 391, 478, 446, 597, 697
Carbon dioxide	176,000/124,000 ft^3	Located in more than 30 buildings.
Carbon monoxide	4,000/1,300 ft^3	132N, 132S, 141, 151, 162, 231, 235, 241, 243, 253, 281, 362, 363, 391, 435
Celite 535	2,000/950 lb	514
Cement, Kast-o-lite	1,300/500 lb	511
ChemTreat BL-1253	1,200 gal	291, 511
ChemTreat BL-1302	600 gal	291
ChemTreat BL-1543	110/55 gal	291
ChemTreat BL-1776	1,000/140 gal	291, 511
ChemTreat BL-1821	700/55 gal	291
ChemTreat CL-1467	700/55 gal	291
ChemTreat CL-2111	800/300 gal	291, 684
ChemTreat CT9001-Antifoulant	55/55 gal	291
Chlorine	750/500 ft^3	151, 153, 166, 197, 298, 332, 391
Chloroform	110/55 gal	131, 132N, 151, 153, 154, 162, 191, 197, 241, 243, 253, 281, 292, 294, 298, 322, 332, 361, 362, 363, 365, 366, 391, 435, 446, 612
Chrome or Chromium	4,700/1,500 lb	121, 151, 152, 154, 176, 212, 231, 235, 241, 281, 332, 378, 391, 697
Chromium(III) chloride	12/1 lb	132N, 151, 162, 241, 281, 298, 3203
Citric acid, anhydrous	1,600/400 lb	132N, 151, 153, 191, 231, 235, 241, 255, 281, 292, 294, 298, 322, 361, 362, 363, 364, 366, 377, 378, 391, 392, 446, 697
Cobalt	16,500/14,000 lb	121, 132N, 151, 152, 162, 212, 231, 235, 241, 292, 361, 391, 697
Concresive Adhesive, Part A/B	330/55 gal	166, 332, 335, 418, 509, 511, 6203
Copper sulfate, crystals & solution	1,100/500 lb	132N, 191, 281, 322, 697
Cutting fluid, Aluminum A-9	100/90 gal	121, 191, 194, 212, 281, 321, 391, 423, 432, 511, 525
Cutting fluid, Cool Tool (I & II)	390/55 gal	131, 132N, 132S, 141, 153, 166, 173, 194, 231, 241, 243, 292, 298, 321, 331, 383, 391, 423, 443, 511

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Cyanuric acid	2,500/500 lb	132N, 151, 191, 231, 281, 291, 318
Dascool 2227	500/55 gal	321
DDO-19, Lubricating oil	500/55 gal	292, 321, 332, 512
Delvac Motor oil	300/55 gal	321, 519
DESMODUR	110/55 gal	191, 231, 5127
Detergent, ND 150	300/55 gal	423, 511, 515, 519, 531, 611
Diesel	30,000/10,000 gal	131, 141, 162, 194, 231, 241, 253, 291, 298, 343, 364, 381, 412, 431, 435, 452, 511, 519, 611, 622
Dimethyl sulfoxide	220/55 gal	132N, 132S, 151, 154, 162, 191, 231, 241, 253, 281, 298, 322, 332, 361, 362, 363, 364, 366, 377, 435, 446, 697
4,4'-Diphenylmethane diisocyanate	1,000/500 lb	231
DowTherm SR-1 30 Heat Transfer Fluid	110/55 gal	432
ELNIC 100 C-5	250/55 gal	322
ELNIC 100 RP-1	60/60 gal	322
ELNIC 100 RP-2	150/110 gal	322
Epolene Wax, Polyethylene, oxidized	110/55 gal	191, 231
Ethyl alcohol	2,000/1,500 gal	Located in more than 60 buildings.
Ethylene, compressed	5,700/1,900 ft^3	132N, 134, 154, 241, 298, 394, 435, 446
Ethylene glycol	500/110 gal	Located in more than 30 buildings.
Ethyl silicate	150/55 gal	121, 132N, 1477, 151, 191, 243, 298, 391
Ferric chloride, Iron chloride(III)	1400/500 lb	132N, 132S, 151, 153, 191, 235, 241, 243, 281, 294, 298, 321, 361, 378, 435, 446
Ferric sulfate	3,500/700 lb	132N, 151, 191, 243, 322, 361, 442, 446, 514, 697
Fertilizer, Pro-Turf 25-3-10	11,000/5,500 gal	531
Freon 11 (Trichlorofluoromethane)	10,000/5,000 lb	281, 292, 404, 697
Freon 12 (Dichlorodifluoromethane)	6,300/4,000 lb	132N, 134, 190, 197, 241, 253, 292, 341, 394, 404, 511, 5207, 611
Freon 14 (Tetrafluoromethane)	2,500/500 ft^3	132N, 132S, 134, 141, 153, 166, 190, 197, 298, 391, 394
Freon 22 (Chlorodifluoromethane)	9,000/5,000 lb	197, 253, 261, 361, 404, 511, 5207
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	17,000/5,000 lb	Located in more than 30 buildings.
Gasoline	24,000/24,000 gal	611
Glass Cleaner, variety	2,300/200 gal	Located in more than 110 buildings.
Glycerine	110/55 gal	Located in more than 30 buildings.
Hafnium oxide	4,700/4,500 lb	131, 132N, 151, 162, 174, 231, 241, 281, 697
Halocarbon 23	400/200 ft^3	231

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Halon 1301 (Bromotrifluoromethane)	2,000/1,600 lb	404
Helium	5,000,000/300,000 ft^3	Located in more than 70 buildings.
Herbicide, Ronstar	2,000/700 lb	519, 520, 531
Herbicide, Roundup	220/40 gal	520, 531
Hexane	250/160 gal	131, 132N, 132S, 151, 154, 191, 231, 241, 253, 281, 292, 298, 327, 341, 361, 362, 363, 612, 691, 697
Hydrochloric acid	600/400 gal	Located in more than 40 buildings.
Hydrogen chloride (gas only)		132S, 134, 151, 162, 166,191, 197, 212, 231, 235, 323, 332
Hydrofluoric acid	1,500/850 lb	132N, 132S, 151, 153, 154, 162, 166, 176, 197, 212, 231, 235, 241, 243, 253, 254, 2554, 281, 292, 294, 298, 322, 332, 378, 391
Hydrogen, compressed	1,500,000/50,000 ft^3	Located in more than 30 buildings.
Hydrogen peroxide<52%	350/55 gal	Located in more than 40 buildings.
Insulating Oil, Inhibiting	1,800/1,200 gal	423, 431, 435
Isopropyl alcohol	650/550 gal	Located in more than 80 buildings.
Joint Compound, All purpose	45,000/12,100 lb	Located in 40 buildings.
Kerosene (Naphtha Petroleum)	300/55 gal	132N, 132S, 141, 151, 171, 194A, 197, 231, 235, 342, 251, 292, 321, 331, 332, 341, 376, 418, 432, 436, 612, 697
Kodak Fixer & Replenisher	650/250 gal	141, 151, 174, 191, 261, 327, 361
Krypton, compressed	1,600/1,100 ft^3	121, 131, 132N, 132S, 141, 151, 162, 194, 197, 212, 235, 241, 298, 391
Lead Bricks or ingots	950,000 lb	Multiple
Lithium Grease	110/55 gal	131, 141, 194A, 235, 332, 391, 406, 411, 442, 511, 514, 519, 597, 611, 6203
Lithium Hydride	4,000/4,000 lb	131, 194, 231, 231V, 232FA, 233V, 321, 612, 614, 625, 693
Lubricating Oil	500/300 gal	131, 151, 153, 162, 191, 231, 281, 321, 332, 341, 362, 435, 443, 511, 517, 519, 611, 697
Macro Brite L-7	220/110 gal	322
Magnesium chloride	6,000/500 lb	132N, 151, 162, 166, 212, 241, 243, 255, 281, 292. 298, 3203, 361, 363, 364, 366, 377, 435, 697
Manganese	3,500/3,000 lb	121, 132N, 151, 162, 212, 231, 235, 241, 243, 281, 294, 298
Mastic Patch adhesive, variety	400/55 gal	151, 332, 418, 511, 523, 6203, 6297
Metex L-5B	220/55 gal	322
Methane	100,000/30,000 ft^3	Located in 40 buildings.
Methyl alcohol	1,800/500 gal	Located in more than 60 buildings.
Methylene chloride	2,000/55 gal	121, 132N, 132S, 151, 154, 162, 165, 166, 174, 1879, 191, 231, 235, 241, 253, 255, 281, 292, 298, 321, 331, 361, 362, 363, 377, 381, 3905, 391, 418, 513, 697

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Methyl ethyl ketone	400/55 gal	121, 1277, 132N, 151, 153, 162, 165, 191, 194, 197, 231, 235, 253, 281, 298, 327, 361, 3905, 391, 432, 442, 6297, 697
Mineral dust, Aquaset	10,000/4,500 lb	335, 419, 514
Mineral oil	2,000/55 gal	Located in more than 40 buildings.
Mineral spirits	400/55 gal	121, 154, 191, 235, 281, 332, 418, 523, 6297, 697
Modified Bitumen adhesive	350/200 gal	511, 515, 523
Neodymium oxide	7,000/1,350 lb	121, 132N, 151, 162, 191, 212, 241, 243, 378, 4999, 697
Neon, compressed	750,000/500,000 ft^3	131, 132N, 134, 151, 162, 174, 191, 194, 197, 212, 231, 235, 298, 341, 381, 391, 394, 4299, 445
Nickel	1,500/500 lb	121, 132N, 132S, 151, 153, 162, 191, 231, 235, 239, 241, 243, 253, 2629, 281, 332, 378, 391, 697
Nickel chloride	80/70 gal	132N, 151, 197, 235, 281, 298, 361, 377, 378, 446, 697
Nickel sulfate	220/110 gal	151, 231, 235, 281, 322, 361, 697
Nitric acid	5,000/1,800 lb	Located in more than 40 buildings.
Nitric oxide	1,000/500 lb	132S, 134, 191, 197
Nitrogen, compressed (Liquified, gaseous)	38,000,000/ 18,000,000 ft^3	Located in more than 80 buildings.
Nitrous oxide	4,000/1,200 ft^3	132S, 141, 153, 166, 197, 253, 281, 292, 435
Oakite (Liqui-det)	80/55 gal	132N, 132S, 141, 151, 194, 196, 231, 235, 243, 251, 298, 321, 322, 329, 331, 332, 341, 361, 362, 363, 383, 423, 445, 511
Oil, Diala AX	2,200/1,050 gal	141, 1481, 191, 194, 2801, 321, 327, 341, 423, 515, 691
Oil, DTE-24	700/440 gal	131, 132N, 321, 341, 519
Oil, DTE-25	450/355 gal	321, 442
Oil DTE-26	2,000/400 gal	131, 190, 231, 321, 511, 518, 519
Oil, DTE, extra heavy	500/165 gal	321, 519, 697
Oil, DTE heavy	850/55 gal	321, 519
Oil, DTE Medium	220/55 gal	321, 445, 519
Oil, Spindle	700/355 gal	321, 423, 697
Oil, Tellus, variety	275/55 gal	132N, 261, 697
Oil, Vactra, variety	500/400 gal	131, 191, 298, 321, 321C
Oil, Vacuum Pump fluid, variety	1,500/55 gal	121, 132N, 151, 153, 176, 194, 235, 241, 253, 292, 298, 321, 362, 376, 377, 391, 438, 697
Oil, Waste	2,500/1,000 gal	611
Oxalic acid	700/500 lb	132N, 132S, 151, 231, 235, 254, 255, 281, 294, 322, 329, 332, 361, 378, 446, 697
Oxygen, compressed	870,000/75,000 ft^3	Located in more than 60 buildings.
OzzyJuice SW3, Cleaner/Degreaser	300/55 gal	131, 132S, 241, 383, 511, 611
Paint (variety)	700,000/320,296 lb	Located in more than 80 buildings.
Perchloroethylene (Tetrachloroethylene)	250/55 gal	132N, 243, 281, 298, 322, 329, 341, 446, 697

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Phosphoric acid	3,600/1,000 lb	Located in more than 30 buildings.
Potassium chloride	3,500/1,200 lb	Located in more than 30 buildings.
Potassium hydroxide	15,000/400 lb	Located in more than 30 buildings.
Potassium Phosphate, Monobasic	10,000/2,000 lb	132N, 151, 162, 165, 166, 1678, 191, 253, 281, 292, 361, 363, 366, 435
Potassium silicate	1,100/500 lb	132N, 281, 298
Power Plus, Cleaner/Degreaser	110/55 gal	611
Printing Ink, variety	1,000/850 lb	261, 551W
Propane	45,000/1,000 gal	Located in more than 70 buildings.
Refrigerant, 123 Suva, (2,2-Dichloro-1,1,1-Trifluoroethane)	35,000/1,500 lb	404
Refrigerant 406A	720/500 lb	404, 511, 5207
Rough Rider Emulsion Degreaser	110/55 gal	364, 531
Rubinate fluid	110/55 gal	231
Sanding Sealer	200/90 gal	418, 511, 6297
sec-Butanol	130/122 gal	132N, 191, 253, 298, 361, 364, 377, 391, 3981, 432
Shur-Stik Wall Covering Adhesive	110/55 gal	418, 511, 6297
Silane, compressed	2,100/200 ft^3	153, 166, 197, 391
Silicon carbide	3,200/500 lb	121, 131, 132N, 132S, 151, 194, 231, 235, 243, 298, 391
Silicone Transformer Fluid/Dow	700/165 gal	235, 253, 515, 697
Simple Green Degreaser	140/55 gal	131, 191, 243, 321A, 322, 324, 418, 442, 511, 519
Sodium bicarbonate	3,600/500 lb	Located in more than 30 buildings.
Sodium chloride	3,200/800 lb	Located in more than 40 buildings.
Sodium cyanide	250/100 lb	132N, 151, 191, 231, 3203, 322, 361, 363, 378, 697
Sodium hydroxide	25,500/14,000 lb	Located in more than 50 buildings.
Sodium hypochlorite (Bleach)	12,000/1,000 gal	Located in more than 40 buildings.
Sodium nitrate	1,500/350 lb	132N, 151, 162, 191, 231, 241, 243, 253, 281, 294, 322, 361, 377, 378, 435, 436, 446, 597, 612, 697
Solvent AZ-EBR	165/55 gal	298
Spill clean-up kit, Acids	1,600/500 lb	Located in more than 30 buildings.
Spill clean-up kit, Caustic	1,000/500 lb	132N, 132S, 151, 153, 154, 166, 1727, 197, 231, 235, 253, 254, 255, 261, 281, 292, 294, 298, 3203, 327, 331, 332, 341, 378, 514, 612, 697
Spill clean-up kit, Solvent	710/500 lb	Located in more than 30 buildings.
Strontium phosphate	1,400/350 lb	162

TABLE B.4.15.1–2.—*Livermore Site Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location[b]
Sulfur hexafluoride, compressed	25,000/10,000 ft^3	134, 141, 151, 153, 190, 191, 194, 197, 212, 231, 235, 253, 281, 381, 391, 424, 431, 515, 518, 6126
Sulfuric acid	11,000/4,500 lb	Located in more than 40 buildings.
Super Dropout	1,590/1,590 lb	442, 513
Suva MP39 (R401A)	800/600 lb	141, 404, 5207
Suva MP66 (R401B)	180/180 gal	511, 5207
Tantalum	75,000/20,000 lb	121, 132N, 132S, 151, 191, 212, 231, 241, 243, 281, 697
Tantalum oxide blend	17,000/8,500 lb	132N, 151, 152, 231
Thinner, Lacquer	3,000/500 gal	121, 132S, 141, 176, 231, 332, 365, 391, 418, 438, 511, 512, 5125, 517, 519, 523, 611, 6203, 6297
Toluene	480/300 gal	Located in more than 30 buildings.
TPX	800/800 lb	231
Transmission fluid, Dexron II (ATF)	220/55 gal	321, 519, 523
Trichloroethylene	350/165 gal	131, 132N, 132S, 141, 151, 153, 165, 191, 194, 197, 231, 235, 241, 243, 253, 281, 292, 298, 322, 332, 341, 391, 392, 445, 446, 691, 697
Trim Clear	110/55 gal	321A, 321C
Trim Sol, coolant	660/165 gal	121, 169C, 231, 241, 281, 298, 321, 331, 383, 391, 431, 432, 435, 511, 625, 691
Tungsten	2,500/500 lb	121, 132N, 132S, 151, 231, 235, 243, 281, 341
Ultra NZ, Floor Wax		531
Voranol	110/55 gal	231, 391
Wax, Floor	300/300 gal	512, 531, 6203
Xenon, compressed	2,000/500 ft^3	121, 132N, 132S, 162, 166, 191, 194, 197, 198, 212, 231, 235, 241, 298, 361, 391, 435
ZEP Formula 50	110/55 gal	321

Source: LLNL 2002m.

Note: Some buildings are part of a complex and employ small ancillary storage facilities. The above list does not denote these facilities. Locations vary year to year. The listing of facilities is not intended to limit inventories. Physical space and administrative controls including safety documentation limit inventories. This table is provided to give the reader an understanding of the types of chemicals, general quantities and variety of locations.

[a] Maximum/Average Quantity: Maximum is defined as a maximum at one of the facilities in a given year. Average is defined as the average quantity found at multiple facilities.

[b] For chemicals located in 30 or more buildings, no location list is provided.

ft^3 = cubic feet; gal = gallons; lb = pounds.

TABLE B.4.15.1–3.—*Site 300 Hazardous Chemicals Quantities by Location in FY2002*

Material	Maximum/ Average Quantity[a]	Location
Acetone	400/30 gal	827, 801, 812, 826, 836, 850, 851, 874, T8010, 875, 899
Acetylene	10,000/7,500 ft^3	801, 876, 873, 874, 875, 879, T8340, 811, 843
Activated Carbon	20,000/15,000 lb	827, 843, 834
Air	28,000/15,000 ft^3	801, 802, 812, 850, 851, 843, 875, 834, T8340
Alcoa Atomized Powder	3,000/2,000 lb	827, 805, 827, 872
Ammonium Perchlorate	760/760 lb	827
Argon	30,000/30,000 ft^3	801, 850, 851, 873, 874, 875, 876, 827
Asphalt Emulsion	300/200 gal	819, 843, 873
Auto Transmission Fluid (including Dextron)	400/300 gal	875, 876, 879
Bacticide Solution	220/110 gal	875
n-Butyl Acetate	55/55 gal	827, 810
Calla Soap	165/55 gal	875
Carbon Dioxide	44,000/5,000 ft^3	834, 843, 874, 875, 879
Cast Iron, Shot (Chips)	6,000/6,000 lb	843
Chlorine	2,250/1,500 lb	812, 844, 847, 853, 886, 888, Well Nos. 18 & 20, Tank boosters
Cleaner, Degreaser, Big Orange	110/55 gal	873, 874, 875, 880, 851
Cleaner, Butcher's Hot Springs	55/55 gal	875
Cleaner, Degreaser, Clean-Way II	110/55 gal	879
Cleaner, Degreaser, Ozzy Juice SW-3	330/110 gal	875, 879
Coating, Acrylic Terpolymer	244/90 gal	843
Coating, Polytherm, FP-576	220/110 gal	873
Coating, Polyurethane, Vulkem 350, Gray	60/60 gal	872
Coating, Polyurethane, Vulkem 351, Gray	110/55 gal	843, 872
Coating, Roof, Acrylic	2,500/500 gal	872, 819, 843, 873
Condensate wastewater	4,500/3,600 gal	875
Cyanuric Acid	500/50 lb	827D Yard
Diesel	12,000/10,000 gal	871, 875, 879, and 882 underground tanks; 805, 810, 827, 834, 836, and 870 aboveground tanks.
Dimethyl Sulfoxide	400/55 gal	827D Yard, 821
2,2-Dinitropropanol in EDC	275/275 gal	821
Ethyl Acetate	100/30 gal	827, 810, 873
Ethyl Alcohol	56/56 gal	801, 802, 806, 810, 812, 817, 823, 825, 827, 850, 851, 872, 874
Ethylene Glycol	200/100 gal	801, 802, 805, 809, 823, 827, 836, 843, 875, 879, 896

TABLE B.4.15.1–3.—*Site 300 Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location
FEFO SOL (in methylene chloride)	1,100/10 gal	821
Floor wax	165/110 gal	873
Freon 12	660/220 lb	875, 801, 879
Freon 13	478/478 ft^3	834
Freon 22	1,400/870 lb	851, 875
Freon 113 (Freon, TF)	150/110 gal	875, 801, 806, 817, 823, 836, 850
Gasoline	15,000/15,000 gal	879
Glycerine	165/165 gal	817, 810, 875
Helium	25,000/25,000 ft^3	801, 802, 812, 848, 851, 873, 874, 882, 834, 850, 843, 865, 875
n-Hexane	220/220 gal	827D
High Explosives	100,000/10,000 lb	locations site-wide
Hydrogen	700/700 ft^3	843, 875
Isoamyl alcohol	55/55 gal	827D
Isopropyl Alcohol	300/100 gal	801, 806, 810, 817, 834, 836, 850, 858, 873, 874, 827E, 805, 827D
Kerosene	160/5 gal	875
Krovar I DF Herbicide	2,000/500 lb	819
Lacquer Thinner	110/35 gal	T8010, 843, 872, 873
Lead (bricks, ingots)	25,000/5,000 lb	801, 802, 803, 812, 825, 826, 827, 845, 850, 851, 879, 869
Lubricant, Synthetic Summit/Vactra, etc.	330/165 gal	836, 805, 875
Methane	3,000/1,500 ft^3	801, 851, 843, 833
Methyl alcohol	90/5 gal	801, 805, 827, 850, 851, 812
Methyl Ethyl Ketone	100/5 gal	827, 843
Mixed Gas, Freon 502	500/200 ft^3	834
Mixed Gas, Freon 503	500/200 ft^3	869
Mixed Gas, Compressed, Not Otherwise Specified (non-hazardous)	1,000/1,000 ft^3	834
Mixed gas, TCE/Nitrogen	7,400/50 ft^3	843
Nalco-71-D5	165/55 gal	875
Nalco-2508	110/55 gal	875
Nalco-2536	55/55 gal	875
Nalco-2593	55/55 gal	869
Nalco-2802	110/55 gal	875
Nalco-2833	55/55 gal	875
Nalco-2858	200/55 gal	827, 875

TABLE B.4.15.1–3.—*Site 300 Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location
Nalco-2896	450/250 gal	875
Nitrogen	312,000/280,000 ft^3	801, 819, 836, 850, 851, 854, and misc. site locations
Nitroplasticizer	175/110 gal	821, 827
N-Octane	55/55 gal	827
Oil, Crankcase, 76 Guardol QLT 30	220/55 gal	875
Oil, Hydraulic (DTE, Unocal, CITGO, 76 UNAX AW32)	1,400/700 gal	801, 810, 873, 805, 836, 875
Oil, Inhibited Insulating	25,000/5,000 gal	801, 802
Oil, Mineral	220/55 gal	805, 817, 827
Oil, Motor (all weights)	650/400 gal	875, 879, and misc. site locations
Oil, Shell Oil Tellus 23	110/55 gal	834
Oil, Transformer, Shell Diala-AX/Equivalent	15,000/15,000 gal	801, 846, 865, 874, 836, 851
Oil, Turbine (Extra Heavy, HD 92)	110/55 gal	875
Oil, Vacuum Pump	330/55 gal	875, 827, 851, 806
Oil, Vitrea 100	55/55 gal	875
Oil, Waste	1,000/110 gal	879, 875, 851, 805
Oxygen	16,000/5,000 ft^3	801, 843, 873, 874, 875, 876, 879, 811, T8340
Paint, acrylic (e.g., semi-gloss)	600/100 gal	872, 843, 873, and misc. locations site-wide
Paint, Street Markings	300/55 gal	805, 843, 872, 873, 875, and site-wide
Paint Spray Wastewater	1,200/600 gal	883
Petroleum ether	220/55 gal	801, 827
Photo wastes	400/110 gal	851
Polyol	120/55 gal	827
Propane	20,000/8,000 ft^3	845, 801, and 879 aboveground tanks; also at 841, 851, 873, 874, 875
Roundup herbicide	100/90 gal	819
Sodium bicarbonate	550/40 lb	812, 827, 873, 858
Sodium chloride	7,400/100 lb	805, 817, 827
Sodium hypochlorite/Purechlor Sanitizer/bleach	500/55 gal	875
Sodium nitrate	1,000/16 lb	827
Steam Cleaning Solution/Split Equipment Cleaner	3,000/400 gal	879; Equipment cleaner

TABLE B.4.15.1–3.—*Site 300 Hazardous Chemicals Quantities by Location in FY2002 (continued)*

Material	Maximum/ Average Quantity[a]	Location
STIK-IT Asphalt Base Seal	560/5 gal	843 and misc. locations site-wide
Stoddard solvent/paint thinner	200/60 gal	827, 843, 872, 873, 876, and misc. site locations
Sulfur hexafluoride	19,500/7,700 ft^3	801, 801, 812, 850, 851
Sulfuric Acid	845/60 lb	875

Source: LLNL 2002m.
Note: Some buildings are part of a complex and employ small ancillary storage facilities. The above list does not denote these facilities. Locations vary year to year. The listing of facilities is not intended to limit inventories. Physical space and administrative controls including safety documentation limit inventories. This table is provided to give the reader an understanding of the types of chemicals, general quantities, and variety of locations.
[a] Maximum/Average Quantity: Maximum is defined as a maximum quantity at one of the facilities in a given year. Average is defined as the average quantity found at multiple facilities.
ft^3 = cubic feet; gal = gallons; lb = pounds.

Table B.4.15.1–4.—*Hazardous Chemicals at Selected Waste Management Facilities*

Facility	Materials[a]	Chemical Hazard Classification
DWTF	Sulfuric acid – 2,786 kg Sodium hydroxide (50% solution) – 1,737 kg Hydrogen peroxide (50% solution) – 1,665 kg Ferric sulfate (50% solution) – 1,709 kg Granulated activated carbon – unlimited Chloroform – 67.7 lb Hydrogen peroxide – 39.3 lb Perchloric acid – 35 lb Carbon disulfide – 34.9 lb Other chemical reagents – minor quantities	Low hazard
RHWM (Rollup)	Acetone – 30,400 lb Styrene – 23,000 lb Petroleum oils – 19,270 lb Methanol – 3,383 lb Other chemical reagents – minor to large quantities	Low hazard

Source: LLNL 1999j, LLNL 2000t, LLNL 2003s.
Note: This table is provided to give the reader an understanding of the types of chemicals and general quantities.
[a] All wastes have been removed prior to the expected closure.
kg = kilograms; lb = pounds.

B.4.15.2 *Waste Management*

This section describes the waste generation at LLNL. For a discussion of the regulatory setting, waste management practices, and treatment/storage facilities at LLNL, see Section B.1. The waste generation rates (CY1993–FY2002) presented in this section represent actual data based upon DOE records.

The waste categories routinely generated onsite under normal operations include radioactive waste (including LLW, MLLW, TRU and mixed TRU); hazardous waste, which includes RCRA hazardous (chemical and explosives) waste, California toxic waste, TSCA waste (primarily asbestos and PCBs), and biohazardous (medical) waste; and nonhazardous solid waste and process wastewater. Additionally, LLNL generates nonroutine wastes and expects to generate wastes from new operations. Each of these categories is discussed separately below. Figure B.4.15.2–1 shows locations of the DWTF and other RHWM facilities.

Normal (Routine) Operations

The affected environment considered under this analysis is limited to those facilities that generate waste under normal (routine) operations at LLNL. Normal operations encompass all current operations that are required to maintain R&D at LLNL facilities.

New Operations

Several new operations are currently under construction or in the operational planning stages at LLNL. However, they are considered outside the scope of the current affected environment description for this analysis because they have not yet reached operational status. New operations are defined as programmatically planned projects with defined implementation schedules that will take place in the future. Two facilities, the NIF and the BSL-3 Laboratory, are examples of these new operations.

Special (Nonroutine) Operations

Special (nonroutine) operations generate nonroutine wastes and are limited-duration projects, such as construction, that are considered separately from facility operations. These efforts can make a large contribution to the overall waste generation activities at LLNL. Three areas are considered special operations: construction, D&D, and environmental restoration. Typically, the projects are well-defined so as to allow waste management activities to directly support the project.

Facility maintenance and infrastructure support operations will continue with refurbishment, renovation, and removal of outdated facilities. The LLNL *FY2004 Ten Year Comprehensive Site Plan* and the *LLNL EIS Facilities and Initiatives Report* identify the specific structures under consideration over the next 10 years (LLNL 2003cj). These programs will potentially generate large volumes of TSCA waste, primarily asbestos and building debris that will increase LLNL's disposal needs.

For several years, excess facility management activities have been underway to remove legacy facilities, material, and equipment from the Livermore Site. This effort has removed over 260,000 square feet (LLNL 2002dm). One hundred sixty-one buildings, accounting for 700,000 gross square feet (an estimated 46,000 tons of construction debris), are potentially scheduled for removal. Future space reduction at LLNL will focus on buildings that are beyond their useful lives. These buildings will become vacant after new buildings are built. Twenty-three buildings, accounting for 53,500 gross square feet, are in poor condition and are categorized as beyond their useful life (LLNL 2002dm).

Building debris estimates associated with D&D projects are included in the assessments of the waste generated from special operations (potentially 40,000 tons of debris). However, separate NEPA review may be required in the future depending on the scale and extent of the work involved.

The analysis presented in this document considers environmental restoration activities as nonroutine operations due, in part, to the fluctuation in year-to-year waste quantities. To comply with CERCLA groundwater remedial actions at the Livermore Site, the Environmental Restoration Division (ERD) has designed, constructed, and operated 5 fixed groundwater treatment facilities and associated pipeline networks and wells, 20 portable groundwater treatment units, 2 catalytic dehalogenation units, and 3 soil vapor extraction facilities. In 2001, the ERD operated 4 fixed, 19 portable, 2 catalytic reductive dehalogenation, and 2 soil vapor treatment units. The ERD also installed an electro-osmosis system to improve its ability to remove contaminants from fine-grained sediments.

At Site 300, the ERD has designed, constructed, and operated 3 soil vapor extraction facilities and 11 groundwater extraction and treatment facilities. In addition, the ERD has capped and closed four landfills and the high explosives rinse water lagoons and burn pits, excavated and closed numerous wastewater disposal sumps, and removed contaminated waste and soil to prevent further impacts to groundwater at Site 300.

Radioactive Waste

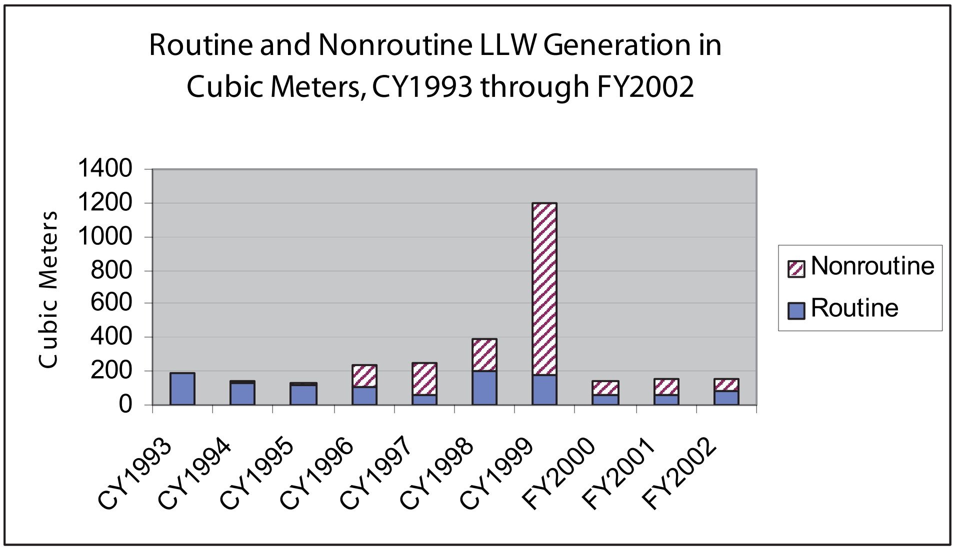
Radioactive waste generated at LLNL includes LLW, MLLW, TRU waste, and TRU-mixed waste. LLNL does not manage or generate high-level waste (a highly radioactive material that results from reprocessing of spent fuel). LLW, MLLW, and TRU wastes are produced primarily in laboratory experiments. Mixed wastes are discussed separately below.

DOE O 435.1 permits onsite storage of LLW and TRU wastes until appropriate disposal becomes available. Currently, there are no regulatory restrictions on the length of time this waste may be stored onsite, provided that disposal or offsite storage options are being pursued and the waste is stored in accordance with all applicable regulations. LLNL maintains the capability to treat solid radioactive wastes onsite. LLNL has treated liquid radioactive wastes at the Treatment Area 514 Tank Farm (LLNL 2002ca). The DWTF is replacing Area 514. LLNL disposes of solid LLW offsite at the Nevada Test Site. Available storage space for LLW and TRU waste is limited by exposure considerations (i.e., radiation exposure to personnel) at a given storage location. However, radioactive wastes, unlike RCRA-regulated wastes, can be stored at various locations onsite provided that the waste is properly packaged, labeled, and monitored. Waste management facilities handling radioactive wastes are listed in Table B.1.1–2.

As part of the effort to minimize the total quantity of radioactive waste that is generated at LLNL, facilities that generate this type of waste are designated as Radioactive Materials Management Areas (RMMAs). An RMMA is an area where the reasonable potential exists for contamination due to the presence of unconfined or unencapsulated radioactive material or an area that is exposed to sources of radioactive particles (such as neutrons and protons) capable of causing activation. Managers of facilities must document the locations of all RMMAs. Procedures to minimize the generation of radioactive wastes are then developed.

Historic and Current Radioactive Waste Generation

Radioactive waste has historically been generated from R&D activities that used radioactive materials. Figure B.4.15.2–2, summarizes historic routine and nonroutine LLW quantities (cubic meters) generated onsite from CY1993 through FY2002. From CY1993 to FY2000, annual TRU waste generation ranged from 0 to 12 cubic meters.



Source: DOE 2002s.

FIGURE B.4.15.2–2.—*Routine and Nonroutine LLW Generation in Cubic Meters*

In 2000, LLNL's reporting cycle and quantities changed from calendar year to fiscal year and tons to cubic meters. Table B.4.15.2–1 summarizes current radioactive waste quantities generated onsite from FY2001 and FY2002.

TABLE B.4.15.2–1.— *Generated Radioactive Waste Received by RHWM in FY2001 and FY2002 (in cubic meters)*

Radioactive Waste Generated	2001	2002
LLW	74	159
TRU waste	0	1
Total Radioactive	74	160

Source: DOE 2002s.
LLW = low-level waste; TRU = transuranic.

Legacy waste is considered to be waste material in storage pending disposal. LLNL is in the process of disposing of this waste as treatment and disposal capacity becomes available. For the most part, legacy waste is either radioactive or classified. As of mid-2003, total LLW, Mixed LLW, and TRU waste inventory was 2,178 cubic meters. Table B.4.15.2–2 provides specific radioactive waste quantities by type.

TABLE B.4.15.2–2.—*Radioactive Legacy Waste Quantities in Storage by Type at LLNL RHWM Facilities*

Waste Type	Quantity in Cubic Meters
LLW	1,566
Mixed LLW	506
TRU waste	106
Total inventory[a]	2,178

Source: LLNL 2003v.
[a] Radioactive waste inventory from Buildings 514, 612, 693, 233 CSU, and 883.
LLW = low-level waste; TRU = transuranic.

LLNL maintains the capability to treat radioactive wastes onsite. In 2002, Treatment Area 514 treated 220 cubic meters of LLW, including 63 cubic meters sewered after treatment (meets approved discharge limits). Additionally, at other facilities, LLNL treated 540 cubic meters of LLW. No TRU waste was treated in 2002.

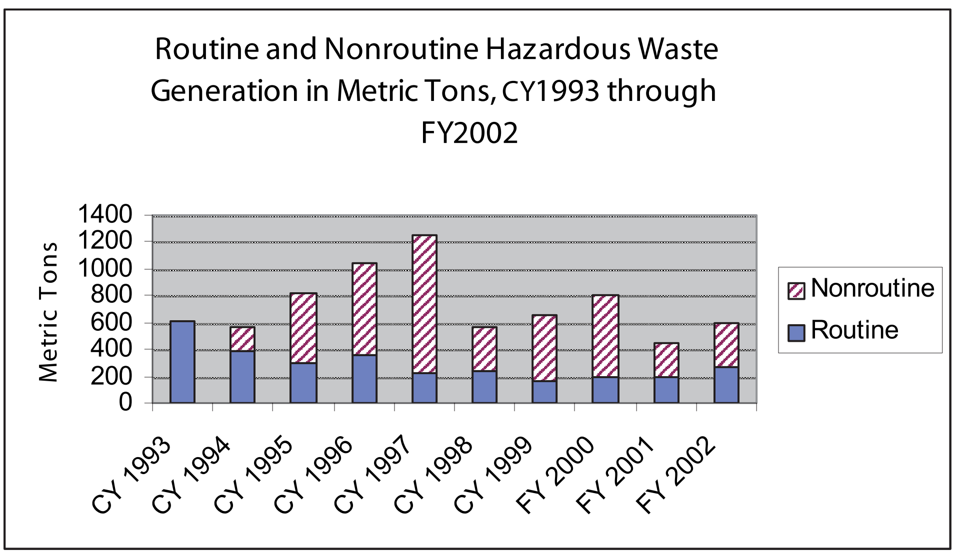
Hazardous Waste

Hazardous waste refers specifically to nonradioactive waste, including RCRA chemical and explosives waste, California toxic hazardous waste, biohazardous (medical) waste, and TSCA waste (primarily asbestos and PCBs). Almost all buildings at LLNL generate hazardous wastes, ranging from common household items such as fluorescent light bulbs, batteries, and lead-based paint to solvents, metals, cyanides, toxic organics, pesticides, asbestos, and PCBs.

RCRA permits onsite management of hazardous waste at the point of generation or in designated waste accumulation areas and permits storage in permitted storage facilities. There are regulatory restrictions on the length of time that waste may be stored onsite, and waste must be stored in accordance with all applicable regulations. LLNL maintains the capability to store and treat certain hazardous wastes onsite. LLNL treats explosive wastes at Site 300. Hazardous wastes are shipped through licensed commercial transporters to various permitted treatment, storage, and disposal facilities offsite. Hazardous waste management facilities are listed in Table B.1.1–2.

Historic and Current Hazardous Waste Generation

The hazardous waste generated at LLNL is predominantly chemical laboratory trash generated from experiments, testing, other R&D activities, and infrastructure fabrication and maintenance. Figure B.4.15.2–3 illustrates the quantities of routine and nonroutine hazardous waste generated for all operations from CY1993 through FY2002. In 2000, LLNL's reporting cycle and quantities changed from calendar year to fiscal year and tons to metric tons. In FY2001 and FY2002, LLNL generated 460 and 600 metric tons of hazardous waste, respectively (DOE 2002s).



Source: DOE 2002s.

FIGURE B.4.15.2–3.—*Routine and Nonroutine Hazardous Waste Generation in Metric Tons*

All hazardous waste is managed within appropriate time limits and quantity limits. No backlogged inventory of hazardous waste exists at LLNL (for discussion regarding legacy mixed wastes see mixed waste section). LLNL maintains the capability to treat hazardous wastes onsite. In 2002, LLNL treated 140 cubic meters of hazardous waste.

Explosive Waste

The explosive waste generated at Site 300 ranges from high explosives and analytical chemicals to wastewater contaminated with explosives. In 2002, 6,000 pounds of explosive waste were stored at the EWSF. Waste high explosives are treated at the EWTF, a facility used for thermal treatment of these wastes. In 2002, the EWTF treated 2,700 pounds. The treatment process involved 64 burns and 19 detonations.

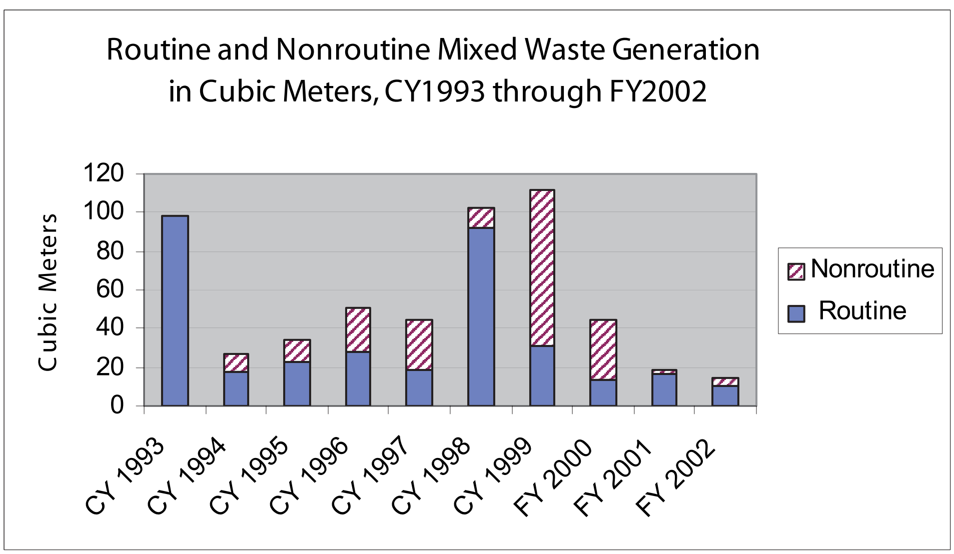
Mixed Wastes

Mixed waste generated at LLNL includes MLLW, TSCA-mixed, and mixed TRU (see Table B.4.15.2–3). MLLW and mixed TRU are produced primarily in laboratory experiments and component tests. Figure B.4.15.2–4 illustrates the quantities of mixed waste generated from CY1993 through FY2002. TSCA-mixed wastes are produced primarily during D&D- and environmental restoration-related activities.

TABLE B.4.15.2–3.— *Mixed Waste Generated in FY2001 and FY2002 (in cubic meters)*

Radioactive Waste Generated	2001	2002
MLLW	23	63
Mixed TRU waste	0	0
Mixed TSCA	0	0
Mixed Total	23	65

Source: DOE 2002s.
MLLW = mixed low-level waste; TRU = transuranic; TSCA = *Toxic Substances Control Act*.



Source: DOE 2002s.

FIGURE B.4.15.2–4.—*Routine and Nonroutine Mixed Waste Generation in Cubic Meters*

LLNL does not maintain the capability to dispose of solid mixed wastes onsite. LLNL treats liquid mixed wastes at the Treatment Area 514 Tank Farm (LLNL 2002p) and DWTF. LLNL treats and disposes of MLLW offsite under the Federal Facility Compliance Order issued jointly to the University of California and the DOE (LLNL 2002cc). LLNL is continuing to work with the DOE to maintain compliance with the *Federal Facilities Compliance Act* Site Treatment Plan (STP) for LLNL that was signed in February 1997. All milestones for 2001 were completed on time. Reports and certification letters were submitted to the DOE as required. An agreement was reached with the DTSC to extend all FY2002 and FY2003 milestones to allow LLNL to concentrate resources on characterizing and disposing of TRU waste. LLNL continued to pursue the use of commercial treatment and disposal facilities that are permitted to accept mixed waste.

These facilities provide LLNL greater flexibility in pursuing the goals and milestones set forth in the STP.

Mixed legacy waste is considered to be waste material in storage pending disposal. LLNL is in the process of disposing of this waste as treatment and disposal capacity becomes available. For the most part, mixed legacy waste is land disposal restricted. As of mid-2003, total MLLW and mixed TRU waste inventory was 530 cubic meters. Table B.4.15.2–4 provides specific radioactive waste quantities by type.

LLNL maintains the capability to treat mixed wastes onsite. In 2002, Treatment Area 514 treated 140 cubic meters of MLLW, including 38 cubic meters sewered after treatment (meets approved discharge limits). Additionally, at other facilities, LLNL treated 43 cubic meters of MLLW. No mixed TRU waste was treated in 2002.

TABLE B.4.15.2–4.—*Mixed Waste Quantities in Storage (FY2002) by Type at LLNL RHWM Facilities*

Waste Type	Quantity in Cubic Meters
MLLW	510
TRU mixed waste	17
Total inventory[a]	530

Source: LLNL 2003v.
[a] Radioactive waste inventory from Buildings 514, 612, 693, 233 CSU, and 883.
MLLW = mixed low-level waste; TRU = transuranic.

Biohazardous Wastes

Biohazardous wastes include bioagents and medical wastes. Bioagents include toxins, toxin fragments, and biohazardous materials.

The Livermore Site is considered a large-quantity generator because 200 pounds of medical waste is normally generated in a calendar month in a 12-month period. Medical wastes consist of biohazardous waste and sharps (e.g., needles, blades, and glass slides) waste. Medical wastes generated at LLNL are managed as a separate waste stream in accordance with the *California Health and Safety Code*, Division 20, Chapter 6.1. In 2000 and 2001, several hundred kilograms of biohazardous waste were generated, treated, and disposed of at an approved offsite facility.

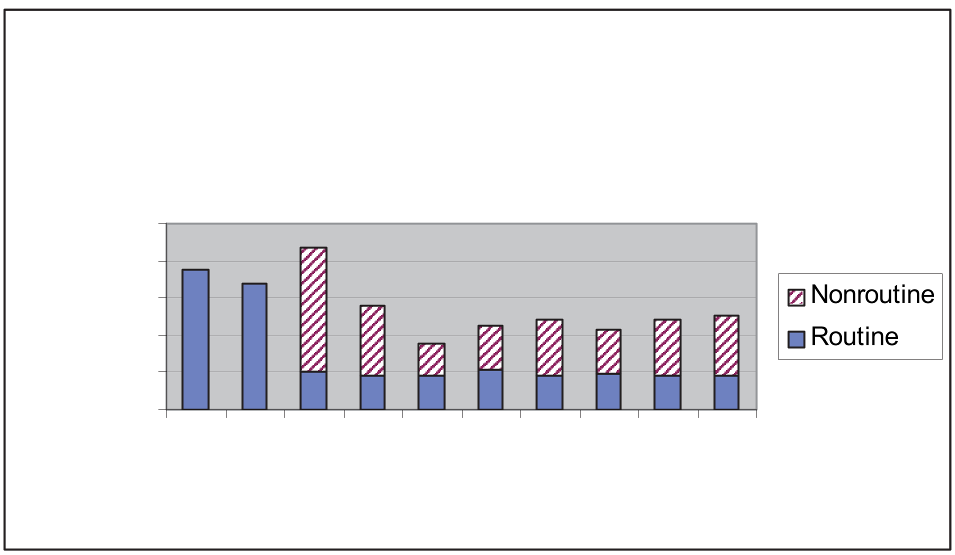
Other biohazardous wastes generated (including bioagents and toxins) are carefully segregated and disposed of based on hazards. For example, radioactive biohazardous or biological waste is disposed of as radioactively contaminated waste at an approved offsite facility.

LLNL's Site 300 is considered a small-quantity generator of medical waste, which means that less than 200 pounds of medical waste is generated in a calendar month in a 12-month period. Therefore, Site 300 is not subject to medical waste generator and treatment permit fees and is not subject to annual inspections by San Joaquin County. Site 300 does, however, submit a minimal annual fee for a Limited Quantity Hauling Exemption, which allows registered LLNL haulers to transport medical waste generated at Site 300 to the Livermore Site for waste consolidation prior to offsite shipment.

Other Wastes

Sanitary Solid Waste

Routine sanitary solid waste consists predominantly of office and laboratory nonhazardous trash. Nonroutine sanitary solid waste consists predominately of nonhazardous building debris generated from major construction and D&D activities. All solid waste from the Livermore Site is currently disposed of at the Altamont Landfill in Livermore, California or diverted for recycling (see Appendix O). The Altamont Landfill has a remaining capacity of approximately 15 million cubic yards (over 10 years) (CIWMB 2002). There are two active landfills in San Joaquin County that have over 10 years of capacity. Figure B.4.15.2–5 summarizes historic sanitary solid waste quantities generated onsite from CY1993 through FY2002 showing portions of routine and nonroutine generated each year with the exception of CY1993 and CY1994. In FY2001 and FY2002, LLNL generated 1,900 and 1,800 metric tons of routine sanitary waste each year and 3,000 and 3,300 metric tons of nonroutine sanitary waste, respectively (DOE 2002s).



Source: DOE 2002s.
[a] Nonroutine quantities included in routine total for CY1993 and CY1994.

FIGURE B.4.15.2–5.—*Sanitary Waste Generation in Metric Tons*

Environmental Restoration Wastes

Environmental investigations and cleanup activities at LLNL began in 1981. The Livermore Site became a CERCLA site in 1987 when it was placed on the National Priorities List (NPL). Site

300 was placed on the NPL in 1990. LLNL continues to perform environmental restoration activities in accordance with CERCLA provisions and approved plans.

Current activities at the Livermore Site include 29 treatment facilities: 27 are groundwater treatment facilities and 2 are vapor treatment facilities (VTFs). A total of 84 groundwater extraction wells operated at 27 separate locations at an average flow rate of 2,540 liters per minute. A total of two vapor extraction wells operated at two separate locations at an average flow rate of 670 cubic meters per minute. Table B.4.15.2–5 presents the treatment area and VOCs removed from groundwater and soil at the Livermore Site.

TABLE B.4.15.2–5.—*Volatile Organic Compounds Removed from Groundwater and Soil at the Livermore Site*

		2002		Cumulative Total	
Treatment Area	**Startup Date**	**Water Treated (million liters)**	**VOCs Removed (kilograms)**	**Water Treated (million liters)**	**VOCs Removed (kilograms)**
TFA	1989	251.4	5.7	3,658	154
TFB	1990	130.2	6.1	787	54.2
TFC	1993	107.9	7.1	595	53.9
TFD	1994	281.3	68.4	1,505	500
TFE	1996	110.5	17.5	544	139
TFG	1996	12.1	0.7	70.4	3.7
TF406	1996	40.5	1.0	211	7.7
TF518	1998	4.9	0.6	37.1	4.3
TF5475	1998	0.72	0.7	2.3	4.8
		Soil Vapor Treated (thousand cubic meters)	**VOCs Removed (kilograms)**	**Soil Vapor Treated (thousand cubic meters)**	**VOCs Removed (kilograms)**
VTF518	1995	0	0	425	153
VTF5475	1999	143.5	37.7	659	306

Source: LLNL 2003l.
VOCs = volatile organic compounds.

Table B.4.15.2–6 summarizes FY2002 and cumulative totals of volumes and masses of contaminants removed from groundwater and soil vapor at Site 300.

Other environmental restoration wastes (soil, personal protection equipment, samples) are rolled into radioactive and hazardous waste categories previously discussed.

Industrial Wastewater

Industrial wastewater is water that contains constituents at concentrations too high to allow discharge to the sanitary sewer, but does not meet the criteria to be designated as hazardous waste. Several thousand gallons of wastewater are held pending analysis each day. Only a small portion would be considered industrial wastewater (<1 percent).

At Site 300, Buildings 806, 807, 809, 825, and 826 process nonhazardous wastewater through several steps (e.g., filters) into Class II surface impoundments (LLNL 2002cc).

Sanitary (Domestic) Wastewater

Liquid effluents with contaminants below limits specified by the city of Livermore are released to the city of Livermore sewer system. In FY2002, LLNL generated approximately 240,000 gallons per day (LLNL 2003l). The sewer system capacity is approximately 1,685,000 gallons per day (LLNL 2002dm). In FY2001 and FY2002, Site 300 (GSA) generated approximately 2,100 gallons per day (LLNL 2002cc). Site 300 remote facilities use septic systems.

TABLE B.4.15.2–6.—*Volatile Organic Compounds Removed from Groundwater and Soil Vapor at Site 300*

		2002		Cumulative Total	
Treatment Area	**Startup Date**	**Water Treated (million liters)**	**VOCs Removed (kilograms)**	**Water Treated (million liters)**	**VOCs Removed (kilograms)**
GSA-Eastern GWTF	1991	78.7	0.17	806.6	6.19
GSA-Central GWTF	1993	4.19	0.59	29.16	10.66
Building 834	1995	0.11	0.81	0.93	31.84
High Explosives Process Area	1999	4.5	0.012	10.5	0.058
Building 832	1999	1.90	0.12	5.68	0.44
Building 854	1999	3.67	0.78	12.25	6.14
Pit 6	1998	N/A	N/A	0.268	0.0014
		Soil Vapor Treated (thousand cubic meters)	**VOCs Removed (kilograms)**	**Soil Vapor Treated (thousand cubic meters)**	**VOCs Removed (kilograms)**
GSA-Central	1994	293.58	1.54	1987.18	66.16
Building 834	1998	406.18	5.19	1657.56	108.26
Building 832	1999	96.2	0.28	282.5	1.39

Source: LLNL 2003l.
GSA = General Services Area; GWTF = groundwater treatment facility; N/A = not applicable; VOCs = volatile organic compounds.

B.4.16 Utilities and Energy

Utilities and energy systems at LLNL consist of water, sanitary sewer systems, electrical transmission and distribution, and communication systems that support operations at the site.

The water supply system currently provides 1.36 million gallons per day of water for fire protection, industrial support of LLNL's research programs, and sanitary use (Table B.4.16–1). The Livermore Site is supplied by the San Francisco Water District through the Hetch Hetchy Aqueduct. When needed, water is also supplied by the Alameda County Flood Control and Water Conservation District. LLNL also maintains the drinking water distribution system at SNL/CA.

The sewer system discharged approximately 300,000 gallons per day of industrial and domestic wastewater (Table B.4.16–1). The site operates a wastewater management control system whereby potentially contaminated laboratory wastewater is routed to retention tanks for analysis and proper disposal. The system provides an additional mechanism for preventing any release of regulated materials from reaching offsite.

All utility and energy systems are currently operating within existing capacity. The Safety and Environmental Protection Directorate uses less than 5 percent of the current usage presented in Table B.4.16–1 (TtNUS 2003).

TABLE B.4.16–1.—*LLNL Utility and Energy Systems*[a]

Utility System	Total LLNL Usage	RHWM	Current Capacity
5ESS telecomm. switch	18,973 (voice lines)	505	20,384
Telecomm. dist. system:			
Copper trunk cables (B256 to 13 nodes)	20,330 (pairs)	540	46,800
Fiber trunk cables	1,468	39	2,368
Copper distribution (Nodes to buildings)	96,950	2,580	115,158
Network speed to desktop	10 Mbps	10 Mbps	10 Mbps
Electricity	57 MW	1.5 MW	125 MW
Natural gas	12,900 therms/day	554 therms/day	24,500 therms/day
Domestic water	1.2M gal/day	0.04 gal/day	2.88M gal/day
Low conductivity cooling water	36.5 MW	1 MW	70.2 MW
Demineralized water	27,700 gal/day	N/A	50,400 gal/day
Sanitary sewer	216,400 gal/day	8,000 gal/day	1,685,000 gal/day
Compressed air	2,400 SCFM	72 SCFM	4,090 SCFM

Source: LLNL 2002dm.
[a] For the purpose of simplicity, the most recent published site comprehensive plan was used as the primary reference.
gal/day = gallons per day; Mbps = megabits per second; MW = megawatts; N/A = not applicable; SCFM = standard cubic feet per minute.

B.4.17 Worker Safety and Human Health

This section summarizes the occupational protection programs responsible for ensuring that hazardous material management and waste management activities are performed in a manner protective of ES&H relative to the permitted waste management units.

B.4.17.1 *Worker Health and Safety*

LLNL employs ISMS to control hazards associated with site operations, including hazards related to the management and use of hazardous materials. The ISMS process includes project planning, hazard assessment, identification and feedback, and continuous improvement planning. LLNL also follows specific management processes to ensure that adequate security and accountability requirements are met for radioactive and high-hazard materials. Inventory controls are implemented to ensure that material quantities are maintained at mission-essential levels.

Hazardous materials used at LLNL include radioactive material, chemicals, and explosive materials. Hazardous materials are managed at LLNL in a way that ensures cradle-to-grave accountability. The inventory systems for radioactive, chemical, and explosive materials provide the tracking mechanisms for inventory and waste control. Materials remain in appropriate storage areas until they are identified as waste and transferred to the waste management organization for disposal.

Radioactive Material

LLNL maintains an inventory of radioactive material used in laboratory research and radiation monitoring activities. All radioactive material used by LLNL is obtained from offsite vendors.

Individual sources at LLNL generally have small quantities of radioactive material and most are sealed. Management of radioactive material at LLNL incorporates the principle of as low as reasonably achievable (ALARA). Specific activities at LLNL associated with radioactive materials are conducted in accordance with the LLNL ES&H Manual (LLNL 2000i), which incorporates the requirements of 10 CFR Part 835, *Occupational Radiation Protection,* and addresses all activities associated with radioactive materials management, including personnel training, inventory control and monitoring, safety assessments, and handling.

LLNL worker doses have typically been well below DOE worker exposure limits. LLNL set administrative exposure guidelines at a fraction of the exposure limits to help enforce doses that are ALARA. Table B.4.17.1–1 presents average individual doses and LLNL collective doses from 1997 through 2001.

TABLE B.4.17.1–1.—*LLNL Radiation Exposure Data (1997 through 2001)*

Year	Collective Dose (TEDE) (person-rem)	Number with Measurable Dose	Average Measurable Dose (TEDE) (rem)
1997	22.1	191	0.116
1998	6.9	107	0.064
1999	14.9	137	0.109
2000	12.7	145	0.086
2001	18.4	153	0.120
Average	17.3	173	0.1
Estimate RHWM worker	0.52	5	0.003

Source: DOE 2001c.
Note: Data for individual divisions within LLNL (for example ES&H Security Directorate) are NR. Organization numbers for LLNL personnel sometimes change due to work changes or corporate reorganizations. During any 3-month period, monitored personnel may change organizations one or more times.
rem = roentgen equivalent-man; RHWM = radioactive and hazardous waste management; TEDE = Total Effective Dose Equivalent.

Chemical Materials

Specific activities at LLNL associated with chemical materials are conducted in accordance with the LLNL ES&H Manual. The manual provides requirements for the proper management of hazardous materials, responsible organizations, and inventory control.

LLNL maintains a centralized chemical inventory database, ChemTrack, for tracking hazardous chemicals in primary containers (primary means those containers shipped by the manufacturer). The ChemTrack system requires bar coding of chemical containers as they enter LLNL to allow container tracking and access to online chemical inventory data. The bar coded chemical containers are tracked to provide location and usage information from arrival at LLNL through disposal of the container by the waste management program. The LLNL links the bar-coded chemical containers to a location and a chemical custodian (may be more than one person), the Material Safety Data Sheets (MSDS) (if available), related chemical properties, hazard data, and regulatory information.

Explosive Materials

Site 300 uses explosives in various R&D and test applications. Explosive quantities used per activity range from milligrams to several kilograms. Overall, the quantities of explosive material maintained onsite are restricted by the approved explosive capacity of various storage areas. The HEAF located at the Livermore Site uses explosives in various activities in small quantities.

An explosives safety program is used to manage explosives at LLNL. It provides guidance for evaluating and safely conducting explosives operations. The LLNL explosives safety committee provides continual review, interpretation, and necessary revision to the explosives safety program. As part of the explosive material management strategy, LLNL uses an explosives inventory system to track and manage explosive inventories. The explosives inventory system database maintains information on material composition, characteristics, and shipping requirements; life cycle cost information; plan of use; security and hazard classifications; and compatibility codes. When an explosive material is entered into the explosives inventory system database upon delivery or receipt, the system performs a safety check to ensure that the intended storage location can accept the type and quantity of material received. The explosives inventory system database will flag any storage capacity overages and incompatible explosive items.

B.4.17.2 *Occupational Health and Safety*

A worker protection program is in place at LLNL to protect the health of all workers. To prevent occupational illnesses and injuries and to preserve the health of all workers involved in site-related activities (construction and operations), DOE-approved health and safety programs have been implemented. Table B.4.17.2–1 presents LLNL injury rates over a 3-year period from 1999 through 2001, in terms of total reportable cases rate, lost work day cases rate, and lost work days rate. The total reportable case value includes work-related death, illness, or injury that resulted in loss of consciousness, restriction from work or motion, or transfer to another job or that required medical treatment beyond first aid. The data for lost work days represent the number of workdays beyond the day of injury or onset of illness that the employee was away from work or limited to restricted work activity because of an occupational injury or illness.

As shown in Table B.4.17.2–1, these health and safety programs have resulted in lower incidences of injury and illness than those that occur in the general industry, construction, and manufacturing workforces.

TABLE B.4.17.2–1.— *Injury and Illness Data (1999 through 2001) Based on 200,000 Work Hours (100 workers)*[a]

Calendar Year	Total Reportable Cases Rate	Lost Work Day Cases Rate	Lost Work Days Rate
1999	3.8 (6.3)[a]	1.1 (3.1)[a]	13.7 (1.9)[a]
2000	3.5 (6.5)[a]	0.9 (3.3)[a]	23.1 (2.0)[a]
2001[b]	3.7	1.1	14.1
3-Year Average	3.7 (6.5)[c]	1.0 (3.2)[c]	17.0 (2.0)[c]

Source: DOE 2002l.
[a] State of California injury and illness data is for all industries including state and local government are given in parentheses.
[b] State of California injury and illness data is for 2001 were not available at the time of the Draft LLNL SW/SPEIS.
[c] Three-year average for State of California data covers 1998 through 2000 timeframe.

B.4.17.3 *Human Health*

LLNL operates under several RCRA Part B permits and must comply with Title 22 of the *California Code of Regulations*, Article 66264.600. Several health risk assessments (HRA) were conducted, pursuant to 22 CCR 66264.601(c). For completeness, LLNL included all permitted waste facility operations in these HRAs, entitled *Health Risk Assessment for Hazardous and Mixed Waste Management Units at LLNL* (LLNL 1997q, LLNL 2003r). Specifically, the HRAs addressed those facilities that can produce atmospheric emissions and that have potential health effects. The RCRA Part B permit includes detailed descriptions of the waste generated at LLNL and the existing waste management units.

The HRAs were prepared in accordance with procedures and guidelines set forth by the DTSC and the BAAQMD. They addressed the risk associated with both the hazardous and radioactive properties of chemicals handled at LLNL's permitted waste management units. By following these procedures, the HRAs presented a health-conservative analysis of a hypothetical MEI potentially receiving a reasonable maximum exposure. The HRAs were developed using modeling of throughput capacities for the LLNL waste management units that reflected maximum annual quantities, which were approximately five times the normal quantities.

Potential carcinogenic risks and noncarcinogenic hazards resulting from the emission of the waste chemicals of concern were characterized largely based on the California Environmental Protection Agency's *Preliminary Endangerment Assessment Guidance Manual* and *Air Toxics "Hot Spots" Program Risk Assessment Guidelines* (California EPA 1994, 2002). The contribution to carcinogenic risk from emissions of radionuclides to air was based on NESHAP dose calculations required by Federal regulation. In all cases, risk and hazard were evaluated at the maximum anticipated operating levels, so that the risk and hazard estimates represented upper-bound values. The contribution to risk from emissions of radionuclides to air was obtained by multiplying the NESHAP calculated dose by the International Commission on Radiological Protection risk factor of 0.05 (lifetime excess cancer mortality risk) per Sievert. The HRAs concluded that the combined excess, offsite cancer risk from the existing RHWM facility radioactive and nonradioactive materials is less than 1×10^{-6}, using the highest calculated risk values from each type of material (LLNL 2000aa, 2003r).

In summary, the HRAs found that the risk and the hazard due to the continued operation of the existing facilities, even at maximum throughput conditions, would be below levels of concern described in the regulatory literature. With increased use, DWTF will treat the same waste streams that are treated in the existing facilities; however, DWTF will have improved air emissions control equipment and will treat some additional new waste streams. The DOE has assessed the environmental impacts associated with the construction and operation of the DWTF in an environmental assessment (DOE/EA-1150) (LLNL 1996c). Based on this assessment, the DOE issued a Finding of No Significant Impact on June 12, 1996. The latest HRA (LLNL 2003r) was prepared in support of the revised permit application, following a revised protocol approved by the DTSC and BAAQMD. The scope of the latest HRA addressed the configuration of existing facilities and full operation of the DWTF.

B.5 ENVIRONMENTAL CONSEQUENCES

This section provides information on the methods of analysis applied in this appendix and the results of analyses for LLNL waste management facilities. The appendix begins with an introduction and a summary of the impact assessment methodologies that have been applied. It continues with descriptions of the impacts of the No Action, Proposed Action, and the Reduced Operation Alternatives. For each alternative, impacts are presented by resource area (for example, infrastructure, land use, geology, and soils) or topic area (for example, waste generation, transportation, environmental justice).

Where possible, impacts of the No Action Alternative, Proposed Action, and Reduced Operation Alternative, the analyses use estimates of impacts with specific parameters. However, in certain resource areas a conservative estimate of possible impacts of the alternative, were indirectly related to estimates of impacts based on a projected increase or decrease of a given parameter (for example, relating biological resource impacts to changes in square footage).

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The NNSA Proposed Action is to continue to operate and enhance LLNL RHWM facilities. The NNSA developed No Action Alternative, Proposed Action, and Reduced Operation Alternative to accomplish this action and to assess environmental impacts of waste management activities at LLNL. For clarity and brevity, the descriptions of the No Action Alternative, Proposed Action, and Reduced Operation Alternative in the text and LLNL activity descriptions, by facility, are provided Sections B.3.1, B.3.2, and B.3.3. Section B.6 focuses on CEQA considerations that characterize the variation of activities across alternatives. All of the activities discussed in this appendix were used in evaluating the impacts of each alternative presented of the LLNL SW/SPEIS.

B.5.1 No Action Alternative

Under the No Action Alternative, ongoing LLNL waste management programs and activities would continue operating at planned levels as reflected in current DOE/NNSA management plans (e.g., recent Class 1 and Class 2 Permit Modification submittals). The DWTF operations would increase to incorporate permit modifications. Planned waste generation levels would increase over today's generation levels (e.g., the NIF contributions). This would also include any recent activities that have already been approved by the DOE/NNSA and have existing NEPA documentation. When these planned operations are implemented in the future, they could result in increased activity above present levels. Thus, the No Action Alternative forecasts, over 10 years, the level of activity for LLNL waste management operations that would implement current management plans (e.g., RCRA Closure of Building 514) for assigned programs. For a complete list of No Action Alternative activities see Section B.3.1.

The following sections discuss these resource areas in relation to the existing conditions.

B.5.1.1 *Land Use and Applicable Plans*

Implementing the No Action Alternative would not affect the existing land-use patterns or applicable plans at LLNL waste management facilities.

No changes to land use or applicable plans would occur at LLNL under the No Action Alternative. The extent of NNSA land available for use by LLNL would remain the same. Buildings 233 CSU, 280, 513, and 514 would undergo a RCRA closure. After RCRA closure, Building 514 would be removed. A one-time shipment (755 gallons) of TRU waste and mixed TRU waste from Lawrence Berkley National Laboratory would occur. Shipments of waste TRU and TRU mixed waste to WIPP would begin. LLNL waste operations would remain consistent with industrial park uses and would have no foreseeable effects on established land-use patterns or requirements.

Under this alternative, the DWTF would increase operations and the following operations would be transferred to Building 695:

- Building 513 Solidification Unit
- Building 513 Shredding Unit
- Area 514-1 Cold Vapor Evaporation Unit
- Area 514-1 Portable Blending Unit (Waste Blending Unit)

- Area 514-1 Tank Blending Unit
- Area 514-1 Centrifugation Unit
- Area 514-1 Carbon Adsorption Unit (Gas Adsorption Unit)

As these changes would occur to an existing building specifically designed for these operations, there would be no changes or impacts to land use.

The completion of 75 Class 1 and up to 10 Class 2 permit modification requests over the next 10 years would be consistent with existing RHWM facilities and would have no foreseeable effects on established land-use patterns or requirements.

B.5.1.2 *Socioeconomic Characteristics and Environmental Justice*

The implementation of the No Action Alternative would result in no changes to the economic and demographic characteristics, as discussed below.

The No Action Alternative would not likely result in any noticeable change in the existing economic base because LLNL (including the waste management workforce) employment levels and associated activities would increase by only 3 percent over current levels. Additionally, the No Action Alternative would have no effect on the amount of expenditures for goods and services in the local and regional economy. Overall expenditures and employment should remain relatively constant.

The No Action Alternative would not likely result in any noticeable change in existing demographic characteristics. Overall expenditures and employment at LLNL should remain relatively constant through 2014, which in turn would tend to maintain demographic characteristics within the region.

The No Action Alternative would have no discernible adverse impacts to land and visual resources, water resources, biological and ecological resources, cultural resources, air quality, infrastructure, transportation, waste generation, noise, or socioeconomics. Thus, no disproportionately high and adverse impacts to minority or low-income communities are anticipated.

As presented in Section B.5.1.16, LLNL operations would have minimal potential to adversely affect human health for offsite residents or onsite workers. Thus, no disproportionately high and adverse impacts to minority or low-income communities would be anticipated for this resource area.

Based on the analyses of all the resource and topic areas, impacts that would result during the course of normal operations would not pose disproportionately high and adverse health or environmental impacts on minority and low-income populations.

B.5.1.3 *Community Services*

The implementation of the No Action Alternative would result in no changes to the community services, as discussed below.

The No Action Alternative would not likely result in any noticeable change in community services. Overall expenditures and employment at LLNL (including the RHWM workforce) should remain relatively constant through 2014, which, in turn, would tend to maintain levels of service. Contributory effects from other industrial and economic sectors within the region should reduce or mask LLNL's current proportional impact.

Nonhazardous solid waste generated at the Livermore Site would continue to be transported to the Altamont Landfill for disposal. The landfill is estimated to have sufficient capacity to receive waste until the year 2038 (Hurst 2003). The current total daily permitted throughput is 11,150 tons (SWIS 2002). Under the No Action Alternative, approximately 4,800 metric tons per year of solid sanitary waste would be collected and transported to the Altamont Landfill.

B.5.1.4 *Prehistoric and Historic Cultural Resources*

Under the No Action Alternative, no waste management facility construction would occur. Some maintenance activities that require ground disturbance could result in the discovery of buried archaeological resources. If any such activities occurred in Sensitive Areas II, III, or IV at Site 300, the LLNL archaeologist would be contacted prior to conducting the maintenance activity to determine how to proceed in compliance with the Programmatic Agreement (Appendix G). Previous notification to the archaeologist would not be required for maintenance activities at the Livermore Site. If any resources are discovered during the activities at the Livermore Site or Site 300, the LLNL archaeologist would be notified and work would stop within the immediate vicinity until the archaeologist has assessed the discovery.

Buildings 233 CSU, 280, 513, and 514 would undergo RCRA closure under this alternative. These buildings have not been evaluated for eligibility to the National Register. Per the Programmatic Agreement, these buildings would undergo evaluation for eligibility prior to initiation of closure activities. If a building is evaluated as eligible, then a determination of the effect to the building from the closure activities would be made by NNSA. If it is determined that an adverse effect would occur, then measures would be developed to avoid, reduce, or mitigate the effect to the building.

The DWTF and Area 612 Complex, located at the Livermore Site, would be modified under the No Action Alternative. At Site 300, the EWTF, EWSF, and Building 883 would be modified. None of these buildings or facilities has been evaluated for eligibility to the National Register. Prior to modification activities taking place, these buildings would undergo the same process of evaluating eligibility, determining effect, and developing measures to avoid, reduce, or mitigate adverse effect as discussed above for buildings undergoing RCRA closure.

Under this alternative, 75 Class I permit modifications and up to 10 Class II permit modifications would be completed. If any of the modifications would result in ground disturbing activity or modifications to eligible or potentially eligible buildings or structures, then the permit modification would require review by the LLNL archaeologist. This is more likely for the Class II permit modifications.

B.5.1.5 *Aesthetics and Scenic Resources*

The No Action Alternative would not adversely change the overall appearance of the existing landscape, obscure views, increase the visibility of LLNL structures, or otherwise detract from the scenic views from LLNL or from areas adjacent to the site. Modifications to the DWTF, RCRA closures, and other activities, including TRU waste shipments, would have no impact to visual resources.

B.5.1.6 *Agriculture*

No changes to potential agriculture resources would occur at LLNL under the No Action Alternative. The extent of NNSA land (including RHWM facilities) available for use by LLNL would remain the same.

B.5.1.7 *Geologic Resources and Hazards*

No impacts to general geology and geologic resources are anticipated. Impacts from geological hazards (seismicity, slope failure) are evaluated below. Risks from contaminated soils are also discussed.

Seismology

Strong earthquake ground motion is responsible for producing almost all damaging effects of earthquakes, except for surface-fault rupture. Ground shaking generally causes the most widespread effects, not only because it occurs at considerable distances from the earthquake source, but also because it may trigger secondary effects from ground failure and water inundation. Potential sources for future ground motion at the LLNL include the major regional faults (see Section B.4).

Seismic hazard analyses have been performed for LLNL. Existing facilities continue to be upgraded or replaced to the extent possible. Larger earthquakes on more distant faults such as the San Andreas do not significantly affect the hazard estimation for LLNL.

Structure

At the Livermore Site, there is little potential for slope instability because the site is situated on flat topography. At Site 300, the areas around the waste management facilities include hillsides. The hillsides surrounding this area consist of moderately to weakly consolidated sand and gravel, and colluvial and alluvial terrace deposits. The hills have evidence of mass movement. There is an increased chance of slope failure during wet years at the hillsides in the vicinity of the RHWM facilities. Slope failure at these locations would have no effect on LLNL RHWM facilities.

Soils

Implementation of the No Action Alternative involving the full operation of the DWTF would not result in impacts since no new facilities would be required. Since no new waste management facilities are proposed, no impacts to the soils due to erosion would occur. Clean RCRA closures of existing RHWM facilities would remove the potential for site contamination.

B.5.1.8 *Ecology*

Under the No Action Alternative increased use of the DWTF as described in the permit, permit modifications, and the transition plan would not affect any of the biological resources. With the exception of the RCRA closures of Buildings 233 CSU, 280, 513, and 514, this alternative would not entail any changes to the physical environment. The RCRA closures of Buildings 233 CSU, 280, 513, and 514 (including demolition) would remove structures from the site; however, the changes in the existing environment would result in no change to biological resources. No indirect impacts would occur because no runoff materials would impact sensitive habitats; runoff is collected and analyzed and disposed of appropriately.

B.5.1.9 *Air Quality*

B.5.1.9.1 *Radiological Air Emissions*

The No Action Alternative would continue to have several RHWM facilities as radiological point source and diffuse source emissions. Based on a projected site-wide increase of radioactive waste generation, radiological emissions are estimated to increase proportionally above the existing conditions. Comparison of the No Action Alternative to the existing conditions show that LLNL projects radiological emissions dose to the MEI would remain less than one millirem per year. Radiological emissions would be within all applicable standards.

B.5.1.9.2 *Nonradiological Air Emissions*

Under the No Action Alternative, LLNL would continue to have eight RHWM nonexempt emission sources. Based on a projected site-wide staff increase of 3 percent, traffic emissions are estimated to increase 3 percent above the existing conditions. Comparison of the No Action Alternative air toxic emissions with Bay Area air toxic emissions shows that LLNL projects toxic emissions are less than one percent of those for the Bay Area. D&D activities (including RCRA closures) at LLNL could have short-term adverse impacts due to emissions of criteria air pollutants from construction worker traffic, construction equipment, and fugitive dust from earth-moving activities. The fugitive dust from these activities could exceed particulate matter under 10 microns in diameter (PM_{10}) concentration standards if no dust control measures were implemented. However, engineered controls, such as the application of water or chemical dust suppressants and seeding of soil piles and exposed soils, would minimize fugitive dust. It is expected that PM_{10} concentrations would be within all applicable standards.

The estimated number of daily commuter vehicles to LLNL during FY2002 was 7,500 to 8,500 (RHWM commuters represented 150 commuters). Under the No Action Alternative, a 3 percent increase in daily commuter traffic would occur. Increases of carbon monoxide and nitrogen oxides, an ozone precursor, would occur with the increase in commuter traffic. However, the EPA model considers that future vehicles will have lower emission rates and more stringent inspection and maintenance programs; actual emissions would be less than the model baseline.

In addition, the BAAQMD’s vehicle buyback program designed to remove older vehicles from the road will continue and contribute to the reduction in commuter vehicle emissions. In addition, the total carbon monoxide emissions for the No Action Alternative were found to be less than 1 percent of the maintenance area’s emissions of carbon monoxide. As a result, the NNSA has concluded that no conformity determination is required for the No Action Alternative.

B.5.1.10 *Water*

Under the No Action Alternative, LLNL would continue to monitor groundwater quality at numerous locations throughout the Livermore Site and Site 300. Past measurements indicate that some contaminants at various sites have periodically exceeded the maximum contaminant levels

(MCLs) in Federal drinking water standards (40 CFR Part 141). However, in accordance with CERCLA provisions and plans, restoration activities would continue to decrease concentrations at these sites over time (LLNL 2002cc).

LLNL RHWM facilities do not use groundwater for any portion of their water supply; therefore, no effects to groundwater quantity would be anticipated under the No Action Alternative.

During storm events at LLNL waste management facilities, including the DWTF, stormwater runoff is collected, sampled, and managed through the sewer system as appropriate. Rain collects from roofs and other hard surfaces within the complexes. Contact with waste containers and equipment is minimized to the extent practical.

Because LLNL manages hazardous materials throughout both sites, including wastes, it is important to know the current LLNL stormwater runoff monitoring program includes visually monitoring all facility discharge locations onsite annually and during storm events and sampling of 10 Livermore Site and 7 Site 300 locations. These samples are the best available indicators of what contaminant(s) could reasonably be transported offsite. No regulatory limits have been set for pollutants in stormwater runoff. During the most recent sampling, no pollutants were detected at levels that would be a cause for concern. No effects to stormwater compliance would be anticipated under this alternative.

Under the No Action Alternative, only minor net changes in building and parking lot areas would be anticipated. Annual variations in LLNL surface runoff would occur with variations in rainfall quantity and intensity and declining capability are a potential concern. However, no overall impact to surface water quantity from activities under the No Action Alternative would be anticipated.

B.5.1.11 *Noise*

Under the No Action Alternative, ongoing waste management activities at LLNL would continue at planned levels as reflected in current DOE management plans. In some cases, these planned levels would include increases over today's operating levels. This would include any activities that have been approved by the DOE and have existing NEPA documentation.

The No Action Alternative would include the background noise levels presented for the affected environment in Section B.4.10 and noise from the following additional activities would change:

- Increased use of the DWTF
- RCRA closures of Buildings 233 CSU, 280, 513, and 514

The acoustical environment in and around LLNL could be affected during implementation of these proposed activities.

Full operation of the DWTF under this alternative would have a negligible effect on background noise levels. The DWTF is only one facility of over 500 buildings at LLNL. With the planned consolidation of operations at the DWTF, noise levels would likely experience a slight decrease. Local worker and waste transportation traffic would contribute to the ambient noise in the area. However, the addition of 5 RHWM commuters to the Livermore Site with nearly 10,000 commuters would be negligible.

RCRA closure activities would generate noise produced by heavy construction equipment, trucks, and power and percussion tools. In addition, increased traffic is expected to increase onsite and offsite along regional transportation routes used to bring equipment and workers to the site. The noise levels would be representative of levels at large-scale building sites.

Relatively high and continuous levels of noise in the range of 93 to 108 dBA would be produced by heavy equipment operations during the initial stages of the RCRA closure. However, after that time, heavy equipment noise would become more sporadic and brief in duration. The noise from trucks, power tools, and percussion would be sustained through most of the activities. As closure activities reach their conclusion, sound levels would decrease to levels typical of daily facility operations (55 to 65 dBA). The D&D work noise levels would contribute to the ambient background noise levels for the duration of construction, after which ambient background noise levels would return to preclosure levels.

Table B.5.1.11–1 presents peak attenuated noise levels expected during construction of these facilities. At a distance of approximately 1,700 feet from the source, peak attenuated noise levels from most construction equipment are within the background range of typically quiet outdoors and residential areas.

TABLE B.5.1.11–1.—*Peak Attenuated Noise Levels (dBA) Expected from Operation of Construction Equipment*

Source	Peak Noise Level	Distance from Source						
		50 ft	100 ft	200 ft	400 ft	1,000 ft	1,700 ft	2,500 ft
Heavy Trucks	95	84 - 89	78 - 83	72 - 77	66 - 71	58 - 63	54 - 59	50 - 55
Dump trucks	108	88	82	76	70	62	58	54
Concrete mixer	108	85	79	73	67	59	55	51
Jackhammer	108	88	82	76	70	62	58	54
Scraper	93	80 - 89	74 - 82	68 - 77	60 - 71	54 - 63	50 - 59	46 - 55
Bulldozer	107	87 - 102	81 - 96	75 - 90	69 - 84	61 - 76	57 - 72	53 - 68
Generator	96	76	70	64	58	50	46	42
Crane	104	75 - 88	69 - 82	63 - 76	55 - 70	49 - 62	45 - 48	41 - 54
Loader	104	73 - 86	67 - 80	61 - 74	55 - 68	47 - 60	43 - 56	39 - 52
Grader	108	88 - 91	82 - 85	76 - 79	70 - 73	62 - 65	58 - 61	54 - 57
Dragline	105	85	79	73	67	59	55	51
Pile driver	105	95	89	83	77	69	65	61
Forklift	100	95	89	83	77	69	65	61

Source: Golden et al. 1979.
dBA = A-weighted decibels; ft = feet.

Closure activities could affect the occupational health of workers, but measures are in effect to ensure that hearing damage to workers does not occur. These measures include regulations contained within *Worker Protection Management for DOE Federal and Contractor Employees* (DOE O 440.1A) and *Occupational Noise Exposure* (29 CFR § 1910.95).

Worker protection against effects of noise exposure is provided when the sound levels exceed those established by the Occupational Safety and Health Administration. When workers are subjected to sound exceeding those limits, feasible administrative or engineered controls are used. If such controls fail to reduce sound levels to within the levels of the table, personal protective equipment (e.g., ear plugs) is provided and used to reduce sound levels to within the levels of the table.

B.5.1.12 *Minerals*

No changes to mineral resources would occur at LLNL under the No Action Alternative. The extent of NNSA land (including RHWM facilities) available for use by LLNL would remain the same.

B.5.1.13 *Traffic and Transportation*

No additional impacts to transportation would occur under the No Action Alternative. While the number of shipments would increase, the amount of material and waste per shipment would be well below (25 percent) the vehicle capacity. Waste shipments would range from 158 to 238 per year (see Table B.5.1.13–1). The addition of 5 new commuters to a site with 10,000 commuters would be negligible.

TABLE B.5.1.13–1.—*LLNL Annual Material Transportation Activities*

Activity	Existing Conditions	No Action Alternative
Material (annual shipments radioactive, chemical, and explosives)	470 shipments[a]/yr	540 shipments/yr
Waste (annual shipments includes hazardous and radioactive)	88 shipments[b]/yr	240 shipments/yr
Annual sanitary waste shipments	518 shipments[c]/yr (7 to 10 per week)	534 shipments/yr
Site-related traffic— total daily traffic (RHWM staff)	9,772 commuters (150 commuters)	10,081 commuters (160 commuters)

Source: LLNL 1992a, DOE 1999a, TtNUS 2003.
[a] Existing conditions take into account 1996-2003 data and 1992 EIS/EIR.
[b] Based on CY2002 data (range is provided to bound impact) and generation fates 1993-2001.
[c] Estimate based on 4,666 metric tons (FY2001) and an average 9 to 13 metric tons per truck.

B.5.1.14 *Materials and Waste Management*

Materials

The No Action Alternative would not cause any major changes in the types of materials used at the waste management facilities or throughout LLNL. Chemical usage at LLNL would increase, consistent with a 3 percent increase in LLNL operations. Continued application of pollution prevention and waste minimization techniques to future operations would offset a portion of the projected increase. Average maximum quantities would likely remain constant as material storage space remains constant; however, average quantities would be expected to increase to meet demand (Tables B.5.1.14–1 and B.5.1.14–2 provide estimates of chemical usage at the Livermore Site and Site 300, respectively. As these facilities engage in their missions, other chemicals could be added or quantities increased. Such changes would be reviewed against LLNL health and safety procedures and policies). Under the No Action Alternative, chemical material projections used for analysis would not exceed existing chemical material management capacities. No substantial or critical material shortages would occur. As reported in the 1999 Supplement Analysis, quantities of chemicals at LLNL declined by over 50 percent (DOE 1999a).

Similar increases in overall quantities of radioactive materials and explosive materials based on current administrative limits are expected. Under the No Action Alternative, radioactive material and explosive material requirements would not exceed existing material management capacities.

Waste Management

Implementation of the No Action Alternative would not cause any major changes in the types of waste streams generated onsite. Although increasing, waste generation levels over the next 10 years at LLNL would remain essentially consistent with recent generation quantities. Any increase would be consistent with increases from new operations and normal fluctuations experienced over the past 10 years with LLNL operations. Waste minimization and pollution prevention techniques would be expected to offset a portion of the projected increases. Onsite waste handling capacities are 4 to 5 times expected waste volumes. Waste projections used for analysis would not exceed existing offsite waste management disposal capacities.

For projection purposes, the CY1993–FY2002 routine waste generation data were considered a reasonable range for existing facilities; an average was used. The amount of waste generated would reflect proportional increases in LLNL activity levels over the next 10 years. New operations wastes would be derived from mission-related work. A margin was added in order to differentiate the No Action Alternative from the existing conditions and bound any operational increases. The waste quantities projected would represent a site-wide aggregate of quantities for each type of waste stream. Table B.3.1–2 presents estimated annual (routine) waste generation quantities by waste category.

Waste generation levels for special (nonroutine) program waste, such as for unused chemicals or laboratory closeout, are derived separately from CY1993–FY2002 nonroutine waste generation. The amount of waste generated is anticipated to reflect proportional increases or decreases in LLNL activity levels over the next 10 years. The waste quantities projected represent a site-wide aggregate of quantities for each type of waste stream. Table B.3.1–2 presents estimated annual (nonroutine) waste generation quantities by waste category.

TABLE B.5.1.14–1.—*Livermore Site Chemical Material Projections by Alternative*

Hazardous Material	Approximate Maximum	No Action	Proposed Action	Reduced Operation	Units
1,1,1,2-Tetrafluoroethane (Refrigerant 134A)	1,600	515	550	475	lb
1,1,1-Trichloroethane	220	72	77	67	gal
Acetic acid	500	103	110	95	gal
Acetone	1,200	762	814	703	gal
Acetonitrile	200	80	85	74	gal
Acetylene	83,000	61,800	66,000	57,000	ft^3
Acoustical Tile Adhesive	200	57	61	52	gal
Actrel 4493L Cleaner	170	170	182	157	gal
Aero Melamine	3,500	3,277	3,500	3,023	lb
Adhesive, Concresive Part B	330	57	61	52	gal
Air, Compressed	85,000	70,040	74,800	64,600	ft^3
Aluminum hydroxide	1,600	546	583	504	gal
Aluminum oxide (Alumina)	6,000	1,617	1,727	1,492	lb
Aluminum	5,000	824	880	760	lb
Ammonia, anhydrous	2,800	1,185	1,265	1,093	ft^3
Ammonium hydroxide	3,600	206	220	190	lb
Ammonium nitrate	2,000	515	550	475	lb
Antifreeze, coolant	260	82	88	76	gal
AQUA POWER, Cleaner/Degreaser	150	57	61	52	gal
Argon, compressed	25,000,000	164,800	176,000	152,000	ft^3
Asbestos Free Roof Cement	165	57	61	52	gal
Asphalt Emulsion-seasonal product	1,100	57	61	52	gal
Barrett SN	300	237	253	219	gal
Belsperse 161, Dispersant	6,500	3,090	3,300	2,850	lb
Beryllium	1,600	1,030	1,100	950	lb
Beryllium oxide	500	361	385	333	lb
Black Magic SS	200	57	61	52	lb
Boron	2,600	515	550	475	lb
Bright Plating solution	130	57	61	52	gal
Brulin MP 1793	200	103	110	95	gal
BSP Captor Solution	170	57	61	52	gal
Brulin 1990 GD	110	57	61	52	gal
Brulin SD 1290	70	57	61	52	gal
Bulls Eye 1-2-3 Primer/Sealer	750	57	61	52	gal
Buffer, 5XTBE	850	57	61	52	gal
Butyl alcohol (n-Butanol)	510	57	61	52	gal
Calcium chloride	3,200	1,597	1,705	1,473	lb
Calcium sulfate	1,300	716	765	660	lb
Carbon, activated	76,000	13,133	14,025	12,113	lb
Carbon dioxide	176,000	127,720	136,400	117,800	ft^3
Carbon monoxide	4,000	1,339	1,430	1,235	ft^3
Carbon tetrachloride	110	0	0	0	gal

TABLE B.5.1.14–1.—*Livermore Site Chemical Material Projections by Alternative (continued)*

Hazardous Material	Approximate Maximum	No Action	Proposed Action	Reduced Operation	Units
Celite 535	2,000	979	1,045	903	lb
Cement, Kast-o-lite	1,300	515	550	475	lb
Cerium oxide	1,300	618	660	570	lb
ChemTreat BL-1253	1,200	646	690	596	gal
ChemTreat BL-1302	1,000	381	407	352	gal
ChemTreat BL-1543	700	57	61	52	gal
ChemTreat BL-1776	1,000	144	154	133	gal
ChemTreat BL-1821	700	57	61	52	gal
ChemTreat CL-1467	700	57	61	52	gal
ChemTreat CL-2111	800	309	330	285	gal
ChemTreat CT9001-Antifoulant	55	52	55	48	gal
Chlorine	1,000	200	220	190	lb
Chloroform	220	85	91	78	gal
Chrome or Chromium	4,700	1,545	1,650	1,425	lb
Chromium(III) chloride	12	4	4	4	lb
Citric acid, anhydrous	1,600	412	440	380	lb
Cobalt	16,500	14,420	15,400	13,300	lb
Concresive Adhesive, Part A/B	330	57	61	52	gal
Concrete, FIXALL	600	412	440	380	lb
Cutting Fluid, Cool Tool (I & II)	390	70	74	64	gal
Copper sulfate, crystals & solution	1,100	515	550	475	lb
Cutting fluid, Aluminum A-9	100	93	99	86	gal
Cyanuric acid	2,500	515	550	475	lb
Dascool 2227	500	57	61	52	gal
DDO-19, Lubricating oil	500	57	61	52	gal
Delvac Motor oil	300	57	61	52	gal
DESMODUR	110	57	61	52	gal
Detergent, ND 150	300	57	61	52	gal
Diesel	30,000	10,300	11,000	9,500	gal
Diesel Fuel additive	55	52	55	48	gal
Dimethyl sulfoxide	220	57	61	52	gal
4,4'-Diphenylmethane diisocyanate	1,000	515	550	475	lb
DowTherm SR-1 30 Heat Transfer Fluid	110	57	61	52	gal
ELNIC 100 C-5	250	57	61	52	gal
ELNIC 100 RP-1	60	56	60	52	gal
ELNIC 100 RP-2	150	113	121	105	gal
Epolene Wax, Polyethylene, oxidized	110	57	61	52	gal
Ethyl alcohol	2,000	1,545	1,650	1,425	gal
Ethylene, compressed	5,700	1,082	1,155	998	ft^3
Ethylene glycol	500	196	209	181	gal
Ethyl silicate	150	57	61	52	gal
Ferric chloride, Iron chloride(III)	1,400	515	550	475	lb
Ferric sulfate	3,500	721	770	665	lb
Fertilizer, Pro-Turf 25-3-10	11,000	5,665	6,050	5,225	gal
Formula 12-L, Corrosion Inhibitor	110	57	61	52	gal
Freon 11 (Trichlorofluoromethane)	10,000	5,150	5,500	4,750	lb

TABLE B.5.1.14–1.—*Livermore Site Chemical Material Projections by Alternative (continued)*

Hazardous Material	Approximate Maximum	No Action	Proposed Action	Reduced Operation	Units
Freon 12 (Dichlorodifluoromethane)	6,300	4,120	4,400	3,800	lb
Freon 14 (Tetrafluoromethane)	2,500	515	550	475	ft^3
Freon 22 (Chlorodifluoromethane)	9,000	5,150	5,500	4,750	lb
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	17,0000	10,815	11,550	9,975	lb
Gasoline	24,000	22,473	24,000	20,727	gal
Gator Aid Mastic Patch	400	57	61	52	gal
Glass Cleaner, variety	2,300	206	220	190	gal
Glycerine	110	57	61	52	gal
Hafnium oxide	4,700	4,401	4,700	4,059	lb
Halocarbon 23	400	206	220	190	ft^3
Halon 1301 (Bromotrifluoromethane)	2,000	1,648	1,760	1,520	lb
Helium	5,000,000	309,000	330,000	285,000	ft^3
Herbicide, Ronstar	2,000	721	770	665	lb
Herbicide, Roundup	220	41	44	38	gal
Herbicide, Surflan	100	41	44	38	gal
Hexane	250	165	176	152	gal
Hydrochloric acid	600	412	440	380	gal
Hydrogen chloride (gas only)	varies	varies	varies	varies	
Hydrofluoric acid	1,500	876	935	808	lb
Hydrogen, compressed	1,500,000	51,500	55,000	47,500	ft^3
Hydrogen peroxide<52%	42,000	9,298	9,930	8,576	gal
Isopropyl alcohol	650	567	605	523	gal
Insulating Oil, Inhibiting	1,800	1,115	1,191	1,028	gal
Joint Compound, All purpose	45,000	12,463	13,310	11,495	lb
Kerosene (Naphtha Petroleum)	500	209	223	192	gal
Kodak Fixer & Replenisher	650	258	275	238	gal
Kohl and Madden Printing Ink	950	438	468	404	lb
Krypton, compressed	1,600	1,133	1,210	1,045	ft^3
Lead Bricks or ingots	1,000,000	936,364	1,000,000	863,636	lb
Lithium Grease	110	57	61	52	gal
Lithium Hydride	4,000	3,745	4,000	3,455	lb
Lubricating Oil	500	309	330	285	gal
Macro Brite L-7	220	113	121	105	gal
Magnesium chloride	6,000	515	550	475	lb
Manganese	3,500	3,090	3,300	2,850	lb
Metex L-5B	220	57	61	52	gal
Methane	100,000	30,900	33,000	28,500	ft^3
Methyl alcohol	1,800	515	550	475	gal
Methylene chloride	2,000	57	61	52	gal
Methyl ethyl ketone	400	57	61	52	gal
Mineral dust, Aquaset	10,000	4,635	4,950	4,275	lb

TABLE B.5.1.14–1.—*Livermore Site Chemical Material Projections by Alternative (continued)*

Hazardous Material	Approximate Maximum	No Action	Proposed Action	Reduced Operation	Units
Mineral oil	2,000	57	61	52	gal
Mineral spirits	400	57	61	52	gal
Modified Bitumen adhesive	350	206	220	190	gal
Neodymium oxide	25,000	4,300	4,593	3,966	lb
Neon, compressed	750,000	283,250	302,500	261,250	ft^3
Nickel	1,500	515	550	475	lb
Nickel chloride	80	72	77	67	gal
Nickel sulfate	220	113	121	105	gal
Nitric acid	7,810	3,502	3,740	3,230	lb
Nitric oxide	5,700	309	330	285	lb
Nitrogen, compressed (Liquified, gaseous)	38,000,000	9,336,950	9,971,500	8,611,750	ft^3
Nitrous oxide	4,000	1,236	1,320	1,140	ft^3
Oakite (Liqui-det)	80	57	61	52	gal
Oil, Diala AX	2,200	1,082	1,155	998	gal
Oil, DTE-24	700	453	484	418	gal
Oil, DTE-25	450	366	391	337	gal
Oil, DTE-26	2,000	412	440	380	gal
Oil, DTE, extra heavy	850	299	320	276	gal
Oil, DTE heavy	850	113	121	105	gal
Oil, DTE Medium	220	57	61	52	gal
Oil, Spindle	700	366	391	337	gal
Oil, Tellus, variety	275	57	61	52	gal
Oil, Vactra, variety	500	244	260	225	gal
Oil, Vacuum Pump fluid, variety	1,500	57	61	52	gal
Oil, Waste	2,500	1,030	1,100	950	gal
Oxalic acid	700	515	550	475	lb
Oxygen, compressed	870,000	77,250	82,500	71,250	ft^3
OzzyJuice SW3, Cleaner/Degreaser	300	57	61	52	gal
Paint (variety)	700,000	329,905	352,326	304,281	lb
Perchloroethylene (Tetrachloroethylene)	250	57	61	52	gal
Phosphoric acid	3,600	1,030	1,100	950	lb
Potassium chloride	3,500	682	729	629	lb
Potassium hydroxide	15,000	412	440	380	lb
Potassium Phosphate, Monobasic	10,000	2,060	2,200	1,900	lb
Potassium silicate	1,100	515	550	475	lb
Power Plus, Cleaner & Degreaser	110	57	61	52	gal
Printing Ink, variety	1,000	876	935	808	lb
Propane	45,000	1,030	1,100	950	gal
n-Propanol	80	57	61	52	gal
Refrigerant, 123 SUVA, (2,2-dichloro-1,1,1-trifluoroethane)	35,000	1,545	1,650	1,425	lb
Purechlor Sanitizer/Sodium hypochlorite/Bleach	3,600	927	990	855	gal
Refrigerant 406A	720	598	639	552	lb
Rough Rider Emulsion Degreaser	110	57	61	52	gal

TABLE B.5.1.14–1.—*Livermore Site Chemical Material Projections by Alternative (continued)*

Hazardous Material	Approximate Maximum	No Action	Proposed Action	Reduced Operation	Units
Rubinate fluid	110	57	61	52	gal
Sanding Sealer	200	93	99	86	gal
sec-Butanol	130	122	130	112	gal
Shur-Stik Wall Covering Adhesive	110	57	61	52	gal
Silane, compressed	2,100	206	220	190	ft^3
Silicon carbide	3,200	515	550	475	lb
Silicone Transformer Fluid/Dow	700	170	182	157	gal
Simple Green Degreaser	140	57	61	52	gal
Sodium bicarbonate	3,600	515	550	475	lb
Sodium cyanide	250	103	110	95	lb
Sodium chloride	3,200	824	880	760	lb
Sodium hydroxide	25,500	14,420	15,400	13,300	lb
Sodium hypochlorite (Bleach)	12,000	1,030	1,100	950	gal
Sodium nitrate	1,500	361	385	333	lb
Solvent AZ-EBR	165	57	61	52	gal
Solvent GR7	110	57	61	52	gal
Spill clean-up kit, Acids	1,600	515	550	475	lb
Spill clean-up kit, Caustic	1,000	515	550	475	lb
Spill clean-up kit, Solvent	710	515	550	475	lb
Sterigent cleaner	330	57	61	52	gal
Strontium phosphate	1,400	361	385	333	lb
Sulfur hexafluoride, compressed	25,000	10,300	11,000	9,500	ft^3
Sulfuric acid	11,000	4,635	4,950	4,275	lb
Super Dropout	1,590	870	930	803	lb
Suva MP39 (R401A)	800	618	660	570	lb
Suva MP66 (R401B)	180	169	180	155	gal
Tantalum	75,000	20,600	22,000	19,000	lb
Tantalum oxide blend	17,000	8,755	9,350	8,075	lb
Tartaric acid	1,500	412	440	380	lb
Thinner, Lacquer	3,000	515	550	475	gal
Toluene	480	309	330	285	gal
TPX	800	749	800	691	lb
Transmission fluid, Dexron II (ATF)	220	57	61	52	gal
Trichloroethylene	350	170	182	157	gal
Trim Clear	110	57	61	52	gal
Trim Sol, coolant	660	170	182	157	gal
Tungsten	2,500	515	550	475	lb
Ultra NZ, Floor Wax	varies	varies	varies	varies	
Voranol	110	57	61	52	gal
Wax, Floor	300	281	300	259	gal
Wollastonite	1,500	258	275	238	lb
Xenon, compressed	2,000	515	550	475	ft^3
ZEP Formula 50	110	57	61	52	gal
Zirconium carbonate	650	155	165	143	lb

TABLE B.5.1.14–1.—*Livermore Site Chemical Material Projections by Alternative (continued)*

Hazardous Material	Approximate Maximum	No Action	Proposed Action	Reduced Operation	Units
Estimated Totals					
Liquids	230,000	70,000	75,000	65,000	gal
Solids	2,400,000	1,400,000	1,500,000	1,300,000	lb
Gas	72,000,000	11,000,000	11,000,000	9,700,000	ft^3

Source: TtNUS 2003.
ft^3 = cubic feet, gal = gallons, lb = pounds.

TABLE B.5.1.14–2.—*Site 300 Chemical Material Projections by Alternative*

Hazardous Material	Approximate Maximum	No Action	Proposed Action	Reduced Operation	Units
2,2-Dinitropropanol in EDC	275	258	275	238	gal
Acetone	400	31	33	29	gal
Acetylene	10,000	7,725	8,250	7,125	ft^3
Activated Carbon	20,000	15,450	16,500	14,250	lb
Air	28,000	12,875	13,750	11,875	ft^3
Alcoa Atomized Powder	3,000	2,060	2,200	1,900	lb
Ammonium Perchlorate	760	712	760	656	lb
Argon	30,000	28,091	30,000	25,909	ft^3
Asphalt Emulsion	300	206	220	190	gal
Auto Transmission Fluid (including Dextron)	400	309	330	285	gal
BT-500	120	28	30	26	gal
Bacticide Solution	220	57	61	52	gal
n-Butyl Acetate	55	52	55	48	gal
Calla Soap	165	57	61	52	gal
Carbon Dioxide	44,000	5,150	5,500	4,750	ft^3
Cast Iron, Shot (Chips)	6,000	5,618	6,000	5,182	lb
Chlorine	2,250	1,545	1,650	1,425	lb
Cleaner, Degreaser, Big Orange	110	57	61	52	gal
Cleaner, Butcher's Hot Springs	55	52	55	48	gal
Cleaner, Degreaser, Clean-Way II	110	57	61	52	gal
Cleaner, Degreaser, Ozzy Juice SW-3	330	113	121	105	gal
Coating, Acrylic Terpolymer	244	93	99	86	gal
Coating, Polytherm, FP-576	220	57	61	52	gal
Coating, Polyurethane, Vulkem 350, Gray	60	56	60	52	gal
Coating, Polyurethane, Vulkem 351, Gray	110	57	61	52	gal
Coating, Roof, Acrylic	2,500	515	550	475	gal
Condensate wastewater	4,500	3,708	3,960	3,420	gal
Cyanuric Acid	500	52	55	48	lb
Diesel	12,000	10,300	11,000	9,500	gal
Dimethyl Sulfoxide	400	57	61	52	gal
Ethyl Acetate	100	31	33	29	gal
Ethyl Alcohol	56	52	56	48	gal
Ethylene Glycol	200	103	110	95	gal
FEFO SOL (in methylene chloride)	1,100	430	459	397	gal
Floor wax	165	113	121	105	gal

TABLE B.5.1.14–2.—*Site 300 Chemical Material Projections by Alternative (continued)*

Hazardous Material	Approximate Maximum	No Action	Proposed Action	Reduced Operation	Units
Freon 12	660	227	242	209	lb
Freon 13	478	448	478	413	ft^3
Freon 22	1,400	896	957	827	lb
Freon 113 (Freon, TF)	150	113	121	105	gal
Gasoline	15,000	14,045	15,000	12,955	gal
Glycerine	165	155	165	143	gal
Helium	25,000	25,750	27,500	23,750	ft^3
n-Hexane	220	227	242	209	gal
High Explosives	100,000	10,300	11,000	9,500	lb
Honing Oil	110	57	61	52	gal
Hydrogen	700	655	700	605	ft^3
Isoamyl alcohol	55	52	55	48	gal
Isopropyl alcohol	300	103	110	95	gal
Kerosene	160	85	91	78	gal
Krovar I DF Herbicide	2,000	515	550	475	lb
Lacquer Thinner	110	36	39	33	gal
Lead (bricks, ingots)	25,000	5,150	5,500	4,750	lb
Lubricant, Synthetic Summit/Vactra,etc.	330	170	182	157	gal
Methane	3,000	1,545	1,650	1,425	ft^3
Methyl alcohol	90	5	6	5	gal
Methyl Ethyl Ketone	100	5	6	5	gal
Mixed Gas, Freon 502	500	206	220	190	ft^3
Mixed Gas, Freon 503	500	206	220	190	ft^3
Mixed Gas, Compressed, Not Otherwise Specified (non-hazardous)	1,000	936	1,000	864	ft^3
Mixed gas, TCE/Nitrogen	7,400	129	138	119	ft^3
Nalco-71-D5	165	57	61	52	gal
Nalco-2508	110	57	61	52	gal
Nalco-2536	55	52	55	48	gal
Nalco-2593	55	52	55	48	gal
Nalco-2802	110	57	61	52	gal
Nalco-2833	55	52	55	48	gal
Nalco-2858	200	57	61	52	gal
Nalco-2896	450	258	275	238	gal
Nitrogen	312,000	288,400	308,000	266,000	ft^3
Nitroplasticizer	175	113	121	105	gal
N-Octane	55	52	55	48	gal
Oil, Crankcase, 76 Guardol QLT 30	220	57	61	52	gal
Oil, Hydraulic (DTE, Unocal, CITGO, 76 UNAX AW32)	1,400	721	770	665	gal
Oil, Inhibited Insulating	25,000	5,150	5,500	4,750	gal
Oil, Mineral	220	57	61	52	gal
Oil, Motor (all weights)	650	412	440	380	gal
Oil, Shell Oil Tellus 23	110	57	61	52	gal

TABLE B.5.1.14–2.—*Site 300 Chemical Material Projections by Alternative (continued)*

Hazardous Material	Approximate Maximum	No Action	Proposed Action	Reduced Operation	Units
Oil, Transformer, Shell Diala-AX/Equivalent	15,000	14,045	15,000	12,955	gal
Oil, Turbine (Extra Heavy, HD 92)	110	57	61	52	gal
Oil, Vacuum Pump	330	57	61	52	gal
Oil, Vitrea 100	55	52	55	48	gal
Oil, Waste	1,000	113	121	105	gal
Oxygen	16,000	5,150	5,500	4,750	ft^3
Paint, acrylic (e.g., semi-gloss)	600	103	110	95	gal
Paint, Street Markings	300	57	61	52	gal
Paint Spray Wastewater	1,200	618	660	570	gal
Pentane	85	80	85	73	gal
Petroleum ether	220	57	61	52	gal
Photo wastes	400	113	121	105	gal
Polyol	120	57	61	52	gal
Propane	20,000	8,240	8,800	7,600	ft^3
Red line 85 Plus & 85 Plus Winterized fuel additive	55	28	30	26	gal
Retention Tank Waste	varies	varies	varies	varies	
Roundup herbicide	100	93	99	86	gal
Sodium bicarbonate	550	304	325	280	lb
Sodium chloride	7,400	103	110	95	lb
Sodium hypochlorite/Purechlor Sanitizer/bleach	500	113	121	105	gal
Sodium nitrate	1,000	420	449	388	lb
Steam Cleaning Solution/Split Equipment Cleaner	3,000	1,236	1,320	1,140	gal
STIK-IT Asphalt Base Seal	560	209	223	192	gal
Stoddard solvent/paint thinner	200	62	66	57	gal
Sulfur hexafluoride	19,500	7,931	8,470	7,315	ft^3
Sulfuric Acid	845	62	66	57	lb
Toluene	220	5	6	5	gal
Triacetin	65	2	2	2	gal
Tufflo Process Oil	55	52	55	48	gal
Estimated Totals					
Liquids	94,000	56,000	60,000	52,000	gal
Solids	170,000	43,000	46,000	40,000	lb
Gas	520,000	390,000	420,000	360,000	ft^3

Source: TtNUS 2003.
ft^3 = cubic feet; gal = gallons; lb = pounds.

All Other Wastes

LLNL operations also involve the four additional waste management activity areas discussed below.

Biohazardous (includes Medical Waste Management Act) Waste

In 2001 and 2002, several hundred kilograms of biohazardous waste were generated, treated, and disposed of at an approved offsite facility. Under the No Action Alternative, biohazardous waste generation would range from 0 to 1 metric ton (most years would be 0.1 to 0.3 metric ton). The existing waste handling capabilities would be adequate to accommodate this waste. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient.

Construction and D&D

The construction of the 100,000 to 200,000 square feet of new facilities at LLNL (no new RHWM facilities) would generate 200 to 400 metric tons of construction debris.

In the past during D&D, LLNL would potentially generate hazardous waste including TSCA waste and radioactive waste including mixed. However, the planned D&D work under the No Action Alternative would directly affect the quantity of sanitary/solid waste and TSCA waste requiring disposal (including RCRA closures of Building 233 CSU, 280, 513, and 514). In the case of RCRA closure at the Building 514 complex, the potential for generating a mixed waste is possible. LLNL would generate building debris, primarily concrete, wood, metal, and other building materials. LLNL would generate TSCA waste, primarily PCBs and asbestos, that would be removed from transformers and buildings. Assuming that up to 255,000 square feet of facilities site-wide would be removed, D&D activities would generate 4,200 metric tons of debris over 10 years. It is estimated that only 350 metric tons would be LLW, MLLW, and hazardous wastes. Much of the debris would be diverted (recycled, reclaimed, reused) based on historical data.

Under the No Action Alternative, routine and nonroutine maintenance and repair projects would occur over the next 10 years. Assuming LLNL would require 2 to 5 percent annual reinvestment and maintenance wastes are proportional to all wastes, routine and nonroutine maintenance and repair projects would generate 90 to 200 metric tons per year of debris.

Environmental Restoration Waste

Site-wide environmental restoration waste generation trends at LLNL would generally remain a function of treatment units, the number of wells, and the number of hours of operation. No appreciable onsite impacts to treatment facilities would occur because existing waste handling capabilities are already in place.

Wastewater

Wastewater would increase to approximately 310,000 gallons per day. Sufficient capacity would remain.

B.5.1.15 *Utilities and Energy*

All utility and energy systems would operate within existing capacity. All waste management activities at the Livermore Site and Site 300, would continue to use less than 5 percent of all utility and energy system's annual projections for the next 10 years, as presented in Table B.5.1.15–1 (TtNUS 2003).

TABLE B.5.1.15–1.—*No Action Alternative Annual LLNL Utility and Energy Systems*

Utility System	RHWM Usage	Total LLNL Usage including RHWM	Current Capacity	Remaining Capacity (percent)
5ESS Telecomm. Switch	(voice lines)	18,973[a]	20,384	7
Telecomm. Dist. System:				
Copper Trunk Cables	(pairs)	20,330[a]	46,800	57
(B256 to 13 nodes)				
Fiber Trunk Cables	40	1512	2,368	36
Copper Distribution	2,657	99,000	115,158	14
(Nodes to buildings)				
Network Speed to Desktop	10 Mbps	10 Mbps	10 Mbps	N/A
Electricity	1.5 MW	82 MW	125 MW	47
Natural Gas	571 therms/day	23,600 therms/day	24,500 therms/day	7
Domestic Water	0.04 gal/day	1.4 gal/day	2.88M gal/day	51
Low Conductivity Cooling Water	1 MW	37.6 MW	70.2 MW	46
Demineralized Water	N/A	28,500 gal/day	50,400 gal/day	43
Sanitary Sewer	8,240 gal/day	224,000 gal/day	1,685,000 gal/day	83
Compressed Air	74 SCFM	2,472 SCFM	4,090 SCFM	40

Source: LLNL 2002dm, TtNUS 2003.
[a] Assumes current capacity is sufficient to accommodate staffing increases.
gal/day = gallons per day; Mbps = megabits per second; MW = megawatts; N/A = not applicable; SCFM = standard cubic feet per minute.

B.5.1.16 *Occupational Protection*

Table B.5.2.16–1 provides estimates of the number of total reportable cases (TRCs) and low work day cases (LWCs) that could occur under the No Action Alternative. The projected injury rates are based on average historic LLNL injury rates over a 3-year period from 1999 through 2001 (DOE 2001c). These rates were then multiplied by the projected employment levels for each alternative to calculate the number of TRCs and LWCs under each of the No Action Alternative, Proposed Action, and Reduced Operation Alternative. The TRC value includes work-related death, illness, or injury that resulted in loss of consciousness, restriction from work or motion, transfer to another job, or required medical treatment beyond first aid. The data for LWCs represent the number of workdays beyond the day of injury or onset of illness that the employee was away from work or limited to restricted work activity because of an occupational injury or illness.

The DOE expects minimal worker radiological health impacts from the LLNL activities under the No Action Alternative. The values for the No Action Alternative were calculated assuming the number of radiation workers and their average annual radiation dose would be the same as the average values for the past 3 years (Table B.5.1.16–2). Table B.5.1.16–2 presents estimated radiation doses for the collective population of workers who would be directly involved in implementing the No Action Alternative, Proposed Action, and Reduced Operation Alternative as well as latent cancer fatalities (LCFs) likely attributable to these doses.

The estimated number of LCFs listed in Table B.5.1.16–2 for the No Action Alternative can be compared to the projected number of fatal cancers from all causes. Population statistics indicate that cancer caused 23 percent of the deaths in the U.S. in 2000. If this percentage of deaths from cancer continues, 23 percent of the U.S. population would contract a fatal cancer from all causes. Thus, in the population of 1,000 workers, 230 persons would be likely to contract fatal cancers from all causes. Under the No Action Alternative, the incremental impacts from LLNL operations would be small.

TABLE B.5.1.16–1.—*Estimated Occupational Safety Impacts to LLNL Workers for the No Action Alternative*

Worker Safety Parameters	No Action Alternative
Workforce –	10,900
Total (RHWM)	(160)
Total recordable cases of accident or injury –	400
Total (RHWM)	(5.9)
Lost workday cases –	110
Total (RHWM)	(1.6)

Source: TtNUS 2003, DOE 2002l.

TABLE B.5.1.16–2.—*Estimated Radiological Dose and Health Impacts to RHWM Workers for the No Action Alternative (Based on 3-Year Average)*

Health Impact	No Action Alternative
Collective involved worker	0.48[a]
Estimated increase in number of LCFs	2×10^{-4}

Source: DOE 2001c.
[a] Estimated level on RHWM facilities workforce represented less than 3 percent of all LLNL involved workers.
Note: Data for individual divisions within LLNL (for example SEP Directorate) are NR. Organization numbers for LLNL personnel sometimes change due to work changes or corporate reorganizations. During any 3-month period, monitored personnel may change organizations one or more times.

B.5.1.17 *Site Contamination*

Soil and groundwater contamination at LLNL occurred as the result of past operations. The cleanup of these soils and groundwater would continue and would meet the health risk-based standards corresponding to the intended future uses of the site. At this time, analyses indicate no significant risk to the general public (LLNL 2002cc).

As of 2001, LLNL operated 30 treatment facilities: 28 groundwater treatment facilities and 2 VTFs. A total of nearly 80 groundwater extraction wells operated at an average flow rate of 2,540 liters per minute. A total of two vapor extraction wells operated at an average flow rate of 670 cubic meters per minute. At present, eight CERCLA environmental restoration (ER) Operable Units (OUs) are being managed to mitigate contamination at Site 300. These OUs are the GSA, the Building 834 Complex, the High Explosive Process Area, Building 850/Pits 3 and 5, Building 854 Pit 6, Building 832 Canyon, and Site 300. As of 2001, LLNL operated 10 treatment facilities at Site 300: 3 groundwater and soil vapor extraction systems and 7 portable treatment facilities. In 2001, 19 wells that extract only groundwater, 7 wells that extract only soil vapor, and 24 wells that extract both were in operation. The state, NNSA, and LLNL would continue to discuss remediation, investigation, monitoring, and potential cleanup activities, as necessary (LLNL 2002cc).

With the RCRA closure of Buildings 513, 514, 280, and 233 CSU; the associated treatment equipment; and the consolidation of waste management operations into DWTF, the potential for soil and groundwater contamination from any LLNL waste management operations would be reduced. Also, where hazardous materials (including wastes in SAAs and WAAs) are handled at LLNL, administrative and engineering controls are in place to minimize the potential for soil and ground contamination from any LLNL operations.

B.5.2 Proposed Action

The Proposed Action would involve continuing waste management operations, increasing DWTF use, and implementing several additional permit modifications (see Table B.3–3). Waste generation at LLNL would be expected to increase over the next 10 years (see Table B.3–2). Over the next 10 years, approximately 100 Class 1 permit modifications, 20 Class 2 permit modifications, 2 Class 3 (see Table B.3.2–1 for a range of possible permit modifications) and one permit renewal would occur. Building 696 would begin operations as a Part B-permitted facility. Closure of several RCRA waste management facilities would begin.

The following sections discuss these resource areas in relation to the No Action Alternative.

B.5.2.1 *Land Use and Applicable Plans*

Implementing the Proposed Action would not affect the existing land-use patterns or applicable plans at LLNL RHWM facilities. No changes to land use or applicable plans would occur at LLNL under the Proposed Action. The extent of DOE land available for use by LLNL would remain the same. As with the No Action Alternative, the DWTF operation would increase to meet waste volumes and increases resulting from transferring these existing capabilities and closures (Buildings 513, 514, 280, and 233 CSU):

Operating the existing Building 696 (currently radioactive waste only) as a RCRA Part B-permitted facility would remain consistent with existing operations at the DWTF complex and further consolidate existing capabilities, patterns, or requirements. Permitted treatment and storage operations would be transferred to Building 696 are described in Section B.3.2.

The completion of 100 Class 1 permit modification requests over the next 10 years in support of LLNL waste operations would remain consistent with existing RHWM facility uses and would have no foreseeable effects on established land-use patterns or requirements.

The completion of 20 Class 2 and 2 Class 3 permit modifications over the next 10 years in support of LLNL waste operations would remain consistent with existing RHWM facility uses and would have no foreseeable effects on established land use patterns or requirements.

B.5.2.2 *Socioeconomic Characteristics and Environmental Justice*

The implementation of the Proposed Action would result in small changes to the economic and demographic characteristics, as discussed below.

The Proposed Action would change the economic base by 5 percent over the No Action Alternative because LLNL (including the RHWM workforce) employment levels and associated activities would increase by 5 percent. Under the Proposed Action, the RHWM workforce would increase to 170 (less than one hundredth of one percent of the region). Additionally, the Proposed Action would have a small effect on the amount of expenditures for goods and services in the local and regional economy. The estimated annual operating budget would increase by approximately 10 percent over the No Action Alternative to $1.7 billion (see Table B.3–2). These increases (less than one hundredth of one percent of the region) would not likely result in any noticeable change with overall regional expenditures and employment remaining relatively constant.

The Proposed Action would not likely result in any noticeable change in existing demographic characteristics. Overall expenditures and employment at LLNL, while increasing slightly through 2014, would tend to maintain demographic characteristics within the region. RHWM contribution would be very small.

The Proposed Action would have no discernible adverse impacts to land and visual resources, water resources, biological and ecological resources, cultural resources, air quality, infrastructure, transportation, waste generation, noise, or socioeconomics. Thus, no disproportionately high and adverse impacts to minority or low-income communities are anticipated.

As presented in Section B.5.1.16, LLNL operations would have minimal potential to adversely affect human health for offsite residents or onsite workers. Thus, no disproportionately high and adverse impacts to minority or low-income communities would be anticipated for this resource area.

Based on the analyses of all the resource and topic areas, impacts that would result during the course of normal operations would not pose disproportionately high and adverse health or environmental impacts on minority and low-income populations.

B.5.2.3 *Community Services*

The implementation of the Proposed Action would result in no changes to the community services, as discussed below.

The Proposed Action would not likely result in any noticeable change in community services. Overall expenditures and employment at LLNL (including RHWM) would increase slightly through 2014 and would tend to maintain levels of service. Contributory effects from other industrial and economic sectors within the region should reduce or mask LLNL's current proportional impact.

Nonhazardous solid waste generated at the Livermore Site would continue to be transported to the Altamont Landfill for disposal. The landfill is estimated to have sufficient capacity to receive waste until the year 2038 (Hurst 2003). The current total daily permitted throughput is 11,150 tons (SWIS 2002). Under the Proposed Action, approximately 5,100 metric tons per year of solid sanitary waste would be collected and transported to the Altamont Landfill.

B.5.2.4 *Prehistoric and Historic Cultural Resources*

Under the Proposed Action, no waste management facility construction would occur. Some maintenance activities that require ground disturbance could result in the discovery of buried archaeological resources. Because the level of operations would be increased, the amount of maintenance activity would be greater, thereby increasing the likelihood of impacting archaeological resources through these activities. If any such activities occurred in Sensitive Areas II, III, or IV at Site 300, the LLNL archaeologist would be contacted prior to conducting the maintenance activity to determine how to proceed in compliance with the Programmatic Agreement (Appendix G). Previous notification to the archaeologist would not be required for maintenance activities at the Livermore Site. If any resources are discovered during the activities at the Livermore Site or Site 300, the LLNL archaeologist would be notified and work would stop within the immediate vicinity until the archaeologist has assessed the discovery.

Buildings 233 CSU, 280, 513, and 514 would undergo RCRA closure under this alternative. These buildings have not been evaluated for eligibility to the National Register. Per the Programmatic Agreement, these buildings would undergo evaluation for eligibility prior to initiation of closure activities. If a building is evaluated as eligible, then a determination of the effect to the building from the closure activities would be made by NNSA. If it is determined that an adverse effect would occur, then measures would be developed to avoid, reduce, or mitigate the effect to the building.

The DWTF and Area 612 Complex, located at the Livermore Site, would be modified under the Proposed Action. At Site 300, the EWTF, EWSF, and Building 883 would be modified. None of these buildings or facilities has been evaluated for eligibility to the National Register. Prior to modification activities taking place, these buildings would undergo the same process of evaluating eligibility, determining effect, and developing measures to avoid, reduce, or mitigate adverse effect as discussed above for buildings undergoing RCRA closure.

Under this alternative, 100 Class I permit modifications, 20 Class II permit modifications, and 2 Class III permit modifications would be completed. If any of the modifications would result in ground disturbing activity or modifications to eligible or potentially eligible buildings or structures, then the permit modification would require review by the LLNL archaeologist. This is more likely for the Class II and III permit modifications.

B.5.2.5 *Aesthetics and Scenic Resources*

The Proposed Action would not adversely change the overall appearance of the existing landscape, obscure views, increase the visibility of LLNL structures, or otherwise detract from the scenic views from the Livermore Site or Site 300 or from areas adjacent to the sites. Modifications to the DWTF, RCRA closures, and other changes would have no impact on visual resources.

B.5.2.6 *Agriculture*

No changes to potential agriculture resources would occur at LLNL under the Proposed Action. The extent of NNSA land (including RHWM facilities) available for use by LLNL would remain the same.

B.5.2.7 *Geologic Resources and Hazards*

No impacts to general geology and geologic resources are anticipated. Impacts from geological hazards (seismicity, slope failure) are evaluated below. Risks from contaminated soils are also discussed.

Seismology

Strong earthquake ground motion is responsible for producing almost all damaging effects of earthquakes, except for surface-fault rupture. Ground shaking generally causes the most widespread effects, not only because it occurs at considerable distances from the earthquake source, but also because it may trigger secondary effects from ground failure and water inundation. Potential sources for future ground motion at the LLNL include the major regional faults (see Section B.4.8).

Seismic hazard analyses have been performed for the LLNL. Existing facilities continue to be upgraded or replaced to the extent possible. As described in the permit application, the DWTF and Area 612 were designed to higher seismic standards than the older facilities expected to undergo RCRA closure. Larger earthquakes on more distant faults such as the San Andreas do not significantly affect the hazard estimation for LLNL.

Structure

At the Livermore Site, there is little potential for slope instability because the site is situated on nearly flat topography. At Site 300, the areas around the RHWM facilities include hillsides. The hillsides surrounding this area consist of moderately to weakly consolidated sand and gravel and colluvial and alluvial terrace deposits. The hills have evidence of mass movement. There is an increased chance of slope failure during wet years at the hillsides in the vicinity of the waste management facilities; however, slope failure at these locations would have no effect on LLNL RHWM facilities.

Soils

Implementation of the Proposed Action would have no impacts because no new RHWM facilities would be constructed. Operating Building 696 under a RCRA Part B permit would have no impacts since Building 696 already operates as a radioactive waste facility within the DWTF complex. As with the No Action Alternative, relocating operations to the DWTF and the clean RCRA closures of Buildings 513, 514, 280, and 233 CSU would not disturb any clean soils and would remove the potential for site contamination.

B.5.2.8 *Ecology*

Under the Proposed Action, increasing DWTF operations as described in the permit, permit modifications, and the transition plan would not affect any of the biological resources considered in this appendix; because, with the exception of the RCRA closures, changes would not entail any changes to the physical environment. As with the No Action Alternative, the RCRA closures of Buildings 513, 514, 280, and 233 CSU (including demolition) would remove structures from the site; however, no changes in the existing environment would impact biological resources. No indirect impacts would because no runoff materials would affect sensitive habitats because runoff would be collected and analyzed and disposed of appropriately.

B.5.2.9 *Air Quality (Including Conformity Analysis)*

Radiological Air Emissions

The Proposed Action would continue to have several RHWM facilities as radiological point sources and diffuse sources of emissions. Based on a projected site-wide increase of radioactive waste generation, radiological emissions would increase proportionally above the existing conditions. Comparison of the Proposed Action to the existing conditions and the No Action Alternative shows that LLNL projects radiological emissions dose to the MEI would remain less than one millirem per year. Radiological emissions would be within all applicable standards.

Nonradiological Air Emissions

Under the Proposed Action there would continue to be eight RHWM nonexempt emission sources. Based on a projected site-wide staff increase of 5 percent, traffic emissions would increase 5 percent above the No Action Alternative. Comparing the Proposed Action air toxic emissions with Bay Area air toxic emissions shows that LLNL projects toxic emissions would be less than one percent of those for the Bay Area. D&D activities (including RCRA closures) at LLNL could have short-term adverse impacts due to emissions of criteria air pollutants from construction worker traffic, construction equipment, and fugitive dust from earth-moving activities. The fugitive dust from these activities could exceed PM_{10} concentration standards if no dust control measures were implemented. However, engineered controls, such as the application of water or chemical dust suppressants and seeding of soil piles and exposed soils, would minimize fugitive dust. It is expected that PM_{10} concentrations would be within all applicable standards.

The estimated number of daily commuter vehicles to LLNL during FY2002 was 7,500 to 8,500 (RHWM commuters represented 170 commuters). Under the Proposed Action, a 5-percent increase in daily commuter traffic would occur. Increases of carbon monoxide and nitrogen oxides, an ozone precursor, would occur with the increase in commuter traffic. However, the EPA model considers that future vehicles will have lower emission rates and more stringent inspection and maintenance programs; actual emissions would be less than the model baseline. In addition, the BAAQMD vehicle buyback program, designed to remove older vehicles from the road, will continue and contribute to the reduction in commuter vehicle emissions. In addition, the total carbon monoxide emissions for the Proposed Action were found to be less than 1 percent of the maintenance area's emissions of carbon monoxide.

B.5.2.10 *Water*

Under this alternative, LLNL would continue to monitor groundwater quality at numerous locations throughout the Livermore Site and Site 300. Past measurements indicate that some contaminants at various sites have periodically exceeded the MCLs in Federal drinking water standards (40 CFR Part 141). However, concentrations at these sites (including RHWM facilities) would continue to decrease over time (LLNL 2002cc).

LLNL RHWM facilities do not use groundwater for any portion of their water supply; therefore, no effects to groundwater quantity would be anticipated under the Proposed Action.

During storm events at LLNL RHWM facilities, including the DWTF, stormwater runoff is collected, sampled, and managed through the sewer system as appropriate. The current LLNL stormwater runoff monitoring program includes visually monitoring all facility discharge locations onsite annually and during storm events and sampling 10 Livermore Site and 7 Site 300 locations. These samples are the best available indicators of what contaminant(s) could reasonably be transported offsite. No regulatory limits have been set for pollutants in stormwater runoff. During the most recent sampling, no pollutants were detected at levels that would be a cause for concern. No effects to stormwater compliance would be anticipated under the Proposed Action.

Under the Proposed Action, only minor net changes in building and parking lot areas would be anticipated. Annual variation in LLNL surface runoff would occur with variations in rainfall quantity and intensity and declining capability. However, no overall impact to surface water quantity from activities under the Proposed Action would be anticipated.

B.5.2.11 *Noise*

Under the Proposed Action, ongoing waste management activities at LLNL would increase above current levels as reflected in current NNSA management plans. This includes any activities that have been approved by the NNSA and have existing NEPA documentation but have not begun.

The Proposed Action includes the background noise levels presented for the affected environment in Section B.4.12 and noise from the following additional activities:

- Increasing DWTF operations
- RCRA closure of Buildings 513, 514, 280, and 233 CSU (same as No Action)
- Increasing traffic (workforce and shipments)

The acoustical environment in and around LLNL could be impacted during implementation of these proposed activities.

Increasing DWTF operations under this alternative would have a negligible effect on background noise levels. The DWTF is only one facility of over 500 buildings at LLNL. Local worker and waste transportation traffic would contribute to the ambient noise in the area. However the addition of 10 RHWM commuters to the Livermore Site with over 10,000 commuters would be negligible.

As with the No Action Alternative, RCRA closure activities would generate noise produced by heavy construction equipment, trucks, and power and percussion tools. In addition, traffic would increase onsite and offsite along regional transportation routes used to bring equipment and workers to the site. The noise levels would be representative of levels at large-scale building sites.

B.5.2.12 *Minerals*

No changes to mineral resources would occur at LLNL under the Proposed Action. The extent of NNSA land (including RHWM facilities) available for use by LLNL would remain the same.

B.5.2.13 *Traffic and Transportation*

Traffic and material and waste transportation activities would increase under this alternative. Waste shipments would range from 205 to 308 per year. The overall impact of activities presented in Table B.5.2.13–1 would be minimal given the current traffic estimates for the region.

TABLE B.5.2.13–1.—*LLNL Annual Material Transportation Activities*

Activity	No Action	Proposed Action
Material (annual shipments radioactive, chemical, and explosives)	540 shipments/yr	600 shipments/yr
Waste (annual shipments includes hazardous and radioactive)	240 shipments/yr	310 shipments/yr
Annual sanitary waste shipments	534 shipments/yr	570 shipments/yr
Site-related traffic — Total daily traffic (RHWM staff)	10,081 commuters (160 commuters)	10,772 commuters (170 commuters)

Source: LLNL 1992a, DOE 1999a, TtNUS 2003.

B.5.2.14 *Utilities and Energy*

All utility and energy systems would operate within existing capacity. The Safety and Environmental Protection Directorate, which manages all waste management activities at the Livermore Site and Site 300, would continue to use less than 5 percent of the utility and energy systems projections for the next 10 years as presented in Table B.5.2.14–1 (TtNUS 2003).

TABLE B.5.2.14–1.—*Proposed Action LLNL Utility and Energy Systems*

Utility System	RHWM Usage	Total LLNL Usage (including RHWM)	Current Capacity	Remaining Capacity (Percent)
5ESS Telecomm. Switch	556 (voice lines)	18,973[a]	20,384	7
Telecomm. Dist. System:				
Copper Trunk Cables (B256 to 13 nodes)	596 (pairs)	20,330[a]	46,800	57
Fiber Trunk Cables	43	1,615	2,368	32
Copper Distribution (Nodes to buildings)	284	107,000	115,158	7
Network Speed to Desktop	10 Mbps	10 Mbps	10 Mbps	NA
Electricity	1.7 MW	82 MW	125 MW	50
Natural Gas	611 therms/day	23,000 therms/day	24,500 therms/day	6
Domestic Water	0.04M gal/day	1.5M gal/day	2.88M gal/day	48
Low Conductivity Cooling Water	1 MW	40.2 MW	70.2 MW	43
Demineralized Water	NA	30,500 gal/day	50,400 gal/day	40
Sanitary Sewer	9,000 gal/day	224,000 gal/day	1,685,000 gal/day	80
Compressed Air	72 SCFM	2,640 SCFM	4,090 SCFM	35

Source: LLNL 2002dm, TtNUS 2003.
[a] Assumes current capacity is flexible to account for staffing increases.
gal/day = gallons per day; Mbps = million bits per second; MW = megawatts; NA = not available; RHWM = radioactive and hazardous waste management; SCFM = standard cubic feet per minute.

B.5.2.15 *Materials and Waste Management*

Materials

The Proposed Action would not cause any major changes in the types of materials used at the RHWM facilities or throughout LLNL. Chemical usage at LLNL would increase, consistent with a 5-percent increase in laboratory operations. Continued application of pollution prevention waste minimization techniques to future operations would offset a portion of the projected increase. Average maximum quantities would likely remain constant as material storage space remains constant; however, average quantities would be expected to increase to meet demand (see Tables B.5.1.14–1 and B.5.1.14–2). Under the Proposed Action, chemical material projections used for analysis would not exceed existing chemical material management capacities. No substantial or critical material shortages would occur. Increases in overall quantities of radioactive materials and explosive materials based on current administrative limits are not expected. Under the Proposed Action, radioactive material and explosive material requirements would not exceed existing material management capacities.

Waste Management

Implementation of the Proposed Action would not cause any major changes in the types of waste streams generated onsite. Waste generation levels over the next 10 years at LLNL would potentially increase above recent generation quantities. This increase would be consistent with increases from new operations and historic normal fluctuations experienced over the past 10 years with LLNL operations. These projections would be decreased should waste minimization and pollution prevention programs continue to have success. Onsite waste handling capacities are 4 to 5 times expected waste volumes. Waste projections used for analysis would not exceed existing offsite waste management disposal capacities.

For projection purposes, the CY1993 – FY2002 routine waste generation data were considered a reasonable range for existing facilities and an average was used. The amount of waste generated would reflect proportional increases in LLNL activity levels over the next 10 years. New operations wastes would be derived from mission-related work and would be additive. A margin representing a statistical standard deviation was added in order to show the maximum likely operational increases. The waste quantities projected represent a site-wide aggregate of quantities for each type of waste category. Table B.3.2–1 presents estimated annual (routine) waste generation quantities by waste category.

Waste generation levels for special (nonroutine) program waste, such as for unused chemicals or laboratory closeout, are derived separately from CY1993 – FY2002 nonroutine waste generation. The waste quantities projected represent a site-wide aggregate of quantities for each type of waste category. Table B.3.2–1 presents estimated annual (nonroutine) waste generation quantities by waste category.

All Other Wastes

LLNL operations also involve the four additional waste management activity areas discussed below.

Biohazardous (includes **Medical Waste Management Act***) Waste*

In 2001 and 2002, several hundred kilograms of biohazardous waste were generated, treated, and disposed of at an approved offsite facility. Under the Proposed Action, biohazardous waste generation would range from 0 to 1 metric ton. The existing waste handling capabilities would be adequate to accommodate this waste. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient.

Construction, Decontamination, and Decommissioning

The construction of the 100,000 to 200,000 square feet of new facilities at LLNL would generate 200 to 400 metric tons of construction debris.

In the past during D&D, LLNL would potentially generate hazardous waste including TSCA waste and radioactive waste including mixed. The planned D&D work under the Proposed Action would more directly impact the quantity of municipal sanitary waste and TSCA waste requiring disposal (including RCRA closures of Building 513, 514, 280, and 233 CSU). In the case of RCRA closure at the Building 514 complex, the potential would exist for generating a mixed waste. LLNL would generate building debris, primarily concrete, wood, metal, and other building materials. LLNL would generate TSCA waste, primarily PCBs and asbestos that would be removed from transformers and buildings. Assuming that up to 700,000 square feet of facilities site-wide would be removed, D&D activities would generate 4,200 tons of debris over 10 years. Most of the debris would be diverted, only 350 metric tons would be hazardous, radioactive, or mixed waste. On an annualized basis, this amount is considered small.

Under the Proposed Action, routine and nonroutine maintenance and repair projects would occur over the next 10 years. Assuming LLNL would require 2 to 5 percent annual reinvestment and maintenance wastes are proportional to all wastes, routine and nonroutine maintenance and repair projects would generate 90 to 200 tons per year of debris.

Environmental Restoration Waste

Site-wide environmental restoration waste generation trends at LLNL would generally remain a function of treatment units, the number of wells, and the number of hours of operation. No appreciable onsite impacts to treatment facilities would occur because existing waste handling capabilities are already in place.

Wastewater

Wastewater would increase to approximately 330,000 gallons per day. Sufficient capacity would exist (see Section B.5.1.14).

B.5.2.16 *Occupational Protection*

Table B.5.2.16–1 provides estimates of the number of TRCs and LWCs that could occur under the Proposed Action. The projected injury rates are based on average historic LLNL injury rates over a 3-year period from 1999 through 2001 (DOE 2001c). These rates were then multiplied by the projected employment levels for each alternative to calculate the number of TRCs and LWCs under each of No Action Alternative, Proposed Action, and Reduced Operation Alternative. The TRC values include work-related death, illness, or injury that resulted in loss of consciousness, restriction from work or motion, transfer to another job, or required medical treatment beyond first aid. The data for LWCs represent the number of workdays beyond the day of injury or onset of illness that the employee was away from work or limited to restricted work activity because of an occupational injury or illness.

TABLE B.5.2.16–1.—*Estimated Occupational Safety Impacts to LLNL Workers for the Proposed Action*

Worker Safety Parameters	Proposed Action
Workforce –	11,400
Total (RHWM)	(170)
Total recordable cases of accident or injury –	420
Total (RHWM)	(7)
Lost workday cases –	110
Total (RHWM)	(2)

Source: DOE 2002l, TtNUS 2003.
RHWM = radioactive and hazardous waste management.

The NNSA expects minimal worker radiological health impacts from the LLNL activities under the Proposed Action. The values for the Proposed Action were calculated assuming the number of radiation workers and their average annual radiation dose would be the same as the average values for the past 3 years (Table B.5.2.16–1). Table B.5.2.16–1 presents estimated radiation doses for the collective population of workers who would be directly involved in implementing No Action Alternative, Proposed Action, and Reduced Operation Alternative as well as LCFs likely attributable to these doses.

The estimated number of LCFs listed in Table B.5.2.16–2 for the Proposed Action can be compared to the projected number of fatal cancers from all causes. Population statistics indicate that cancer caused 23 percent of the deaths in the U.S. in 2000. If this percentage of deaths from cancer continues, 23 percent of the U.S. population would contract a fatal cancer from all causes. Thus, in the population of 1,000 workers, 230 persons would be likely to contract fatal cancers from all causes. Under the Proposed Action, the incremental impacts from LLNL operations would be small.

TABLE B.5.2.16–2.—*Estimated Radiological Dose and Health Impacts to RHWM Workers for the Proposed Action (Based on 3-year Average)*

Health Impact	Proposed Action
Collective involved worker	0.52[a]
Estimated increase in number of LCFs	3×10^{-4}

Source: DOE 2001c, LLNL 2002q.
[a] Estimated based on RHWM facilities workforce represented less than 3 percent of all LLNL involved workers.
Note: Data for individual divisions within LLNL (for example ES&H Security Directorate) are NR. Organization numbers for LLNL personnel sometimes change due to work changes or corporate reorganizations. During any 3-month period, monitored personnel may change organizations one or more times.
LCFs = latent cancer fatalities.

B.5.2.17 *Site Contamination*

Soil and groundwater contamination at LLNL occurred as the result of past operations. The cleanup of these soils and groundwater would continue and would meet the health risk-based standards corresponding to the intended future uses of the site. At this time, analyses indicate no significant risk to the general public (LLNL 2002p).

As of 2001, the Livermore Site operated 30 treatment facilities: 28 are groundwater treatment facilities and 2 are VTFs. A total of nearly 80 groundwater extraction wells operated at an average flow rate of 2,540 liters per minute. A total of two vapor extraction wells operated at an average flow rate of 670 cubic meters per minute. At present eight CERCLA environmental restoration OUs are being managed to mitigate contamination at Site 300. These OUs are the GSA, the Building 834 complex, the High Explosive Process Area, Building 850/Pits 3 and 5, Building 854 Pit 6, Building 832 Canyon, and Site 300. As of 2001, LLNL operated 10 treatment facilities at Site 300: 3 groundwater and soil vapor extraction systems and 7 portable facilities. Nineteen wells that extract only groundwater, 7 wells that extract only soil vapor, and 24 wells that extract both operated in 2001. The state, NNSA, and LLNL would continue to discuss remediation, investigation, monitoring and potential cleanup activities, as necessary (LLNL 2002cc).

With the RCRA closure of Buildings 513, 514, 280, and 233 CSU; the associated treatment equipment; and the consolidation of waste management operations into the DWTF, the potential for soil contamination from any LLNL waste management operations would be minimized. Also, in the future, chemical, oil, or hazardous material (including wastes in SAAs and WAAs) spills or releases are possible, given the variety of materials handled at LLNL; however, controls are in place to minimize the potential for soil contamination from any LLNL operations.

B.5.3 Reduced Operation Alternative

The Reduced Operation Alternative reflects minimum levels of activity required to maintain waste management operations and activities assigned to support LLNL capabilities over the next 10 years. In some specific operations, waste management operations would increase over the base period. The operations are those that, during the base period, have not yet been operated (e.g., the NIF).

This alternative does not eliminate assigned missions or capabilities, but could entail not consolidating, enhancing, or upgrading operations. However, under this alternative, LLNL waste management operations would not be reduced beyond those required to maintain safety, permit requirements, or other agreements, such as the Site Treatment Plan.

Approximately 20 Class 1 permit modifications would be submitted. No Class 2 or Class 3 permit modifications would be submitted. No new construction would be included. No RCRA closures would be completed other than those that would be performed under the No Action Alternative. A permit renewal would be submitted.

This alternative addresses the same facilities described in Section B.3.1 for the No Action Alternative. This alternative differs from the No Action Alternative in that operations would decease to the lowest reasonably foreseeable levels over the next 10 years. The following sections discuss these resource areas in relation to the No Action Alternative.

B.5.3.1 *Land Use and Applicable Plans*

Implementing the Reduced Operation Alternative would not affect the existing land-use patterns or applicable plans at LLNL waste management facilities.

No changes to waste management facilities land use or applicable plans would occur at LLNL under the Reduced Operation Alternative. The extent of NNSA land available for use by LLNL would remain the same as the No Action Alternative. LLNL waste operations would remain consistent with industrial park uses and would have no foreseeable effects on established land-use patterns or requirements.

Under this alternative, the DWTF operations would not increase and Building 696 would not obtain permit status.

The completion of 50 Class 1 permit modifications request would be consistent with existing waste facility uses and would have no foreseeable effects on established land-use pattern or requirements.

B.5.3.2 *Socioeconomic Characteristics and Environmental Justice*

The implementation of the Reduced Operation Alternative would result in a small change to the economic and demographic characteristics and environmental justice, as discussed below.

The Reduced Operation Alternative would result in a small change in the existing economic base because LLNL (including the RHWM workforce) employment levels and associated expenditures would be reduced by approximately 8 percent from the No Action Alternative.

The Reduced Operation Alternative would have no discernible adverse impacts to land and visual resources, water resources, biological and ecological resources, cultural resources, air quality, infrastructure, transportation, waste generation, noise, or socioeconomics. Thus, no disproportionately high and adverse impacts to minority or low-income communities are anticipated.

As presented in Section B.5.3.16, LLNL operations would have minimal potential to adversely affect human health for offsite residents or onsite workers. Thus, no disproportionately high and adverse impacts to minority or low-income communities would be anticipated for this resource area.

Based on the analyses of all the resource and topic areas, impacts that would result during the course of normal operations would not pose disproportionately high and adverse health or environmental impacts on minority and low-income populations.

B.5.3.3 *Community Services*

The implementation of the Reduced Operation Alternative would result in no changes to the community services, as discussed below.

The Reduced Operation Alternative would not likely result in any noticeable change in community services. Overall expenditures and employment at LLNL (including the RHWM workforce) should remain relatively constant through 2014, which, in turn, would tend to maintain levels of service. Contributory effects from other industrial and economic sectors within the region should reduce or mask LLNL's current proportional impact.

Nonhazardous solid waste generated at the Livermore Site would continue to be transported to the Altamont Landfill for disposal. The landfill is estimated to have sufficient capacity to receive waste until the year 2038 (Hurst 2003). The current total daily permitted throughput at the Altamont Landfill is 11,150 tons (SWIS 2002). Under the Reduced Operation Alternative, approximately 4,400 metric tons per year of solid sanitary waste would be collected and transported to the Altamont Landfill.

B.5.3.4 *Prehistoric and Historic Cultural Resources*

Under the Reduced Operation Alternative, no waste management facility construction would occur. Some maintenance activities that require ground disturbance could result in the discovery of buried archaeological resources. Because the level of operations would be reduced, the amount of maintenance activity would be lower, thereby reducing the likelihood of impacting archaeological resources through these activities. If any such activities occurred in Sensitive Areas II, III, or IV at Site 300, the LLNL archaeologist would be contacted prior to conducting the maintenance activity to determine how to proceed in compliance with the Programmatic Agreement (Appendix G). Previous notification to the archaeologist would not be required for maintenance activities at the Livermore Site. If any resources are discovered during the activities at the Livermore Site or Site 300, the LLNL archaeologist would be notified and work would stop within the immediate vicinity until the archaeologist has assessed the discovery.

Buildings 233 CSU, 280, 513, and 514 would undergo RCRA closure under this alternative. The DWTF, Area 612 Complex, EWTF, EWSF, and Building 883 would not be modified. Thus no effects would occur to these buildings or facilities.

Under this alternative, 50 Class I permit modifications would be completed. If any of the modifications would result in ground disturbing activity or modifications to eligible or potentially eligible buildings or structures, then the permit modification would require review by the LLNL archaeologist. Since these activities are not likely to occur under Class I permit modifications, the need for this review is also unlikely.

B.5.3.5 *Aesthetics and Scenic Resources*

The Reduced Operation Alternative would not adversely change the overall appearance of the existing landscape, obscure views, increase the visibility of LLNL structures, or otherwise detract from the scenic views from the Livermore Site or Site 300 or from areas adjacent to the sites. No modifications to waste management facilities would be completed and no impact to visual resources would be expected.

B.5.3.6 *Agriculture*

No changes to potential agriculture resources would occur at LLNL under the Reduced Operation Alternative. The extent of NNSA land (including the RHWM facilities) available for use by LLNL would remain the same.

B.5.3.7 *Geologic Resources and Hazards*

No impacts to general geology and geologic resources are anticipated. Impacts from geological hazards (seismicity, slope failure) are evaluated below.

Seismology

Strong earthquake ground motion is responsible for producing almost all damaging effects of earthquakes, except for surface-fault rupture. Ground shaking generally causes the most widespread effects, not only because it occurs at considerable distances from the earthquake source, but also because it may trigger secondary effects from ground failure and water inundation. Potential sources for future ground motion at the LLNL include the major regional faults (see Section B.4).

Seismic hazard analyses have been performed for the LLNL. Existing facilities would continue to be upgraded or replaced to the extent possible. Larger earthquakes on more distant faults such as the San Andreas do not significantly affect the hazard estimation for LLNL.

Structure

At the Livermore Site, there is little potential for slope instability because the site is situated on flat topography. At Site 300, the areas around the waste management facilities include hillsides. The hillsides surrounding this area consist of moderately to weakly consolidated sand and gravel and colluvial and alluvial terrace deposits. The hills have evidence of mass movement. There is an increased chance of slope failure during wet years at the hillsides in the vicinity of the waste management facilities. Slope failure at these locations would have no effect on LLNL waste management facilities.

Soils

Since no new waste management facilities are proposed, no impacts to the soils due to erosion would occur.

B.5.3.8 *Ecology*

Under the Reduced Operation Alternative, increased use of the DWTF as described in the permit and permit modifications would not affect any of the biological resources considered in this appendix. As with the No Action Alternative, four RCRA closures would occur; however, no changes to the physical environment would occur. No indirect impacts would occur because no runoff materials would impact sensitive habitats because runoff would be collected and analyzed and disposed of appropriately.

B.5.3.9 *Air Quality*

Radiological Air Emissions

Under the Reduced Operation Alternative LLNL would continue to have several RHWM facilities as radiological point sources and diffuse sources of emissions. Based on a projected site-wide increase of radioactive waste generation, radiological emissions would increase proportionally above the existing conditions. Comparison of the Reduced Operation Alternative to the existing conditions and the No Action Alternative show that the LLNL projects' radiological emissions dose to the MEI would remain less than 1 millirem per year. Radiological emissions would be within all applicable standards.

Nonradiological Air Emissions

Under the Reduced Operation Alternative, LLNL would continue to have eight RHWM nonexempt emission sources. Based on a projected site-wide staff decrease of 8 percent, traffic emissions would decrease 8 percent below the No Action Alternative. Comparison of the Reduced Operation Alternative air toxic emissions with Bay Area air toxic emissions show that LLNL projects toxic emissions are less than one percent of those for the Bay Area. D&D activities (including RCRA closures) at LLNL could have short-term adverse impacts due to emissions of criteria air pollutants from construction worker traffic, construction equipment, and fugitive dust from earth-moving activities. The fugitive dust from these activities could exceed PM_{10} concentration standards if no dust control measures were implemented. However, engineered controls, such as the application of water or chemical dust suppressants and seeding of soil piles and exposed soils, would minimize fugitive dust. It is expected that PM_{10} concentrations would be within all applicable standards.

The estimated number of daily commuter vehicles to LLNL during FY2002 was 7,500 to 8,500 (RHWM commuters represented 170 commuters). Under the Reduced Operation Alternative, an 8 percent decrease in daily commuter traffic would occur. Decreases of carbon monoxide and nitrogen oxides, an ozone precursor, would occur with the decrease in commuter traffic. Additionally, the EPA model considers that future vehicles will have lower emission rates and more stringent inspection and maintenance programs; actual emissions would be less than the model baseline. Also, the BAAQMD vehicle buyback program, designed to remove older vehicles from the road, would continue and contribute to the reduction in commuter vehicle emissions. Further, the total carbon monoxide emissions for the Reduced Operation Alternative would be less than 1 percent of the maintenance area's emissions of carbon monoxide. As a result, NNSA has concluded that no conformity determination is required for the Reduced Operation Alternative.

B.5.3.10 *Water*

Under this alternative, LLNL would continue to monitor groundwater quality at numerous locations throughout the Livermore Site and Site 300. Past measurements indicate that some contaminants at these sites have periodically exceeded the MCLs in Federal drinking water standards (40 CFR Part 141). However, concentrations at these sites would continue to decrease over time (LLNL 2002cc).

LLNL RHWM facilities do not use groundwater for any portion of its water supply; therefore, no effects to groundwater quantity would be anticipated under the Reduced Operation Alternative.

During storm events at LLNL waste management facilities, including the DWTF, the stormwater runoff that is collected is sampled and managed through the sewer system as appropriate. Some stormwater runs directly off the facility.

The current LLNL stormwater runoff monitoring program includes visually monitoring all facility discharge locations onsite annually; and, during storm events, sampling 10 Livermore Site and 7 Site 300 locations. These samples are the best available indicators of what contaminant(s) could reasonably be transported offsite. No regulatory limits have been set for pollutants in stormwater runoff. During the most recent sampling, no pollutants were detected at levels that would be a cause for concern. No effects to stormwater compliance would be anticipated under this alternative.

Under the Reduced Operation Alternative, only minor net changes in building and parking lot areas would be anticipated. Annual variation in LLNL surface runoff would occur with variations in rainfall quantity and intensity and declining capability. However, no overall impact to surface water quantity from activities under the Reduced Operation Alternative would be anticipated.

B.5.3.11 *Noise*

Implementation of the Reduced Operation Alternative could include activity levels at some facilities that would increase over the 2002 activity levels. In these cases, the activity levels would be those that were not exercised sufficiently during the recent years to maintain the capability or to satisfy testing requirements of the NNSA.

The frequency of impulse noise events at the EWTF under the Reduced Operation Alternative would be 5 percent less than the 2002 level of activity and approximately 8 percent less than the No Action Alternative level for all treatment activities combined.

B.5.3.12 *Minerals*

No changes to mineral resources would occur at LLNL under the Reduced Operation Alternative. The extent of NNSA land (including RHWM facilities) available for use by LLNL would remain the same.

B.5.3.13 *Traffic and Transportation*

No additional impacts to transportation would occur under the Reduced Operation Alternative. Waste shipments would range from 134 to 201 per year (Table B.5.3.13–1). This would be below the range associated with the No Action Alternative.

TABLE B.5.3.13–1.—*Lawrence Livermore National Laboratory Annual Material Transportation Activities*

Activity	No Action	Reduced Operation Alternative
Material (annual shipments radioactive, chemical, and explosives)	540 shipments	550 shipments
Waste (annual shipments includes hazardous and radioactive)	240 shipments	200 shipments
Annual sanitary waste shipments	534 shipments	492 shipments
Site-related traffic	10,081	9,283
Total daily traffic (RHWM staff)	(150)	(140)

Source: LLNL 1992a, DOE 1999a, TtNUS 2003.

B.5.3.14 *Utilities and Energy*

All utility and energy systems would operate within existing capacity. Waste management activities at the Livermore Site and Site 300 would continue to use less than 5 percent of all utility and energy systems annual projections for the next 10 years as presented in Table B.5.3.14–1 (TtNUS 2003).

TABLE B.5.3.14–1.—*Reduced Operation Alternative Annual Lawrence Livermore National Laboratory Utility and Energy Systems*

Utility System	RHWM Usage	Total LLNL Usage (including RHWM)	Current Capacity	Remaining Capacity (percent)
5ESS Telecomm. Switch	480 (voice lines)	18,973[a]	20,384	7
Telecomm. Dist. System:				
Copper trunk cables (B256 to 13 nodes)	513 (pairs)	20,300[a]	46,800	57
Fiber trunk cables	37	1,395	2,368	41
Copper distribution (Nodes to buildings)	2,450	92,100	115,158	20
Network speed to desktop	10 Mbps	10 Mbps	10 Mbps	NA
Electricity	1.4 MW	82 MW	125 MW	57
Natural gas	526 therms/day	22,600 therms/day	24,500 therms/day	19
Domestic water	0.04M gal/day	1.29M gal/day	2.88M gal/day	55
Low conductivity cooling water	0.95 MW	34.7 MW	70.2 MW	46
Demineralized water	NA	26,300 gal/day	50,400 gal/day	48
Sanitary sewer	7,600 gal/day	222,000 gal/day	1,685,000 gal/day	83
Compressed air	68 SCFM	2,280 SCFM	4,090 SCFM	44

Source: LLNL 2002b, TtNUS 2003.
[a] Assumes current usage would remain the same.
gal/day = gallons per day; Mbps = million bits per second; MW = megawatts; NA = not available; SCFM = standard cubic feet per minute.

B.5.3.15 *Materials and Waste Management*

Materials

The Reduced Operation Alternative would not cause any major changes in the types of materials used at the RHWM facilities or throughout LLNL. Chemical usage at LLNL would decrease, consistent with a 5-percent decrease in LLNL operations. Average maximum quantities would likely remain constant as material storage space remains constant; however, average quantities would be expected to decrease with lower demand (see Tables B.5.1.14–1 and B.5.1.14–2). Under the Reduced Operation Alternative, chemical material projections used for analysis would not exceed existing chemical material management capacities. No substantial or critical material shortages would occur. As reported in the 1999 Supplement Analysis, quantities of chemicals at LLNL declined by over 50 percent (DOE 1999a).

Decreases in overall quantities of radioactive materials and explosive materials based on current administrative limits would be expected. Under the Reduced Operation Alternative, radioactive material and explosive material requirements would not exceed existing material management capacities.

Waste Management

Implementation of the Reduced Operation Alternative would not cause any major changes in the types of waste streams generated onsite. Waste generation levels over the next 10 years at LLNL would remain essentially consistent with recent generation quantities. Any increase would be consistent with increases from new operations and normal fluctuations experienced over the past 10 years with LLNL operations. Continued application of pollution prevention and wastes minimization techniques to further operations would offset a portion of the projected increase. Onsite waste handling capacities are four to five times expected waste volumes. Waste projections used for analysis would not exceed existing offsite waste management disposal capacities.

For projection purposes, the CY1993–FY2002 routine waste generation data were considered a reasonable range for existing facilities, with no major increases or decreases in the amount of wastes generated. New operations wastes would be derived from mission-related work and additive. The amount of waste generated would reflect proportional decreases in LLNL activity levels over the next 10 years. The waste quantities projected represent a site-wide aggregate of quantities for each type of waste stream. Table B.3.3–2 presents estimated annual (routine) waste generation quantities by waste category.

Waste generation levels for special (nonroutine) program waste, such as for unused chemicals or laboratory closeout, are derived separately from CY1993–FY2002 nonroutine waste generation. The waste quantities projected represent a site-wide aggregate of quantities for each type of waste stream. Table B.3.3–2 presents estimated annual (nonroutine) waste generation quantities by waste category.

All Other Wastes

LLNL operations also involve the four additional waste management activity areas discussed below.

Biohazardous (Includes* Medical Waste Management Act*) Waste

In 2001 and 2002, several hundred kilograms of biohazardous waste were generated, treated, and disposed of at an approved offsite facility. Under the Reduced Operation Alternative, biohazardous waste generation would range from 0 to 1 metric ton per year. The existing waste handling capabilities would be adequate to accommodate this waste. No additional offsite impacts would occur, because offsite disposal capacity would continue to be sufficient.

Construction, Decontamination, and Decommissioning

Under the Reduced Operation Alternative, no construction, renovation, or modification of facilities would occur over the next 10 years. No construction waste would be generated.

Except those projects identified under the No Action Alternative, no additional D&D projects were identified under the Reduced Operation Alternative. However, the potential for completing a new D&D project would exist. Assuming that up to 255,000 square feet of facilities would be removed, D&D activities would generate 4,200 tons of debris. Most of the debris would be diverted; only 350 metric tons would be hazardous, radioactive, or mixed waste.

Under the Reduced Operation Alternative, routine and nonroutine maintenance and repair projects would occur over the next 10 years. Assuming LLNL would require 2 to 5 percent annual reinvestment and maintenance waste are proportional to all wastes, routine and nonroutine maintenance and repair projects would generate 90 to 200 tons per year of debris.

Environmental Restoration Waste

Site-wide environmental restoration waste generation trends at LLNL would generally remain a function of treatment units, the number of wells, and the number of hours of operation. No appreciable onsite impacts to treatment facilities would occur because existing waste handling capabilities are already in place.

Wastewater

Wastewater would decrease to approximately 290,000 gallons per day. Sufficient capacity would remain.

B.5.3.16 *Occupational Protection*

Table B.5.3.16–1 provides estimates of the number of TRCs and LWCs that could occur under the Reduced Operation Alternative. The projected injury rates are based on average historic LLNL injury rates over a 3-year period from 1999 through 2001 (DOE 2001c). These rates were multiplied by the projected employment levels for each alternative to calculate the number of TRCs and LWCs under the No Action Alternative, Proposed Action, and Reduced Operation Alternative. The TRC value includes work-related death, illness, or injury that resulted in loss of consciousness, restriction from work or motion, or transfer to another job or that required medical treatment beyond first aid. The data for LWCs represent the number of workdays beyond the day of injury or onset of illness that the employee was away from work or limited to restricted work activity because of an occupational injury or illness.

TABLE B.5.3.16–1.—*Estimated Occupational Safety Impacts to Lawrence Livermore National Laboratory Workers for the Reduced Operation Alternative*

Worker Safety Parameters	Reduced Operation Alternative
Workforce –	9,285
Total (RHWM)	(140)
Total recordable cases of accident or injury –	344
Total (RHWM)	(6)
Lost workday cases –	92
Total (RHWM)	(1)

Source: DOE 2002l.
RHWM = radioactive and hazardous waste management.

NNSA expects minimal worker radiological health impacts from the LLNL activities under the Reduced Operation Alternative. The values for the Reduced Operation Alternative were calculated assuming the number of radiation workers and their average annual radiation dose would be the same as the average values for the past 3 years (Table B.5.3.16–1). Table B.5.3.16–1 presents estimated radiation doses for the collective population of workers who would be directly involved in implementing the No Action Alternative, Proposed Action, and Reduced Operation Alternative as well as LCFs likely attributable to these doses.

The estimated number of LCFs listed in Table B.5.3.16–2 for the Reduced Operation Alternative can be compared to the projected number of fatal cancers from all causes. Population statistics indicate that cancer caused 23 percent of the deaths in the U.S. in 1997. If this percentage of deaths from cancer continues, 23 percent of the U.S. population would contract a fatal cancer from all causes. Thus, in the population of 1,000 workers, 230 persons would be likely to contract fatal cancers from all causes. Under the Reduced Operation Alternative, the incremental impacts from LLNL operations would be small.

TABLE B.5.3.16–2.—*Estimated Radiological Dose and Health Impacts to Radioactive and Hazardous Waste Management Workers for the Reduced Operation Alternative (Based on 3-Year Average)*

Health Impact	Reduced Operation Alternative
Collective involved worker	0.45
Estimated increase in number of LCFs	2×10^{-4}

Source: DOE 2001c.
Note: Data for individual divisions within LLNL (for example ES&H Security Directorate) are NR. Organization numbers for LLNL personnel sometimes change due to work changes or corporate reorganizations. During any 3-month period, monitored personnel may change organizations one or more times.
LCFs = latent cancer fatalities.

B.5.3.17 *Site Contamination*

Soil and groundwater contamination at LLNL occurred as the result of past operations. The cleanup of these soils and groundwater would continue and would meet the health risk-based standards corresponding to the intended future uses of the site. At this time, analyses indicate no significant risk to the general public (LLNL 2002cc). The state, NNSA, and LLNL would continue to discuss remediation, investigation, monitoring, and potential clean-up activities, as necessary (LLNL 2002cc).

As with the No Action Alternative, RCRA closures would occur and the potential for soil contamination from any continued use of these facilities would be reduced. Under the Reduced Operation Alternative, facility-wide chemical usage and waste generation would decrease. Correspondingly, the likelihood of chemical, oil, or hazardous material (including wastes in SAAs and WAAs) spills or releases would be reduced and potential impacts would be minimized by existing controls.

B.6 *CALIFORNIA ENVIRONMENTAL QUALITY ACT* CONSIDERATIONS BY RESOURCE AREA

The NNSA recognizes the need to provide DTSC with necessary information to facilitate their decision-making process. This section contains CEQA project-specific information in one section even though the impact analysis also appears under the individual environmental resources and issue areas in this appendix and the main volume of this LLNL SW/SPEIS.

For completeness of CEQA analysis, NNSA also gathered information on all operations at LLNL including Site 300. Information regarding all facilities, site support services, site-wide water and utility use, site-wide waste generation, hazardous chemicals purchased, process wastewater, and radioactive dose data were incorporated into the analysis where appropriate. These activities include many R&D activities and routine operations; infrastructure, administrative, and central services for LLNL; facility maintenance and refurbishment activities; and environmental, ecological, and natural resource management activities.

This section considers these operations and their effects on environmental conditions under the No Action Alternative, Proposed Action, and Reduced Operation Alternative as part of the cumulative impacts.

In general, waste management operations at LLNL comprise less than three percent of the overall levels of activity at LLNL. This estimate is based, in part, on the relative percentage of waste management workforce (approximately 170 workers) to the overall workforce at LLNL (10,600 workers). Under the No Action Alternative and Proposed Action, conditions at LLNL

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Soil and groundwater contamination at LLNL occurred as the result of past operations. The cleanup of these soils and groundwater would continue and would meet the health risk-based standards corresponding to the intended future uses of the site. At this time, analyses indicate no significant risk to the general public (LLNL 2002cc). The state, NNSA, and LLNL would continue to discuss remediation, investigation, monitoring, and potential clean-up activities, as necessary (LLNL 2002cc).

As with the No Action Alternative, RCRA closures would occur and the potential for soil contamination from any continued use of these facilities would be reduced. Under the Reduced Operation Alternative, facility-wide chemical usage and waste generation would decrease. Correspondingly, the likelihood of chemical, oil, or hazardous material (including wastes in SAAs and WAAs) spills or releases would be reduced and potential impacts would be minimized by existing controls.

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RHWM were projected to increase by 3 percent and 10 percent above the existing operations, respectively. Under the Reduced Operation Alternative, site operations were projected to decrease by 8 percent. These projected changes are consistent with the analysis presented in the LLNL SW/SPEIS and the earlier sections of this appendix.

To complete the CEQA analysis, four descriptive categories are used to discuss environmental impacts: Potentially Significant Impact, Potentially Significant Unless Mitigated, Less Than Significant Impact, and No Impact. These categories have been created and assigned to individual impacts only for the purposes of supporting CEQA requirements and are used here only in a CEQA context. Under NEPA, the significance of environmental impacts determines the need for the NEPA document. Once that decision has been made, specific impacts are not categorized according to level of impact in an EIS. The following describes the environmental impact categories used in this document:

- **Potentially Significant Impact—**There is substantial evidence that the impact of the proposed project may be significant and cannot be avoided or reduced to a less-than-significant level.
- **Potentially Significant Unless Mitigated—**Absent mitigation measures or project revisions, the impact of the proposed project would be considered significant.
- **Less Than Significant Impact—**The proposed project would result in an impact, but at a level that is not considered significant.
- **No Impact—**The proposed project would not result in an impact.

Based upon examination of the potential environmental effects of direct and indirect actions, NNSA has determined the following resource areas would be specifically analyzed in detail with CEQA considerations:

- Aesthetics
- Agricultural Resources
- Air Quality
- Biological Resources
- Cultural Resources
- Geology and Soils
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Land Use and Planning
- Minerals

- Noise
- Population and Housing
- Public Services
- Recreation
- Transportation and Traffic
- Utilities and Service Systems
- Cumulative Effects
- Mandatory Findings of Significance

Each impact section begins with a brief summary of the resource conditions, followed by a list of the standards of significance relevant to the area being discussed. The use of specific standards of significance is typical of CEQA; however, their use is acceptable in an EIS. They are used in this appendix in the discussion of all significance decisions to meet CEQA requirements. After the standards of significance, each section discusses impacts and mitigation measures as appropriate. Table B.6–1 contains a series of CEQA considerations by resource area that provide specific issues evaluated in context with proposed permit modifications. Each issue consists of a brief description and a corresponding impact indicator (○-No Impact, Δ-Less than Significant Impact, and ●-Potentially Significant Impact).

TABLE B.6–1.—*Impact Issues Associated with Permit Modifications*

Issues Associated with Potential Impacts	Alternative		
	Proposed Action	**No Action**	**Reduced Operation**
Aesthetics			
Have a substantial adverse effect on a scenic vista.	○	○	○
Substantially damage scenic resources including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway.	○	○	○
Substantially degrade the existing visual character or quality of the site and its surroundings.	○	○	○
Create a new source of substantial light of glare which would adversely affect day or nighttime views in the area.	○	○	○
Agricultural Resources			
Convert prime farmland, unique farmland, or farmland of statewide importance (farmland) as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use.	○	○	○
Conflict with existing zoning or agriculture use, or *Williamson Act* contract.	○	○	○
Involve other changes in the existing environment which, due to their location or nature, could result in conversion of farmland, to non-agricultural uses.	○	○	○
Air Quality			
Conflict with or obstruct implementation of the applicable air quality plan.	○	○	○
Violate any air quality standard or contribute substantially to an existing or projected air quality violation.	○	○	○
Result in cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable Federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors).	○	○	○
Expose sensitive receptors to substantial pollutant concentrations.	○	○	○
Create objectionable odors affecting a substantial number of people.	○	○	○
In addition, the following is addressed to meet the requirements set forth under Section 711.4, Fish and Game Code and 753.5, Title 14, Code of California Regulations relating to filing of environmental fees: Degradation of any air resources which will individually or cumulatively result in a loss of biological diversity among the plants and animals residing in that air.	○	○	○

TABLE B.6–1.—*Impact Issues Associated with Permit Modifications (continued)*

Issues Associated with Potential Impacts	Alternative		
	Proposed Action	**No Action**	**Reduced Operation**
Biological Resources			
Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service.	○	○	○
Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service.	○	○	○
Have a substantial adverse effect on Federally protected wetlands as defined by Section 404 of the *Clean Water Act* (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means.	○	○	○
Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.	○	○	○
Conflict with local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.	○	○	○
Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.	○	○	○
In addition, the following are addressed to meet the requirements set forth under Section 711.4, Fish and Game Code and 753.5, Title 14, Code of California Regulations relating to filing of environmental fees: Plants: Changes to any riparian land or wetlands under state or Federal jurisdiction. Changes to soil required to sustain habitat for fish and wildlife. Any adverse effect to native and non-native plant life. Effects to rare and unique plant life and ecological communities dependent on plant life. Any adverse effect to listed threatened and endangered plants. Effects on habitat in which listed threatened and endangered plants are believed to reside. Effects on species of plants listed as protected or identified for special management in the Fish and Game Code, the Public Resources Code, the Water Code, or regulations adopted thereunder. Effects on marine and terrestrial plant species subject to the jurisdiction of the Department of Fish and Game and ecological communities in which they reside.	○	○	○
In addition, the following are addressed to meet the requirements set forth under Section 711.4, Fish and Game Code and 753.5, Title 14, Code of California Regulations relating to filing of environmental fees:	○	○	○

TABLE B.6–1.—*Impact Issues Associated with Permit Modifications (continued)*

Issues Associated with Potential Impacts	Alternative		
	Proposed Action	**No Action**	**Reduced Operation**
Animals: Effects on listed threatened or endangered animals. Effects on habitat in which listed threatened or endangered animals are believed to reside. Effects on species of animals listed as protected or identified for special management in the Fish and Game Code, the Public Resources Code, the Water Code, or regulations adopted thereunder. Effects on marine and terrestrial animal species subject to the jurisdiction of the Department of Fish and Game and the ecological communities in which they reside.			
Cultural Resources			
Cause a substantial adverse change in the significance of a historical resource as defined in 15064.5.	○	○	○
Cause a substantial adverse change in the significance of an archaeological resource pursuant to 15064.5.	○	○	○
Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.	○	○	○
Disturb any human remains, including those interred outside of formal cemeteries.	○	○	○
Geology and Soils			
Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving: Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. (Refer to Division of Mines and Geology Special Publication 42.) Strong seismic ground shaking. Seismic-related ground failure, including liquefaction. Landslides.	●	●	●
Result in substantial soil erosion or the loss of topsoil.	○	○	○
Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse.	○	○	○
Be located on expansive soil, as defined in the Uniform Building Code, creating substantial risks to life or property.	○	○	○
Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of water.	○	○	○

TABLE B.6–1.—*Impact Issues Associated with Permit Modifications (continued)*

Issues Associated with Potential Impacts	Alternative		
	Proposed Action	**No Action**	**Reduced Operation**
Hazards and Hazardous Materials			
Create a significant hazard to the public or the environment throughout the routine transport, use, or disposal of hazardous materials.	○	○	○
Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment.	○	○	○
Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school.	○	○	○
Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to public or the environment.	○	○	○
Impair implementation of, or physically interfere with, an adopted emergency response plan or emergency evacuation plan.	○	○	○
Hydrology and Water Quality			
Violate any water quality standards or waste discharge requirements.	○	○	○
Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficient in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of preexisting nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted).	○	○	○
Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on or offsite.	○	○	○
Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on or offsite.	○	○	○
Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff.	○	○	○
Otherwise substantially degrade water quality.	○	○	○
Place within a 100-flood hazard area structures which would impede or redirect flood flows.	○	○	○
Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam.	○	○	○
Inundation by sieche, tsunami, or mudflow.	○	○	○

TABLE B.6–1.—*Impact Issues Associated with Permit Modifications (continued)*

Issues Associated with Potential Impacts	Alternative		
	Proposed Action	**No Action**	**Reduced Operation**
In addition, the following are addressed to meet the requirements set forth under Section 711.4, Fish and Game Code and 753.5, Title 14, Code of California Regulations relating to filing of environmental fees: Changes to riparian land, rivers, streams, watercourses, and wetlands under state and Federal jurisdiction. Changes to any water resources which will individually or cumulatively result in a loss of biological diversity among the plants and animals residing in that water.	○	○	○
Land Use and Planning			
Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect.	○	○	○
Conflict with any applicable habitat conservation plan or natural community conservation plan.	○	○	○
Minerals			
Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.	○	○	○
Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.	○	○	○
Noise			
Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.	○	○	○
Exposure of persons to or generation of excessive ground bourne vibration or ground bourne noise levels.	○	○	○
A substantial permanent increase in ambient noise levels in the vicinity above levels existing without the project.	○	○	○
A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.	○	○	○

TABLE B.6–1.—*Impact Issues Associated with Permit Modifications (continued)*

Issues Associated with Potential Impacts	Alternative		
	Proposed Action	**No Action**	**Reduced Operation**
Population and Housing			
Induce substantial population growth in area, either directly (e.g., by proposing new homes and businesses) or indirectly (e.g., through extension of roads or other infrastructure).	○	○	○
Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere.	○	○	○
Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere.	○	○	○
Public Services			
Result in substantial adverse physical impacts associated with the provision of new or physically altered government facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the following public services: fire protection, police protection, schools, parks, other public facilities.	○	○	○
Recreation			
Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated.	○	○	○
Include recreational facilities or require construction or expansion of recreational facilities that might have an adverse physical effect on the environment.	○	○	○
Transportation and Traffic			
Cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system.	○	○	○
Exceed, either individually or cumulatively, a level of service standard established by the country congestion management agency for designated roads or highway.	○	○	○
Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment).	○	○	○
Result in inadequate emergency access.	○	○	○
Result in inadequate parking capacity.	○	○	○
Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks).	○	○	○

TABLE B.6–1.—*Impact Issues Associated with Permit Modifications (continued)*

Issues Associated with Potential Impacts	Alternative		
	Proposed Action	**No Action**	**Reduced Operation**
Utilities and Service Systems			
Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board.	○	○	○
Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.	○	○	○
Require or result in the construction of new stormwater drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.	○	○	○
Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed.	○	○	○
Result in determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the projects projected demand in addition to the providers existing commitments.	○	○	○
Be served by a landfill with sufficient permitted capacity to accommodate the projects solid waste disposal needs.	○	○	○
Comply with Federal, state, and local statutes and regulations related to solid waste.	○	○	○
Cumulative Effects			
Increase the need for developing new technologies, especially for managing any hazardous or nonhazardous wastes that the project generates.	○	○	○
Increase the need for developing new technologies for any other aspects of the projects.	○	○	○
Leads to a larger project or leads to a series of projects, or is a step to additional projects (excludes final remedies).	○	○	○
Alters the location, distribution, density, or growth rate of the human population of an area.	○	○	○
Affect existing housing, public services, public infrastructure, or creates demands for additional housing.	Δ	Δ	Δ
Be cumulatively considerable on the environments with cumulative adverse effects on air, water, habitats, natural resources, etc.	Δ	Δ	Δ
Mandatory Findings of Significance			
Have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory.	○	○	○
Have impacts that are individually limited but cumulatively considerable.	○	○	○
Have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly.	○	○	○

Legend of Impact: ● = Potentially Significant Impact; Δ = Less Than Significant Impact; ○ = No Impact.

B.6.1 Aesthetics

This section describes impacts to aesthetics. The analysis focuses on impacts due to implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative, which are compared to existing resources. The ROI for this analysis is the surrounding areas within the general view shed of the waste management facilities.

Significance Criteria

Impacts to visual resources were qualitatively evaluated by assessing the potential degree of visual contrast that implementation of proposed permit modifications and associated waste management activities under each alternative would create with the existing landscape character. An impact is considered significant if it would noticeably increase visual contrast and reduce aesthetic quality. Temporary visual effects (such as construction) are not considered to be significant. Only visual effects that would last beyond construction (or D&D) are potentially considered significant.

California Environmental Quality Act Considerations

Under all alternatives full operation of the DWTF, as described in the permit, permit modifications, and the transition plan, would not affect any of the aesthetic parameters considered in this appendix. With the exception of the RCRA closure of Buildings 513 and 514, full operation would not entail any changes to the physical environment. The RCRA closures of Buildings 513 and 514 (including demolition) would open up views onsite; however, the effect on visual quality of the site and surrounding area would be minimal due to the density of the surrounding structures.

Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.2 Agricultural Resources

This section describes impacts to agricultural resources. The analysis focuses on impacts due to implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative, which are compared to existing resources. The ROI for this analysis is the surrounding areas within the general footprint of the waste management facilities.

Significance Criteria

Impacts to agricultural resources were qualitatively evaluated by assessing the potential degree of land use changes that implementation of proposed permit modifications and associated waste management activities under each alternative would create with the existing land-use character. An impact is considered significant if it would convert farmland to nonagricultural use. Temporary construction activities (such as removal, maintenance, or placement of underground utilities) are not considered to be significant.

California Environmental Quality Act Considerations

Under all alternatives, full operation of the DWTF as described in the permit, permit modifications, and the transition plan, would not affect any of the agricultural resources considered in this appendix. With the exception of the RCRA closure of Buildings 513 and 514, full operation would not entail any changes to the physical environment. The clean RCRA closures of Buildings 513 and

514 (including demolition) would remove structures from the site; however, no changes in the existing environment would result in conversion of farmland to nonagricultural uses.

Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.3 Air Quality

This section addresses air quality. It focuses on radiological and nonradiological (includes criteria, hazardous, and toxic air pollutants) emissions. The ROI for air quality varies according to the type pollutant.

Significance Criteria

Air quality impacts are judged to be significant if the No Action Alternative, Proposed Action, and Reduced Operation Alternative would directly or indirectly:

- Produce emissions that would cause or contribute to a violation of state or Federal ambient air quality standards
- Cause pollutant emissions in excess of BAAQMD impact significant thresholds
- Conflict with specific Air Quality Management Plan polices or programs

An alternative may have significant effects on LLNL or the RHWM facilities if it would increase demand in waste storage, treatment, and disposal in excess of storage, treatment, and disposal capabilities to the point that substantial expansion would be necessary. Significant impacts also could result from system deterioration due to improper maintenance or extension of facilities and waste management operations beyond its useful life. Effects also would be identified as significant if Federal, state, or local standards or requirements regulating the RHWM facilities (RCRA-permitted) would be violated.

California Environmental Quality Act Considerations

Under all alternatives, full operation of the DWTF, as described in the permit, permit modifications, and the transition plan, would not affect any of the air quality parameters considered in this appendix. Adequate waste management capacities exist to support all LLNL operations and LLNL waste management operations. Also full operation of the DWTF would be expected to decrease potential impacts because the existing outdoors waste operations at Area 514 would be moved inside to the DWTF (a modern waste management facility).

RHWM facilities are estimated to emit approximately 6 pounds of criteria pollutants per day. On the basis on the air toxics inventories, LLNL is ranked as a low-risk facility for nonradiological emissions. Emissions of HAPs are well below regulatory limits for single pollutants and combined pollutant HAP thresholds. No traffic-related emissions impacts associated with the No Action Alternative, Proposed Action, and Reduced Operation Alternative at RHWM facilities would be expected. No violations of Federal, state, or local standards or requirements would be expected. RCRA closures at Buildings 513, 514, 280, and 233 CSU would occur. Under all alternatives, no impacts would be expected.

The hazard risk assessment completed for the permit found that the risk and the hazard due to the continued operation of the existing facilities, even at maximum throughput conditions, would be below levels of concern described in the regulatory literature. Once the DWTF becomes operational, the facility would treat the same waste streams that are treated in the existing facilities; however, the DWTF would have improved air emissions control equipment and would treat some additional new waste streams. DOE also assessed the environmental impacts associated with the construction and operation of DWTF in an environmental assessment (DOE/EA-1150) (LLNL 1996c). Based on this assessment, the DOE issued a Finding of No Significant Impact on June 12, 1996.

Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.4 Biological Resources

This section analyses potential impacts on biological resources. The ROI for biological resources includes the Livermore Site, including the waste management facilities and surrounding native habitats within the vicinity of the site. All of the existing native habitat at the waste management facilities would be retained under all alternatives.

Significance Criteria

The determination of significant impacts to biological resources includes direct and indirect impacts. Direct impacts are those in which activities reduce or remove a biological resource. Indirect impacts could occur when the activity causes other actions that affect biological resources. Indirect impacts could also occur from the introduction of runoff materials into sensitive habitats.

California Environmental Quality Act Considerations

Under all alternatives, full operation of the DWTF, as described in the permit, permit modifications, and the transition plan, would not affect any of the biological resources considered in this appendix. With the exception of the RCRA closure of Buildings 513 and 514, full operation would not entail any changes to the physical environment. The RCRA closures of Buildings 513 and 514 (including demolition) would remove structures from the site; however, no changes in the existing environment would result in biological resources. No indirect impacts would occur because no runoff materials would impact sensitive habitats because runoff is collected and analyzed and disposed of appropriately.

Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.5 Cultural Resources

This section analyses potential impacts to cultural resources. The ROI for cultural resources includes the Livermore Site, and associated waste management facilities.

Significance Criteria

Impacts to cultural resources have been assessed using the following criteria of significance. Impacts to cultural resources listed on or eligible for the NRHP are considered significant. Impacts to buildings, structures, or archaeological sites that do not qualify for inclusion in the NRHP are not considered to be significant impacts to cultural resources.

California Environmental Quality Act Considerations

Under all alternatives, full operation of the DWTF, as described in the permit, permit modifications, and the transition plan, would not affect any of the cultural resources considered in this appendix, because proposed actions would not entail any changes to cultural resources.

Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.6 Geology and Soils

This ROI for geology and soils includes lands within the property boundaries of the RHWM facilities, LLNL, and adjacent contiguous land.

Significance Criteria

A project may result in a significant geologic impact if it increases the likelihood of earthquake damage, loss of mineral resources (see Section B.6.10), slope and/or foundation instability, erosion or sedimentation, land subsidence, or other severe problems of a geologic nature. Any physical changes to the property that would increase the likelihood of these events would be considered a significant impact. For CEQA purposes only, an additional significance criterion is identified. Under CEQA guidelines, a project that exposes people or structures to a major geologic hazard such as an active earthquake fault is considered a significant impact. No physical change to the environment is required for this environmental impact to be considered significant under CEQA.

California Environmental Quality Act Considerations

Under all alternatives, no impacts associated with increasing the likelihood of earthquake damage, loss of mineral resources (see Section B.6.10), slope and/or foundation instability, erosion or sedimentation, land subsidence, or other severe problems of a geologic nature would be expected. Clean RCRA closures at Buildings 513, 514, 280, and 233 CSU would not result in impacts.

Worker exposure near the geologically active Greenville and Las Positas faults by implementing the No Action Alternative and Proposed Action (the Reduced Operation Alternative decreases the number of personnel) would result in impacts and, for purposes of CEQA only, would result in a significant impact. The RCRA closures at Buildings 513, 514, 280, and 233 CSU would result in reduced impacts. No new mitigations would be implemented; Area 612 and the DWTF were previously assessed as described in the current permit.

Buildings 612, 614, and 625 have been seismically reviewed and have received a performance rating of “Good,” which indicates that, during a major seismic disturbance, some structural and nonstructural damage and falling hazards may result, but that these would not significantly jeopardize life. A major seismic disturbance is defined as an earthquake at LLNL that would be given a Modified Mercalli Intensity Scale rating of at least IX. A rating of “Good” represents an acceptable level of earthquake safety. Building 693, built in 1987, was constructed to meet the 1985 UBC seismic standards, which were the standards in effect at that time. Building 695 and the Building 693 Annex have been designed to meet 1994 UBC seismic standards.

Specific CEQA considerations resulting in impacts are presented in Table B.6–1.

B.6.7 Hazards and Hazardous Materials (Includes Waste)

This section analyzes the impacts of RHWM facilities and associated operations and the implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative on existing utilities and service systems. Hazards and hazardous materials covered include radioactive, chemical, and explosive materials and wastes, including radioactive, mixed, hazardous, biohazardous, and other solid and liquid wastes. The ROI relative to hazardous material and waste is LLNL and the RHWM facilities capacities.

Significance Criteria

An alternative may have significant effects on LLNL or the RHWM facilities if it would increase demand in excess of hazardous material storage or waste storage, treatment, and disposal capacities to the point that substantial expansion would be necessary. Significant impacts also could result from system deterioration due to improper maintenance or extension of facilities and waste management operations beyond their useful life. Significant impacts to the public could result from routine or accident conditions involving the release of hazardous materials (includes waste) into the environment from the RHWM facilities. Effects also would be identified as significant if Federal, state, or local standards or requirements regulating the RHWM facilities (RCRA-permitted) would be violated.

***California Environmental Quality Act* Considerations**

No impacts to the public or the environment involving hazardous materials and wastes associated with RHWM facilities and associated operations would result from implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative (see Table B.6–1). Adequate waste management capacities exist to support all LLNL operations and LLNL waste management operations. Under all alternatives, full operation of the DWTF, as described in the permit, permit modifications, and the transition plan, would decrease potential impacts because the existing outdoor waste operations at Area 514 would be moved inside to the DWTF (a modern waste management facility). Full implementation of the DWTF capabilities would be consistent with the goals established under the Federal Facility Compliance Order and Site Treatment Plant.

A health risk assessment completed for the permit found that the risk and the hazard due to the continued operation of the existing facilities, even at maximum throughput conditions, would be below levels of concern described in the regulatory literature (see Section B.4.18.3). Once the DWTF becomes operational, the facility would treat the same waste streams that are treated in the existing facilities; however, the DWTF would have improved air emissions control equipment and would treat some additional new waste streams. DOE also assessed the environmental impacts associated with the construction and operation of the DWTF in an Environmental Assessment (DOE/EA-1150) (LLNL 1996c). Based on this assessment, DOE issued a Finding of No Significant Impact on June 12, 1996.

LLNL would continue to use trained personnel and approved program procedures to control waste from the point of generation through storage, treatment, and disposal. LLNL waste management procedures would continue to cover the identification, generation, handling, packaging, storing, and transporting of all wastes including radioactive, hazardous, mixed, and medical wastes. No violations of Federal, state, or local standards or requirements would be expected. Clean RCRA closures at Buildings 513, 514, 280, or 233 CSU would occur.

LLNL would continue to use trained personnel and approved program procedures to control hazardous materials laboratory-wide. Laboratory-wide hazardous material maximum inventories would not change across the No Action Alternative, Proposed Action, and Reduced Operation Alternative. RHWM activities would account for less than 3 percent of the total hazardous material use at LLNL. As reported in the 1999 Supplement Analysis, quantities of chemicals at LLNL declined by over 50 percent. No additional material storage facilities are planned.

Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.8 Hydrology and Water Quality

This section analyzes impacts to hydrology and water resources. The ROI considered for water resources includes the RHWM facilities and the LLNL property.

Significance Criteria

An alternative may have significant effects on hydrology and water quality if it would increase demand in excess of the aquifer, drainage systems, or the floodplain areas to the point that interference or substantial changes would occur. Significant impacts also could result from deterioration due to erosion, silting, flooding, or groundwater level changes. Effects also would be identified as significant if Federal, state, or local standards or requirements regulating groundwater and surface water quality, stormwater, and wastewater discharge system would be violated.

California Environmental Quality Act Considerations

The RHWM facilities are not located in the 100-year floodplain, no surface water discharges would occur (rainwater is controlled) and no onsite groundwater use would occur. Groundwater monitoring is in place. No impacts are expected as a result of the two alternatives or the Proposed Action. Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.9 Land Use and Planning

This section analyses land-use impacts potentially resulting from implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative. Impacts to waste management facilities and surrounding land uses (including LLNL and offsite) are evaluated and compared to existing land use conditions.

Significance Criteria

The proposed changes under the No Action Alternative, Proposed Action, and Reduced Operation Alternative would cause a significant impact on land use if their implementation would conflict with established land use patterns.

California Environmental Quality Act Considerations

Implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative would not impact land use because no changes to onsite land uses would occur as part of the No Action Alternative, Proposed Action, and Reduced Operation Alternative. Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.10 Minerals

This section analyzes impacts to mineral resources resulting from implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative. Impacts to mineral resources are evaluated and compared to existing mineral resource conditions.

Significance Criteria

The proposed changes under the No Action Alternative, Proposed Action, and Reduced Operation Alternative would cause a significant impact if their implementation would result in the loss of availability of a known mineral resource.

***California Environmental Quality Act* Considerations**

Implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative would not impact mineral resources because no changes to onsite land uses would occur as part of the No Action Alternative, Proposed Action, and Reduced Operation Alternative. Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.11 Noise

This section addresses noise and vibration impacts resulting from RHWM facilities and associated operations and the implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative and determines potential effects of that noise and vibration on nearby and onsite sensitive receptors. The ROI includes the Livermore Site and Site 300 property boundaries.

Significance Criteria

Criteria used to analyze the significance of noise impacts are derived from applicable land-use compatibility guidelines or from regulatory thresholds established by NNSA (state and local codes are considered but are not applicable). Significant impacts could result from a substantial temporary, periodic, or permanent increase in ambient noise levels in the vicinity of the RHWM facilities above existing levels.

***California Environmental Quality Act* Considerations**

Under all alternatives, full operation of the DWTF, as described in the permit, permit modifications, and the transition plan, would decrease ambient noise levels because the existing outdoor waste operations at Area 514 would be moved inside to the DWTF (a modern waste management facility). Further, LLNL employs a proactive ear protection program. No violations of Federal, state, or local standards or requirements would be expected (see Table B.6–1).

No offsite temporary noise disturbance associated with RCRA closures at Buildings 513, 514, 280, or 233 CSU would occur (see Table B.6–1). No residential locations are within 400 feet of the four facilities. With recent construction of the NIF, planned construction of several laboratory buildings, recent removal of over 200,000 square feet of buildings and structures, the potential removal of an additional 700,000 square feet of buildings, and an active environmental restoration drilling program, the RCRA closures would not alter the ambient noise levels associated with LLNL.

Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.12 Population and Housing

This section analyzes population and housing impacts resulting from the No Action Alternative, Proposed Action, and Reduced Operation Alternative. The ROI includes Alameda County, San Joaquin County, Contra Costa County, and Stanislaus County.

Significance Criteria

The significance of population and housing impacts is relative to the characteristics of the geographic area and the timeframe of the analysis. Regional changes in population and housing are considered neither beneficial nor adverse impacts. These changes reflect the normal range of fluctuations in population and housing.

Population and housing changes in a given area can result in beneficial or adverse impacts to the extent that such changes would be expected to result in environmental and socioeconomic effects. However, increasing population in and of itself is not an environmental effect. Increases in population and housing would be constrained by local planning regulations. However, population and housing growth could lead to secondary impacts that could be adverse, such as the potential traffic and infrastructure costs that growth could induce.

***California Environmental Quality Act* Considerations**

Implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative would not result in impacts on population and housing. The projected changes in the RHWM workforce under each of the No Action Alternative, Proposed Action, and Reduced Operation Alternative would be small. Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.13 Public Services

This section analyzes impacts to public services. Public services include police, fire, and other services including landfill space. The ROI includes LLNL, the city of Livermore, Alameda County, and San Joaquin County.

Significance Criteria

A project could have a significant impact on public services if it would result in hazardous conditions, emergency response time, a need for additional facilities, or substantial increases in staffing levels.

***California Environmental Quality Act* Considerations**

Under all alternatives, full operation of the DWTF, as described in the permit, permit modifications, and the transition plan, would not affect any public services. The projected changes in the RHWM workforce are small. No changes to existing hazardous conditions or emergency response times would occur. No additional security, fire, or other public service facilities would be needed. No additional waste management facilities would be required; in fact, several waste management facilities would undergo RCRA closure under two of the No Action Alternative, Proposed Action, and Reduced Operation Alternative. A specific CEQA consideration resulting in no impacts is presented in Table B.6–1.

B.6.14 Recreation

This section analyzes recreation impacts resulting from the No Action Alternative, Proposed Action, and Reduced Operation Alternative. The ROI includes Alameda, San Joaquin, Contra Costa, and Stanislaus counties.

Significance Criteria

The significance of recreation is relative to the characteristics of the geographic area. Additional recreational facilities are considered beneficial. Minor changes in annual fiscal impacts are not considered to be environmental impacts and are not discussed in this section.

California Environmental Quality Act Considerations

No changes to existing recreation opportunities would be expected under the No Action Alternative, Proposed Action, and Reduced Operation Alternative. Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.15 Transportation and Traffic

This section presents the transportation and traffic analysis of the No Action Alternative, Proposed Action, and Reduced Operation Alternative. The ROI includes the Livermore Site, Site 300, and local transportation corridors (Greenville Road and Vasco Road).

Significance Criteria

Transportation and traffic impacts are identified as significant based on the level of service criteria. As the volume of traffic at any intersection affected by a project alternative increases, the capacity of that intersection to handle that increased volume is affected. As the level of service becomes worse, delays at intersections increase. Thus, a particular alternative would be considered to create a significant impact if the addition of its traffic resulted in a level of service at or beyond the maximum capacity. For any intersection operating beyond capacity, an increase in overall intersection delays of four percent or greater is considered to represent a significant impact.

This section assesses the traffic, parking, transit, and pedestrian impacts of each alternative.

California Environmental Quality Act Considerations

Currently daily waste management commuters are approximately 150 vehicles, assuming no carpooling, transit, or other transportation mode. Under the Proposed Action, the No Action Alternative, and the Reduced Operation Alternative, waste management commuters would number 170, 160, and 140, respectively. The current traffic loads associated with Greenville Road and Vasco Road vary from 12,000 to 15,600 vehicles per day and 16,600 and 30,000 vehicles per day, respectively. Both Greenville Road and Vasco Road are at or beyond capacity in the vicinity of I-580. Total LLNL traffic levels on these roads are estimated to be 21 percent and 36 percent, respectively, adjacent to the Livermore Site. Waste management commuter traffic would be approximately 1.5 percent of the total LLNL traffic. Additionally, 5 to 15 hazardous material shipments/receipts, 1 to 2 radioactive and hazardous waste shipments, and 7 to 10 shipments of municipal solid waste occur per week at LLNL.

Overall, the accident history near LLNL is good. LLNL parking is adequate with additional space designed into new projects including when buildings are removed.

Under all alternatives, waste management traffic would be less than 0.3 percent of the total traffic in the area including projected increases in RHWM commuters and total hazardous material and waste shipments. The level of service on these roads would not increase to or beyond the maximum capacity. No impacts would be expected (see Table B.6–1).

Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.16 Utilities and Service Systems

This section analyzes the impacts of waste management facilities and associated operations and the implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative on existing utilities and service systems. Utilities covered include water distribution, wastewater, storm drainage, electrical, natural gas, telephone, and solid waste management systems. The ROI includes the Livermore Site and Site 300 property boundaries and, in the case of solid waste, regional landfill capacity.

Significance Criteria

An alternative may have significant effects on a utility or service if it would increase demand in excess of utility or service capacity to the point that substantial expansion would be necessary. Significant impacts could also result from system deterioration due to improper maintenance or extension of service beyond its useful life. Effects would also be identified as significant if Federal, state, or local standards or requirements regulating a public utility system would be violated.

California Environmental Quality Act Considerations

No impacts to utility systems would result from implementation of the two alternatives or Proposed Action (see Table B.6–1). Adequate system capacities exist to support all LLNL operations and LLNL waste management operations. No violations of Federal, state, or local standards or requirements would be expected.

Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

B.6.17 Cumulative Impacts

Cumulative impacts are defined as two or more individual affects that, when considered together, are considerable or that compound or increase other environmental impacts. Cumulative impacts from several projects are derived from the combined incremental impact of the project added to other approved, pending, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor but collectively significant effects.

This section analyzes the cumulative impacts of waste management facilities and associated operations and the implementation of the Proposed Action along with several relevant projects. These other projects considered for cumulative impacts included:

- LLNL SW/SPEIS (Proposed Action, includes several recent environmental assessments)
- SNL/CA Site-Wide Environmental Assessment (Maximum Operation Alternative)

Significance Criteria

An alternative may have significant cumulative effects if it would adversely affect air, water, habitats, natural resources, and other resource areas. Cumulative effects also would be identified as significant if Federal, state, or local standards or requirements regulating aspects of NNSA facilities would be violated.

***California Environmental Quality Act* Considerations**

Several resource areas would, for the purposes of CEQA only, experience cumulatively significant impacts. Worker exposure near the geologically active Greenville and Las Positas faults, cumulatively, would result in a significant impact. Currently both Greenville Road and Vasco Road are at or beyond capacity in the vicinity of I-580. The projected increases in commuters would be greater than 4 percent and result in a significant impact.

Adequate infrastructure (including utilities and hazardous material management) system capacities and waste management capabilities exist to support all LLNL operations and SNL/CA operations. No violations of Federal, state, or local standards or requirements would be expected. Changes in emissions, discharges, and resource management would be less than significant. Specific CEQA considerations resulting in no impacts or Less Than Significant Impacts are presented in Table B.6–1.

B.6.18 Mandatory Findings of Significance

This section analyzes the Mandatory Findings of Significance with impacts of the RHWM facilities and associated operations and the implementation of the No Action Alternative, Proposed Action, and Reduced Operation Alternative.

Significance Criteria

An alternative could have significant effect if it would adversely affect air, water, habitats, natural resources, and other resource areas. Effects also would be identified as significant if Federal, state, or local standards or requirements regulating aspects of the NNSA facilities would be violated.

***California Environmental Quality Act* Considerations**

No impacts are expected. Specific CEQA considerations resulting in no impacts are presented in Table B.6–1.

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APPENDIX C: ENVIRONMENT, SAFETY, AND HEALTH

The purpose of this appendix is to discuss the environment, safety, and health (ES&H) programs at Lawrence Livermore National Laboratory (LLNL), including the Livermore Site and Site 300. Of particular importance is the support this appendix provides to discussions of the related parts of Chapters 4 and 5 of the *Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (LLNL SW/SPEIS).

Section C.1 discusses the regulatory requirements for ES&H programs with which LLNL must comply. Section C.2 discusses the organizations of LLNL that have ES&H responsibilities. This section also discusses LLNL's implementation of the Integrated Safety Management System (ISMS) and the Work Smart Closure Process in support of ES&H programs. Section C.3 discusses occupational exposures to radiation, toxic materials, and other industrial hazards arising from the normal operations of facilities. Section C.4 discusses environmental monitoring programs and the impact of releases of radioactive and toxic materials from normal plant operations. The potential impact to workers and members of the general public from hypothetical accidents is discussed in Appendix D, with transportation accidents discussed in Appendix J. Section C.5 discusses the methods and protocols used by LLNL to assure the quality of these programs.

The line management of LLNL is responsible for providing safe working conditions for LLNL employees, for limiting exposure of the general public in the vicinity to hazardous and radioactive materials, and for implementing environmentally sound operating practices to ensure environmental compliance. The Hazards Control Department, the Environmental Protection Department, and the Health Services Department at LLNL assist in meeting these responsibilities.

C.1 REGULATORY REQUIREMENTS

The U.S. Department of Energy (DOE), in response to Defense Nuclear Facility Safety Board (DNFSB) Recommendation 95-2 (DOE 1995a), committed to implementing an ISMS across the complex by issuing an implementation plan in April 1996 and, subsequently, DOE Safety Management System Policy 450.4 (DOE P 450.4) in October 1996. This policy, along with DOE Acquisition Regulation clauses 970.5204-2 and 970.5204-78 (49 *Code of Federal Regulations* [CFR] Part 970), requires contractors to follow ISMS objectives, guiding principles, and functions, and to describe the approach for implementing and tailoring Integrated Safety Management to the contractor's site/facility or activities. The LLNL ISMS description provides a formally approved institutional structure for Integrated Safety Management developed by LLNL using written guidance and continued detailed interaction and coordination from the National Nuclear Security Administration (NNSA) and DOE. The description contains the LLNL institutional approach for the incorporation and implementation of DOE P 450.4 to "…systematically integrate safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment." Upon final approval by NNSA, this policy establishes the agreement on the content and processes for Integrated Safety Management implementation and continued utilization at LLNL (LLNL 2003cc).

The ISMS is an approach to defining the scope of work, identifying the hazards, establishing controls, performing the work, and concluding with feedback and improvement. The system defines a process for identifying, planning, and performing work that provides for early identification of hazards and associated control measures for hazards mitigation or elimination. The ISMS process also forms the basis for work authorization and both internal and external assessment that provides a continuous feedback and improvement loop for identifying shortcomings and successes for incorporation into subsequent activities.

ISMS controls for workplace hazards are specified in a safety and health framework based upon a set of written policies, rules, orders, and standards. LLNL, University of California, and DOE used the necessary and sufficient process to select a comprehensive set of standards that define the ES&H requirements for LLNL into Contract 48 (LLNL 2002db) in accordance with Clause 5.5(f): "Environmental, safety, and health requirements applicable to this contract may be determined by a DOE approved process to evaluate the work and associated hazards and identify an appropriately tailored set of standards, practices, and controls…"

Applying the necessary and sufficient process requires the adherence to DOE policy, "Authorizing Use of the Necessary and Sufficient Process for Standards-Based Environment, Safety and Health Management," DOE P 450.3 of January 25, 1996, and the DOE Manual, "The Department of Energy Closure Process for Necessary and Sufficient Sets of Standards," DOE M 450.3-1 of March 1996. These documents define the process and its required elements. During the establishment of the necessary and sufficient process at DOE, it was determined that the resulting standards should be called Work Smart Standards.

The Work Smart Standards are important as input to the ISMS and as a key operational component for developing controls. In the relationship between the standards and ISMS, the standards provide general and specific requirements that are tailored to LLNL activities and the ISMS establishes the structure and implementation mechanisms for using these Work Smart Standards as the basis for performing work safely.

As changes occur, there will be new knowledge, technologies, and issues. With these, there will be new laws, regulations, and standards. Consequently, there is a need to periodically review and update the Work Smart Standards in Contract 48 using a formal process. A formal change control process for the standards utilizes the principles of the necessary and sufficient process. The change control process provides a system to keep these standards up to date and includes provisions for addressing new and special situations that might arise from any source.

More information on the LLNL ISMS and Work Smart Closure Process will be discussed later in this appendix. A complete listing of Work Smart Standards requirements, including the necessary and sufficient groupings, may be found at http://labs.ucop.edu/internet/comix/contract/LLNL/wss_llnl.pdf.

C.2 ORGANIZATIONS TO ADDRESS ENVIRONMENT, SAFETY, AND HEALTH

C.2.1 Lawrence Livermore National Laboratory Organizations and Responsibilities

Each associate director and program leader at LLNL is responsible for ensuring that work activities under their direction are conducted in a manner that produces high quality results, preserves environmental quality, and protects the health and safety of the workers and the public. The Safety and Environmental Protection Directorate provides ES&H and other technical support services to all directorates, primarily through the Hazards Control, Environmental Protection, and Health Services departments.

The management and execution of the ES&H Program is a distributed task, i.e., each LLNL line organization integrates applicable elements of the ES&H Program into its work activities. Some administrative offices with significant ES&H-related responsibilities, e.g., the Office of the Laboratory Counsel and the Office of Contract Management, presently report to the Director's Office. Other organizational elements provide technical support and advisory, assurance, and oversight functions. The management structure for the ES&H Program provides for the following key responsibilities:

- Implementation of the ES&H Program is a line management responsibility that is delegated from the director to the associate directors, and then flows through each associate director's line/program/discipline management chain to each employee.

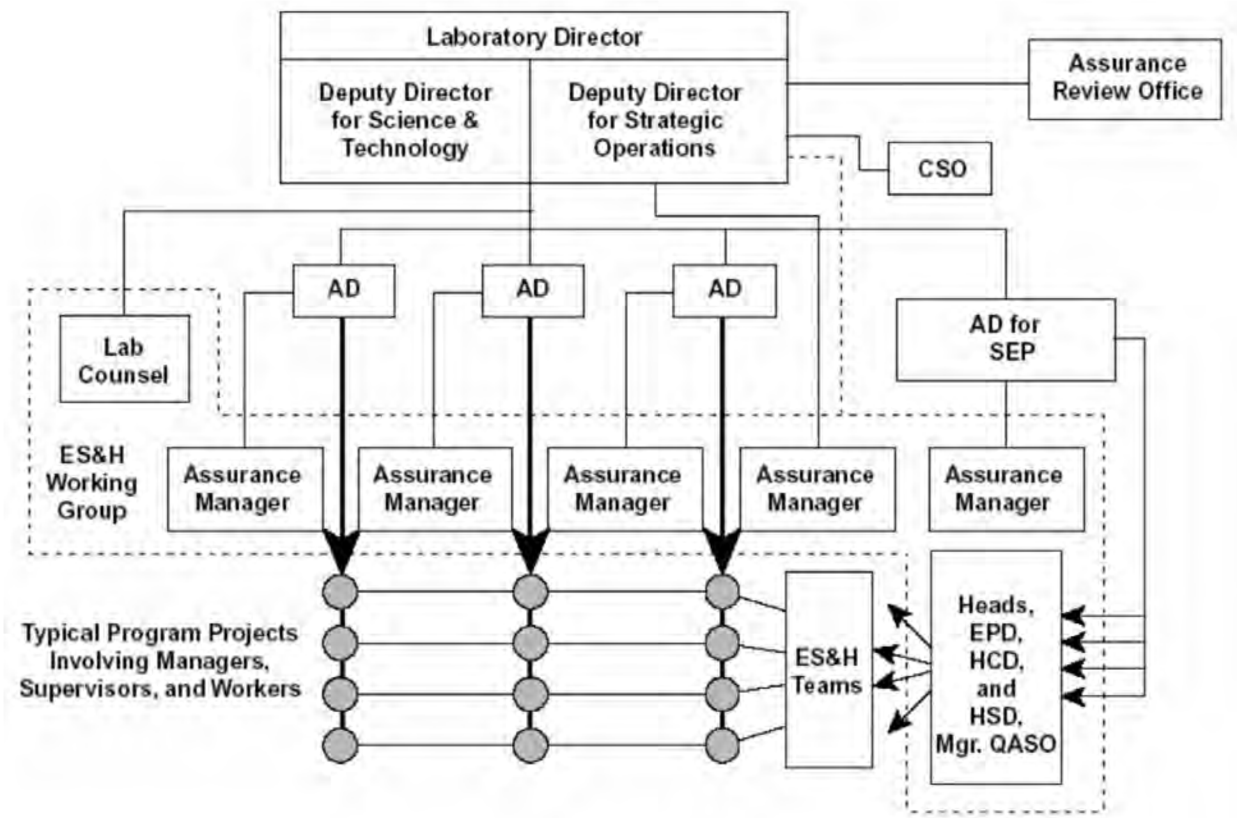
- The Deputy Director for Operations advises the Director on ES&H policies and institutional issues, with input from the ES&H Working Group and other ES&H committees, and oversees the effectiveness of activities and programs to implement these policies.

- ES&H institutional planning and technical support to the directorates are provided by the Associate Director/Safety Environment Protection Directorate.

- Assurance that ES&H Program implementation is performed at the directorate level by an assurance manager who, reporting to the associate director, also provides independent oversight.

- Institutional independent oversight of the ES&H Program implementation by the directorates is performed by the Assurance Review Office.

The basic relationships and groupings of positions and organizational elements contributing to ES&H management at LLNL are depicted in Figure C.2.1–1. This management structure is used for the full range of activities—construction, startup, routine operations, maintenance, emergencies, and demolition. The figure illustrates LLNL's formal lines of decisionmaking authority and responsibility and outlines the hierarchy of the organizational elements (LLNL 2003k).

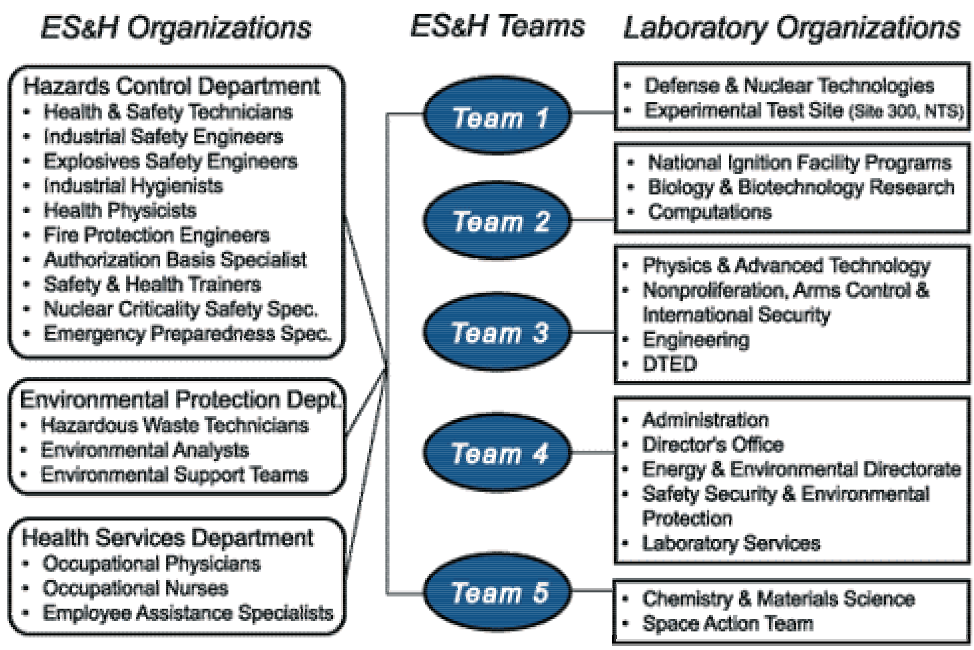


Source: Original.
AD = Associate Director; CSO = Council on Strategic Operations; EPD = Environmental Protection Department; ES&H = Environmental, Safety, and Health; HCD = Hazards Control Department; QASO = Quality Assurance Support Office.

FIGURE C.2.1–1.—*Organizational Structure and Connections at Lawrence Livermore National Laboratory for Operations and Environmental, Safety, and Health Management*

The associate directors have the responsibility and authority for conducting LLNL's programmatic work and for applying and fulfilling LLNL's ES&H policies in the performance of that work. Associate directors must be aware of statutory, regulatory, and contractual ES&H requirements applicable to their operations and facilities. In meeting their obligations, each associate director can simultaneously function in one or more of the following four operational functions: program, payroll, facility, and services. For many mission projects, the Program Associate Director is also the Payroll, Facility, and Services Associate Director. Authorities for the different operational functions vary, but the Program Associate Director has the primary responsibility.

Figure C.2.1–1 also shows the ES&H Working Group composition and how it is connected into the entire organizational structure of LLNL. Figure C.2.1–2 depicts the support structure by which ES&H organizations, subject matter experts, and teams interface with all LLNL programs and organizations. The composition of each team is tailored to the work of specific programs and organizations. An ES&H Team can be configured with a wide range of disciplines. In addition, experts from outside LLNL can be called in when needed. ES&H Teams are assigned to each Directorate and the Director's Office. Details of the ES&H Teams' responsibilities are included in the ES&H Manual (LLNL 2000i).



Source: LLNL 1998d.

FIGURE C.2.1–2.—*Environment, Safety, and Health Support Structure*

The ES&H Working Group (which reports to the Deputy Director for Operations) is composed of assurance managers from each directorate, the four heads of the ES&H and quality assurance technical support organizations, and representatives from the Legal Office (as nonvoting members). The Deputy Director for Operations selects the chairperson of the group on a calendar year basis.

The ES&H Working Group reviews and makes recommendations for approving most institutional-level ES&H implementation documents containing requirements and guidance, which are developed by the ES&H technical support organizations. These documents are based upon contractually required laws, regulations, and standards. The final documents are approved and signed by the Deputy Director for Operations prior to publication in the ES&H Manual (LLNL 2000i). There are four standing subcommittees: Environmental, Institutional, Nuclear Facilities, and Hazards Control, Health Services, and Emergency Services, that support the ES&H Working Group in fulfilling its obligations by analyzing and reviewing specific ES&H issues. The subcommittees comprise Working Group members, program representatives, and subject-matter experts.

The Council on Strategic Operations is a committee of associate director-level managers that reviews and advises the Deputy Director for Strategic Operations on institutional cross-cutting operational issues. Approximately half of their time is spent on ES&H items having major impact on LLNL.

ES&H expertise and technical support to LLNL line organizations is provided by four functional organizations reporting to the Associate Director/Safety and Environmental Protection Directorate (LLNL 1996b): Hazards Control Department, Environmental Protection Department, Health Services Department, and Quality Assurance Office.

In general, these organizations are responsible to the Associate Director/Safety and Environmental Protection Directorate for performing the following functions:

- Interpret DOE directives and, in collaboration with LLNL Counsel, ES&H laws and regulations
- Develop or revise LLNL policies for review by the ES&H Working Group and Senior Management Council and approval by the Director
- Develop policy implementation guidance for review and approval by the ES&H Working Group
- Publish ES&H and Quality Management/Quality Assurance manuals, guidelines and other supplemental information on how to satisfy ES&H and quality assurance requirements
- Develop and conduct ES&H and assurance program personnel training
- Review operations and procedures, and advise on appropriate protective measures and controls
- Assist line organizations with preparing safety, environmental, and quality management documentation
- Monitor operations and work sites to provide management with the information needed to help maintain a minimal-risk work environment
- Provide services and direct support to line organizations to aid them in meeting their ES&H requirements
- Provide health services, such as examinations, treatment of occupational and minor nonoccupational injury and illness, consultations, agent-specific health surveillance, and fitness-for-duty evaluations
- Provide ES&H review of new facilities design

C.2.1.1 *Organization of the Hazards Control Department*

The head of the Hazards Control Department reports to the Associate Director/Safety and Environmental Protection Directorate, who is responsible for providing assistance to line managers for occupational health and safety programs and environmental protection programs at LLNL. The Hazards Control Department provides assistance to line managers for radiological and nonradiological occupational safety (LLNL 2002bk).

The Hazards Control Department is comprised of three divisions: the ES&H Teams Division, the Safety Programs Division, and the Emergency Management Division.

The ES&H Teams Division has the primary responsibility of providing environmental, safety and health support to LLNL programs and organizations. The five ES&H Teams provide services and support programmatic and overhead organizations to help them ensure a safe and healthy workplace. Each team services specific program areas and consists of safety and health discipline members and health and safety technologists. In addition, environmental analysts from the Environmental Protection Department and Health Services Department personnel are matrixed into the teams.

The Safety Programs Division supports LLNL by providing the institutional leadership and direction of those safety programs necessary to maintain a safe and healthy workplace for staff and the surrounding community. This is accomplished by offering technical analysis and support, training programs, analytical services, and guidance to LLNL on how to comply with applicable rules, regulations, orders, and standards.

The Safety Programs Division works to ensure that consistent safety programs are developed and implemented for LLNL. This division maintains safety programs in authorization basis, chemical and biological safety, occupational safety, criticality safety, and radiation safety, and provides safety education and training. This division also provides other institutional functions, such as chemical safety officer, respirator program administrator, electrical safety officer, internal dosimetry program coordinator, pressure safety coordinator, non-ionizing radiation safety officer, x-ray safety coordinator, and other institutional functions as assigned by the Hazard Control Department Head. Additional institutional services provided include the safety glasses office; respirators shop; whole body counter; hand-held instrument maintenance and calibration; chemical and radiological analyses and full dosimetry services; training services covering; other computer-based and classroom instruction, and coordination and development of the combined ES&H Manual and the health and safety portion of the manual.

The Emergency Management Division responds to emergency incidents on LLNL and Sandia National Laboratories/California properties to ameliorate the effect of incidents so as to limit the further loss of life, extension of injuries, and loss of property to LLNL, its employees, and the surrounding community. This division houses the institutional function of Laboratory Fire Marshal. In support of this mission, the division performs emergency dispatch and response for security emergencies, fire prevention and control, and liaison with surrounding emergency agencies.

C.2.1.2 *Organization of the Environmental Protection Department*

As the lead organization at LLNL for providing environmental expertise and guidance on operations at LLNL, the Environmental Protection Department is responsible for environmental monitoring, environmental regulatory interpretation and implementation guidance, environmental restoration, environmental community relations, and hazardous waste management in support of LLNL's programs. This department prepares and maintains environmental plans, reports, and permits; maintains the environmental portions of the ES&H Manual; informs management about pending changes in environmental regulations pertinent to

LLNL; represents LLNL in day-to-day interactions with regulatory agencies and the public; and assesses the effectiveness of pollution control programs. These functions are organized into three divisions within the department: Operations and Regulatory Affairs Division, Radioactive and Hazardous Waste Management (RHWM) Division, and the Environmental Restoration Division.

The Environmental Protection Department monitors air, sewerable water, groundwater, surface water, soil, sediments, vegetation, and foodstuff, as well as direct radiation; evaluates possible contaminant sources; and models the impact of LLNL operations on humans and the environment. In 2002, 11,877 samples were taken, and 212,689 analytes were tested. The type of samples collected at a specific location depends on the site and the potential pollutants to be monitored (LLNL 2003c).

A principal component of the Environmental Protection Department's mission is to work with LLNL programs to provide guidance and expertise so that operations can be conducted in a manner that assures compliance with regulatory guidelines. As requested by programs, Environmental Protection Department helps LLNL programs manage and minimize hazardous, radioactive, and mixed wastes; determines the concentrations of environmental contaminants remaining from past activities; cleans up environmental contamination to acceptable standards; responds to emergencies in order to minimize and assess any impact on the environment and the public; and provides training programs to improve the ability of LLNL employees to comply with environmental regulations.

The Operations and Regulatory Affairs Division currently consists of six groups that specialize in environmental compliance and monitoring and provide LLNL programs with a wide range of information, data, and guidance to make more informed environmental decisions. This division prepares the environmental permit applications and related documents for submittal to Federal, state, and local agencies; acts as the liaison between LLNL and regulatory agencies conducting inspections; tracks chemical inventories; prepares *National Environmental Policy Act* (NEPA) documents for DOE and NNSA and conducts related field studies; oversees wetland protection and floodplain management requirements; coordinates cultural and wildlife resource protection and management; facilitates and provides support for the pollution prevention and recycling programs; teaches environmental training courses; coordinates the tank environmental compliance program; conducts compliance and surveillance monitoring; provides environmental impact modeling and analysis, risk assessment, and reporting; and develops new methods and innovative applications of existing technologies to improve environmental practices. The Operations and Regulatory Affairs Division also assists in responding to environmental emergencies such as spills. During normal working hours, an environmental analyst from the Operations and Regulatory Affairs Division Environmental Operations Group responds to environmental emergencies and notifies a specially trained Environmental Duty Officer. Environmental Duty Officers are on duty 24 hours a day, 7 days a week, and coordinate emergency response with LLNL's ES&H Team and other first responders or environmental specialists (LLNL 2003l).

All hazardous, radioactive, medical, and mixed wastes generated at LLNL facilities are managed by RHWM in accordance with local, state, and Federal requirements. RHWM processes, stores, packages, solidifies, treats, and prepares waste for shipment and disposal, recycling, or discharge to the sanitary sewer. As part of its waste management activities, RHWM tracks and documents the movement of hazardous, mixed, and radioactive wastes from waste accumulation areas, which are located near the waste generator, to final disposition; develops and implements approved standard operating procedures; decontaminates LLNL equipment; ensures that containers for waste shipment meet the specifications of the U.S. Department of Transportation and other regulatory agencies; responds to emergencies; and participates in the cleanup of potential hazardous and radioactive spills at LLNL facilities. RHWM prepares numerous reports, including the annual and biennial hazardous waste reports required by the state and Federal environmental protection agencies. RHWM also prepares waste acceptance criteria documents, safety analysis reports, and various waste guidance and management plans. RHWM meets regulations requiring the treatment and disposal of LLNL's mixed waste in accordance with the requirements of the *Federal Facility Compliance Act* (Public Law 102-386). The schedule for this treatment is negotiated with the State of California and involves developing new onsite treatment options as well as finding offsite alternatives. RHWM is responsible for implementing a program directed at eliminating the backlog of legacy waste, which is waste that is not presently certified for disposal. This effort includes a large characterization effort to identify all components of the waste and a certification effort that will provide appropriate documentation for the disposal site.

The Environmental Restoration Division was established to evaluate and remediate soil and groundwater contaminated by past hazardous materials handling and disposal processes, and from leaks and spills that have occurred at the Livermore Site and Site 300, both prior to and during LLNL operations. This division conducts field investigations at the Livermore Site and Site 300 to characterize the existence, extent, and impact of contamination. This division also evaluates and develops various remediation technologies, makes recommendations, and implements actions for site restoration. The Environmental Restoration Division is responsible for managing remedial activities, such as soil removal and groundwater extraction, and for assisting in closing inactive facilities to prevent environmental contamination. As part of its responsibility for *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) (42 U.S.C. §9601 et seq.) compliance issues, the division plans, directs, and conducts assessments to determine the impact of past releases on the environment and the restoration activities needed to reduce contaminant concentrations to protect human health and the environment. This division interacts with the community on these issues through environmental community relations. Public workshops are held annually and information is provided to the public as required in the community relations plans. To comply with CERCLA groundwater remedial actions at the Livermore Site, the Environmental Restoration Division has to date designed, constructed, and operated 5 fixed groundwater treatment facilities and associated pipeline networks and wells, 20 portable groundwater treatment units, 2 catalytic dehalogenation units, and 3 soil vapor extraction facilities. In 2001, the Environmental Restoration Division operated 4 fixed, 19 portable, 2 catalytic reductive dehalogenation, and 2 soil vapor treatment units. The division also installed an electro-osmosis system to improve its ability to remove contaminants from fine-grained sediments. At Site 300, the division has designed, constructed, and operated 3 soil vapor extraction facilities and 11 groundwater extraction and treatment facilities. In addition, the division has capped and closed four landfills and the explosives rinse water lagoons and burn pits, excavated and closed numerous wastewater disposal sumps; and removed contaminated waste and soil to prevent further impacts to groundwater at Site 300. The Environmental Restoration Division is actively designing, testing, and applying innovative remediation and assessment technologies to contaminant problems at the Livermore Site and Site

300. The division also provides the sampling and data management support for groundwater surveillance and compliance monitoring activities (LLNL 2003l).

The Environmental Protection Training Program provides LLNL workers the appropriate training support to ensure that they have the knowledge, skills, and abilities to competently, safely, and effectively carry out the environmental protection responsibilities of their work assignments. In 2001, this program provided nearly 9,000 hours of environmental protection training to LLNL workers involved in science related work at LLNL. The Environmental Protection Training Program also provided an additional 3,000 hours of specialized training to LLNL environmental professionals involved with the management of waste and other environmental protection activities. The environmental training developed and delivered to LLNL workers during 2001 addressed the requirements of NEPA, the *Resource Conservation and Recovery Act*, the *Superfund Amendment and Reauthorization Act*, Occupational Safety and Health Administration, and other Federal and State of California regulatory requirements. Training subjects included hazardous waste management; low-level waste generation and certification; transuranic waste generation and certification; spill prevention, control, and countermeasures; pollution prevention; and other related topics. The training program staff is supported in the development and delivery of training by environmental protection subject matter experts from the three Environmental Protection Department divisions. The divisions provide the assessment and interpretation of training to be given to LLNL workers and to internal Environmental Protection Department specialists. In addition, the divisions supply subject matter experts and personnel who are trained and qualified to be instructors. The staff consists of trained professionals and technical and administrative personnel familiar with the various environmental regulations and requirements and cognizant of LLNL operations requiring environmental protection training (LLNL 2003l).

C.2.1.3 *Health Services Department*

The Health Services Department provides an occupational health program that meets regulatory requirements and professional standards to assist in providing a safe and healthful work environment. The Health Services Department provides:

- Treatment for occupational and minor non-occupational injuries and illnesses
- Emergency care, stabilization, and transfer to local emergency room
- Return-to-work assistance after injuries and illnesses
- Multidisciplinary worksite inspections regarding health hazards and environmental conditions; medical surveillance, qualification and fitness for duty examinations
- Educational programs designed to address health concerns in the workplace
- Health promotion services
- Physical therapy for occupational injuries and illnesses
- Decontamination and treatment for chemical or radiological exposures

- Employee assistance services

LLNL implemented the Return-to-Work Program in November of 1999 to better serve the needs of employees who suffer work- or nonwork-related injuries or illnesses resulting in lost worktime or medical restrictions. This program is an integral part of the LLNL Integrated Safety Management program. The intent of the program is to implement a system for returning employees to work quickly and safely after injury or illness, and to improve LLNL's capability of identifying and appropriately managing temporary and permanent disabilities. Specifically, the Return-to-Work Program objectives are:

- Provide support to employees in their recovery from injuries or illnesses by providing temporary, modified, or alternate assignments

- Provide enhanced support to employees following both occupational or non-occupational injuries or illnesses by better coordinating programs, processes, and services

- Minimize the amount of absence and resulting impact to both the employee and the organization due to these injuries or illnesses

- Implement effective disability case management

C.2.2 Integrated Safety Management System and Work Smart Standards

On March 3, 1999, Secretary of Energy Richardson directed all DOE and contractor employees to put Integrated Safety Management in place by September 2000 (Richardson 2000). LLNL previously met its first major milestones when it delivered the first versions of the Superblock description to the NNSA Oakland Operations Office in October 1998 and the LLNL institutional description in December 1998. In parallel, the LLNL Work Smart Standards were completed and confirmed in March 1999. They were signed and incorporated into Contract 48 on August 5, 1999. Further accomplishments were made with the Superblock ISMS Phase I and II Verification completed in September 1999 and the NNSA Oakland Operations Office approval of the Superblock ISMS description on September 30, 1999, contingent on addressing two items, which have been done, and the process proceeds for finalization. The second version of this institutional ISMS description addressing NNSA Oakland Operations Office comments, including LLNL items to make it more complete and understandable, was completed in October 1999. The verification of the LLNL institutional ISMS was successfully completed in September 2000. The Superblock ISMS description and the LLNL site-wide ISMS descriptions are reconciled (LLNL 2003cc).

The creation and development of Integrated Safety Management in NNSA operations has evolved over time. The *Price-Anderson Amendments Act* in 1988 (Public Law 100-408) is seen as a start in Integrated Safety Management along with the fundamental changes brought about with the end of the Cold War. Actions by the Defense Nuclear Facilities Safety Board in their Recommendations 90-2 and 92-5, site visits by the Tiger Teams, and DOE Nuclear Safety Order upgrades led to increased attention and formalization in DOE operations. The DOE initiation of the Necessary and Sufficient Standards in 1995, which became the Work Smart Standards, continued that process. Defense Nuclear Facilities Safety Board Recommendation 95-2 combined several prior recommendations and considerations in reports and became the primary driver for Integrated Safety Management, which is contained in the DOE Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 95-2 (DOE 1995a). The DOE Safety Management System Policy, DOE P 450.4, of October 15, 1996 (LLNL 2002b), presented the structure to "provide a formal, organized process whereby people plan, perform, assess, and improve the safe conduct of work." It was "institutionalized through DOE directives and contracts to establish the Department-wide safety management objective, guiding principles, and functions." The applicable Department of Energy Acquisition Regulation amendment followed in 1997 and Clause 6.7, "Integration of Environment, Safety, and Health into Planning and Execution," became part of the University of California DOE contract for LLNL on October 1, 1997. Direction and guidance on Integrated Safety Management continues to be developed and refined as the process proceeds with Secretary Richardson's Memorandum of March 3, 1999, on "Safety-Accountability and Performance," (Richardson 1999a) and the revised ISMS Guide, DOE P 450.4-1A, of May 27, 1999 (DOE P 450.4), being recent major items.

The LLNL ISMS description (LLNL 2003cc) provides a formally approved institutional structure for Integrated Safety Management developed by LLNL using written guidance and continued detailed interaction and coordination from NNSA and DOE. It contains the LLNL institutional approach for the incorporation and implementation of the DOE Safety Management System Policy, DOE P 450.4 to "…systematically integrate safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment." Upon final approval by NNSA, it establishes the agreement on the content and processes for Integrated Safety Management implementation and continued utilization at LLNL.

The description identifies the core requirements that provide the foundation for safety management at LLNL. These requirements implement DOE's seven guiding ISMS principles and five core functions along with LLNL's Fundamental Guiding Principle.

DOE Seven Guiding Principles
1. Line management responsibility for safety
2. Clear roles and responsibilities
3. Competence commensurate with responsibilities
4. Balanced priorities
5. Identification of safety standards and requirements
6. Hazard controls tailored to work being performed
7. Operations authorization
DOE Five Core Functions
1. Define the scope of work
2. Analyze the hazards
3. Develop and implement hazard controls
4. Perform work within controls
5. Provide feedback and continuous improvement

Lawrence Livermore National Laboratory Fundamental Guiding Principle

Each worker, supervisor, and manager is directly responsible for ensuring his or her own safety and promoting a safe, healthful, and environmentally sound workplace and community.

The above fundamental requirements provide the necessary specificity and detail for Integrated Safety Management implementation through LLNL documentation. The ES&H Manual is the principal institutional mechanism for implementation. The LLNL Fundamental Guiding Principle differs somewhat from the Occupational Safety and Health Administration General Duty Clause (clause 5a (1) of the *Occupational Safety and Health Act* of 1970, which is contained in an LLNL Work Smart Standards (LLNL 2002db). This states that that it is the employer's duty to provide a safe and healthy workplace. These two concepts go hand-in-hand.

Core Requirements

The comprehensive set of core requirements developed and presented in the description has the following principal elements:

Accountability

Regarding the LLNL Fundamental Guiding Principle, all workforce members are held accountable for meeting LLNL's ES&H requirements. Accountability is established and enforced through the following primary means:

- Communicate ES&H expectations to employees
- Reinforce expectations through timely verbal feedback
- Implement formal appraisal and salary actions for each employee, annually
- Award and recognize notable contributions to ES&H
- Use corrective action in cases of employee misconduct

Safety Responsibility

Ultimately, management is responsible for safety.

Management Chain

Organizations that authorize work identify a management chain for each work activity. Such organizations identify the individuals serving in the chain, such as first-level supervisor (Responsible Individual) up to responsible Associate Director. The management chain has clear roles, responsibilities, and authorities for managers, supervisors, and workers. The chain has direct control over the funding of the work activity. It exists for all LLNL operations down a clear line of funding and ES&H responsibility. The chain has full responsibility for implementing DOE's seven guiding principles and five core functions. Ultimately, it ensures that individuals perform work safely.

Subcontractors

LLNL's commitment to safety and Integrated Safety Management is formally extended to subcontractors and subcontract employees for whom LLNL has safety responsibility. Safety requirements are to be incorporated into all subcontracts and flowed down to lower-tier subcontractors, as appropriate.

Graded Approach and Tailoring

At LLNL, ISMS provides for a graded approach; i.e., different levels of rigor and formality, when applying controls commensurate with the hazards involved. To complement this, tailored controls address the hazards, satisfy the applicable requirements, and provide protection to the public, workers, and the environment.

Work Planning and Authorization

Work would be planned, reviewed, and authorized before the activity begins. An appropriate prestart review is conducted to validate satisfaction of the safety requirements. Once the work begins, it is appropriately controlled. Workers are responsible for adhering to the safety controls, and responsible individuals ensure the work is performed according to the defined work controls). Responsible individuals ensure that workers have access to and knowledge of governing procedures and work controls for any given activity.

Feedback and Improvement

Work activities would be monitored to ensure that governing procedures and safety documents are being followed. Workers are to inform responsible individuals of safety concerns and opportunities for improvement. A worker can stop work if there is an unsafe or unapproved condition. Each directorate develops and operates a safety self-assessment program guaranteeing a proactive approach to safety and improve safety performance. Directorates are also responsible for root-cause analysis and correction of safety-related problems. After an activity is completed, lessons learned are shared to enhance operational safety and facilitate cost effectiveness.

Integration

Integration of program and safety planning from the director down to individual workers is attentive to the institution/facility/activity process. Basic to LLNL integration and operations is the ES&H Manual and incorporation of its ISMS fundamentals. Worker involvement is critical to Integrated Safety Management, thus an important integration direction is a formalized upward involvement of workers as well as top down through the institution/facility/activity process. In this context, all work activities are to be performed according to the provisions of the ES&H Manual with the assistance of ES&H subject matter experts and ES&H Teams. Horizontal integration across the directorates is accomplished through many established groups.

Directorate Implementation Plans

To establish the flow down of ISMS requirements from institutional requirements to the working level, each directorate has an ISMS implementation plan or other established directorate plans or documents that succeed the implementation plan to satisfy the requirements specified in the description. Separate directorate implementation plans are appropriate because each directorate has unique programmatic missions with different types of facilities, technical work, and hazards. Directorate implementation plans or succeeding documents shall reference specific implementing provisions for each of the core requirements established in the description. When uniform practices are mandated, each directorate references the specified implementing provisions. Directorate implementation plans define the organization's document hierarchy and the safety roles, responsibilities, and authorities for each position level within the organization. Initial directorate implementation plans are subject to institutional review to assure that the requirements established in the description are satisfied. The directorate implementation plan may be the chosen continuing operating document or it may be the transition document; thus, appropriate succeeding documentation may be necessary. This is specifically noted or added in particular sections for completeness and emphasis.

Environment, Safety, and Health Manual

To be in line with the increased formalization brought about by Integrated Safety Management, LLNL has assembled broadly-used institutional ES&H documents into a formal document structure called the ES&H Manual (LLNL 2000i). This new comprehensive manual consolidates many documents into one convenient online package. It includes what was formerly the Health & Safety Manual and the Environmental Compliance Manual. LLNL performs work to meet the requirements of the new manual. Its requirements are based on the Work Smart Standards identified for specific LLNL work and associated hazards. With the implementation of Integrated Safety Management, employees must understand the latest ES&H requirements and their responsibilities.

Communications and Training

Integrated Safety Management communications has the long-term goal of helping to change LLNL's safety culture. The strategy behind long-term communications and training is to position the concept of workplace safety alongside those of technical excellence and quality work in everyday LLNL life. This is done by placing the subject of safety and key safety messages in front of employees frequently, using a variety of media, making sure employees have appropriate training, and by involving employees in identifying and solving safety problems.

Many different communication tools and approaches would be used to engage employees at all levels. Planning includes campaigns to promote awareness of specific concerns such as eye protection, expanded development and communication of lessons learned, promotion of the online ES&H Manual, communications guidance for supervisors, computer-based information sources, and special events. Feedback mechanisms will be used to identify problems and successes as Integrated Safety Management continues to mature.

The application of a best management practices is providing the framework for future communication. The best management practices were derived from a laboratory study of industrial and scientific sites known for good safety records, from laboratory-led focus groups, and from experiences of various employees and managers. The best management practices include repetition of message, promotion of off-the-job safety, participation of senior management, continuous training, and employee involvement.

Standards and Requirements

Contract 48 stands as the fundamental basis for LLNL operations. It provides the legal foundation for all activities. Clause 6.7 of Contract 48 is the foundation of Integrated Safety Management and is consistent with DOE P 450.4-1A (LLNL 2002db).

Work Smart Standards

Clause 5.5 of Contract 48 contains the language providing for Work Smart Standards, which establish workplace safety controls and are an integral part of Integrated Safety Management. DOE, University of California, and LLNL collaborated in the necessary and sufficient process to tailor Work Smart Standards for LLNL, which replaced existing contractual ES&H requirements. An outside independent team of ES&H experts confirmed the standards to be appropriate and feasible for LLNL in March 1999. On August 5, 1999, the DOE Oakland Operations Manager and LLNL Director gave signature approval for the Work Smart Standard set, which was incorporated into Contract 48 (LLNL 2003k).

Maintenance of Work Smart Standards

These Work Smart Standards can be modified to meet LLNL's changing needs. A formal change control process, using the necessary and sufficient process, provides a mechanism to keep the Work Smart Standards current.

Flow Down of Requirements

LLNL operations are addressed through safety management processes and controls noted in the ES&H Manual. This manual and other institution-level documents include formal processes for applying requirements locally at the facility and activity levels. A key to the flow down process is the formal incorporation of the Work Smart Standards into the ES&H Manual.

Change Control Process

A formal change control board reviews requests for changes to this description and to the currently separate ISMS description for the LLNL Superblock. The Superblock description addresses hazards that require a higher level of formality and specificity than those for most other LLNL operations. There are three members of the change control board, representing NNSA, University of California, and LLNL. These members are appointed by their respective organizations. The change control board Chair is the NNSA representative (LLNL 2003k).

C.3 OCCUPATIONAL HEALTH AND SAFETY

C.3.1 Occupational Radiation Exposures

Ionizing radiation includes alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. The amount of energy deposited in any medium (e.g., tissue) is measured in rads. A dose of one rad means the absorption of 100 ergs per gram of absorbing tissue. The effect of ionizing radiation on humans is measured in rems and is calculated from the absorbed dose multiplied by a quality factor corresponding to each type of radiation. This dose equivalent is applied to the location, i.e., the human organ, of energy absorption. The dose equivalent for the various human organs can be multiplied by a weighting factor for that organ in order to obtain the effective dose equivalent. The weighting factor of an organ or tissue is the proportion of the risk of effects resulting from irradiation of that organ or tissue to the total risk of effects when the whole body is irradiated uniformly. In this way, the dose equivalent to the various irradiated organs (from various sources and internal and external exposure pathways) can be effectively summed in a manner that allows comparison between exposure scenarios.

Employees working in the radioactive materials area are the site personnel most likely to be exposed to radiation either internally or externally. Exposure pathways for internal dose include inhalation and dermal absorption. Internal exposure is typically monitored by bioassays (e.g., urinalysis, whole-body scans, lung counts). Routine bioassays are done on workers who, under typical conditions, are likely to receive a dose from occupational exposures of 0.1 rem or more in a year. Others who would be assayed include occupationally exposed minors, members of the public, and pregnant workers who are likely to receive an internal dose of at least 0.05 rem (or, in the case of pregnant workers, an equivalent dose to the embryo/fetus). Internal exposures are minimized in keeping with the concept of as low as reasonably achievable, which is applied through the use of engineering devices (e.g., high-volume air hoods), administrative controls, and personal protective equipment such as gloves, protective clothing, and respirators. All work areas are sampled periodically, and areas susceptible to internal exposures are monitored continuously.

External exposures are those received from radiation-emitting sources outside the body; e.g., accelerators, radioactive sources, and radioactive equipment. All personnel at LLNL are assigned a whole-body dosimeter that is attached to their security badge. The badge and dosimeter must be worn at all times when onsite. The dosimeter measures the external radiation dose of the badge wearer.

Dosimeters are read monthly for workers who are likely to receive a measurable external radiation dose under normal conditions, or who could receive a radiation dose under off-normal conditions and might not otherwise be aware of it. They are read quarterly for workers who handle radioactive material but are not likely to receive a measurable external radiation dose under normal conditions, or who would otherwise be aware of off-normal conditions that may result in radiation exposure. They are read semi-annually for workers who are not likely to receive a measurable external radiation dose under normal conditions such as office workers.

The total radiation dose for workers is the sum of internal and external exposure. The total radiation dose to all workers during 2002 was 28.0 person-rem. The maximum individual dose to a worker was less than 2 rem. This is within the regulatory standard for radiological workers, those given unescorted access to radiation areas, of 5 rem per year. Table C.3.1–1 gives the distribution of total (internal + external) annual radiation dose for the recent 5-year period of 1998 through 2002.

TABLE C.3.1–1.—*Distribution of Worker Dose for 1998-2002*

Dose Range (rem)	Number of Workers				
	1998	**1999**	**2000**	**2001**	**2002**
>2.0	0	0	0	0	0
1.5 – 1.999	0	0	0	0	3
1.000 – 1.499	0	1	1	3	4
0.5 – 0.999	4	6	3	7	10
0.1 – 0.499	8	24	22	26	30
0.01 – 0.099	85	106	112	126	115
<0.01	7,236	8,868	8,855	8,721	8,979
Total (Population) worker dose (person-rem)	**6.9**	**14.9**	**12.7**	**18.4**	**28.0**

Source: LLNL 2003as.

Worker doses from occupational exposure to radiation are projected based on recent experience with continuing operations and projections of specific additional operation impacts on involved workers. The bulk of the dose to involved workers from current operations (approximately 90 percent of total worker dose) is from operations at Building 332. This trend is expected to continue; changes in involved worker dose at LLNL are due chiefly to increased operations in that building. The only exception to this is for increases due to the National Ignition Facility operations. Worker dose from NIF operations is based on operation-specific studies.

Increases in worker dose due to new and expanded operations would be expected for the No Action Alternative, Proposed Action, or Reduced Operation Alternative described in this document. The Reduced Operation Alternative would see an increase of worker population dose to 38 person-rem per year. The increase would be a result of NIF operations. The No Action Alternative worker population dose would be 89 person-rem per year. The increase in the latter value over that of the previous 5 years would be a result of increased operations in Building 332 and in the NIF. The corresponding Proposed Action dose would be 93 person-rem per year. Increases in the latter over the No Action Alternative would chiefly be a result of increases in the NIF operations. Maximum individual worker dose would remain within the regulatory standard for the No Action Alternative, Proposed Action, and Reduced Operation Alternative.

LLNL has safety procedures and controls in place to minimize the potential of even inadvertent exposures to personnel. During the recent 5-year period of 1998 through 2002, there were two inadvertent exposures to radiation. LLNL reports such incidents in occurrence reports that include a description of the event, an evaluation of the causes, and corrective actions as appropriate. The dose from these inadvertent exposures is included in the historical record of worker dose (see Table C.3.1–1). These are included in the estimates of radiological impacts to workers for the No Action Alternative, Proposed Action, and Reduced Operation Alternative.

In June 2002, a radiological worker in Building 151 was exposed to radiation as a result of handling unsealed radioactive material. The exposure was discovered during routine monthly processing of ring-type finger dosimeters. Reviews of the work's activities lead to the conclusion that the exposure occurred during handling of californium-249. A dose to the hands of two times the allowed annual DOE extremity radiation dose limit (50 rem) was assigned to the employee. Note that this is an extremity dose, rather than an effective dose equivalent. Higher doses are allowed on extremities than other parts of the body that contain blood-forming organs. The worker did not follow established administrative requirements including requesting ES&H Team support, using adequate shielding, and limiting exposure time. A systematic approach to inform the ES&H Team of activities and operations to improve the integration of the ES&H program were implemented (LLNL 2003ba).

In December 2002, a Fissile Material Handler in the Building 332 Metallography Laboratory detected contamination on his hands after removing them from a glovebox. A second fissile material handler was found to have contamination on his gloves and laboratory coat but subsequent surveys showed that he had received no further contamination. The room was shut down to all programmatic operations and equipment decontaminated. The contamination was determined to originate from a pair of tweezers in an unmarked plastic box in the room. The tweezers were identified as legacy items, with the exact origin undetermined. Subsequent surveys of the laboratory turned up three additional unlabeled items that were contaminated. All such items were appropriately dispositioned. The first fissile material handler was determined to have received an effective dose equivalent of 0.72 rem (LLNL 2003aa).

There were no occurrences involving exposure to radioactivity during the 5-year period prior to 2002.

C.3.2 Chemical and Physical Agent Exposures

As described in Appendix A, LLNL operations and research involve the use of a wide variety of chemicals and physical hazards that could result in short and/or long-term exposures. Workers may be exposed to a variety of chemical and physical hazards at LLNL. Typical physical hazards include non-ionizing radiation, such as static magnetic and electric fields, extremely low frequency fields, radio frequency fields, and microwaves; lasers; electrical shock; falling; and noise; and normal construction activities, skin abrasions, and muscle strains. The purpose of this section is to examine typical potential exposures, expected health effects associated with these exposures, and programs that are in place to limit and reduce potential exposures.

Industrial Hygiene

Some workers at LLNL are potentially exposed to chemicals and physical hazards. LLNL is a research and development facility; therefore, ongoing processes with potential exposure to chemicals occur on a daily basis. The small number of workers who may be exposed to toxic chemicals are exposed in small quantities and only sporadically.

The Hazards Control Department evaluates the workplace to ensure that potential exposures are as low as reasonably achievable. LLNL has a program in place to ensure that the workers are protected from potential workplace hazards. This program is documented in the ES&H Manual (LLNL 2000i).

Engineering controls and safety procedures are the foundation of worker safety at LLNL. These include the facility safety plans, basic safety ground rules that must be followed by all personnel present within a building or area, and the operational safety plans, used primarily by experimenters for specific operations. The operational safety plans are more limited in scope and more specific in content than the facility safety plans.

Toxic Chemicals

Results for toxic material samples collected by the Hazards Control Department in 2001 were reviewed. The sampling activities included routine inspections and use of continuous room monitors, stack monitors, and personnel samplers. Summary sample data for 2001 are shown in Table C.3.2–1. There were 1,350 measurements of ambient air concentrations of toxic materials in 2001. In 1,030 of the 1,350 samples, the concentration of the chemical being analyzed was below the analytical limit of detection (LLNL 2002bk, LLNL 2003bf).

TABLE C.3.2–1.—*Personnel Exposure Monitoring Data for Calendar Year 2001*

Number of chemical analyses performed	1,350
Number of chemical analyses below the limit of detection	1,030 (76.3%)
Number of chemical analyses with measurable results	320 (23.7%)
Number of analyses with results above the DOE action level	1 (0.07%)[a]
Number of analyses above the OSHA PEL or ACGIH TLV	0[a]

Source: LLNL 2003bf.
[a] Data corrected for use of personal respiratory protective devices. Uncorrected numbers indicate 32 (2.4%) sample analyses above the OSHA PEL or ACGIH TLV) (LLNL 2003bf).
ACGIH = American Conference of Governmental industrial Hygienists; DOE = U.S. Department of Energy;
OSHA = Occupational Safety and Health Administration; PEL = permissible exposure limit; TLV = threshold limit value.

There were 32 instances where the measured concentration exceeded established exposure limits, either administrative limits, Occupational Safety and Health Administration permissible exposure limits or American Conference of Governmental Industrial Hygienists threshold limit values; however, in all of these cases, personnel were wearing respiratory protection equipment. The threshold limit values are concentrations of airborne substances that represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. The limit is based on a normal 8-hour workday and a 40-hour workweek. These results indicate the effectiveness of LLNL's program to maintain worker exposures as low as reasonably achievable (LLNL 2003bf).

All workers who handle or work around hazardous materials must be informed of the hazards and be trained in safe handling techniques. Furthermore, in any work area where hazardous substances are present, there must be a written plan for identifying and labeling hazards, maintaining collections of material safety data sheets, providing ongoing training on hazard recognition and control, and notifying workers of their rights to obtain safety information. The plan may also include other requirements such as the use of personal protective equipment, medical surveillance, and emergency planning. These requirements are fulfilled by meeting Integrated Safety Management requirements described in Document 2.1, “Laboratory and ES&H Policies, General Worker Responsibilities, and Integrated Safety Management,” Document 10.2, “LLNL Health Hazard Communication Program,” Document 14.1, “Chemicals,” and Document 14.2, “LLNL Chemical Hygiene Plan for Laboratories,” in the ES&H Manual (LLNL 2000i). The Hazards Control Department assists supervisors and employees in maintaining safe work areas by providing information on the hazardous properties of materials, recommending methods for controlling them, and monitoring the work environment (LLNL 2000i).

The Health Services Department provides an opportunity to all LLNL employees who work with hazardous chemicals to receive medical attention whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed or when medical surveillance is required by Work Smart Standards. In addition, the Health Services Department provides medical attention whenever an event takes place in the work area, such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure. After the examination and treatment, the Health Services Department provides recommendations for further medical followup, including any work restrictions (LLNL 2000i).

Carcinogens

Potential carcinogens are only used in LLNL operations when it is not possible to use noncarcinogenic material. Any use of carcinogens requires stringent controls to be in place to prevent exposures to workers, the public, and the environment. Examples of activities with the potential for exposure to carcinogenic material are listed below:

- Brazing with cadmium-containing alloys or grinding of cadmium-coated work pieces
- Work that generates or involves contact with soots and tars, including coal gasification; use of mineral oil products that may contain polyaromatic hydrocarbons; work performed in close proximity to diesel engines running indoors; electric arc discharge machining; and discharging of gas propellants in a vacuum
- Handling refractory ceramic fibers
- Welding stainless steels, due to the formation of hexavalent chromium compounds and nickel oxide
- Plating chromium and conducting other operations that disperse hexavalent chromium compounds or irritatingly strong concentrations of sulfuric acid into the air
- Generating hard wood dust including carpentry and cabinetry
- Applying sprays of hexavalent chromium compounds including, but not limited to, primers, paints, and sealants containing barium, calcium, sodium, strontium, or zinc chromate
- Handling inorganic arsenic compounds and arsenic metal, including gallium arsenide, in a manner that can result in exposure to arsenic

- Handling animals in research activities involving carcinogens
- Using or synthesizing carcinogens in chemistry or biochemistry laboratories

When potential or actual carcinogens are used in operations, a responsible individual ensures that all controls specified in the ES&H Manual are in place before starting work. Some limitations and exceptions may be permitted as defined in a governing safety plan, facility safety plan, or operational safety plan.

Responsible individuals in laboratories, with the assistance of the ES&H Team, screen new materials using the LLNL list of controlled carcinogens for laboratories. For nonlaboratories, information on material safety data sheets, product label, or vendor’s literature is used to determine if a potential carcinogen is present as well as the LLNL list of controlled carcinogens for nonlaboratories. The Occupational Safety and Health Administration requires that potential carcinogens in concentrations greater than 0.1 percent be listed on the material safety data sheets. If these sheets indicate that the material is a carcinogen, then it is screened using the LLNL list of controlled carcinogens for nonlaboratories.

The responsible individual, with the assistance of the ES&H Team, analyzes operations involving carcinogens to determine the hazard(s) involved and the applicable controls. The formality of the analysis depends on the type of carcinogen involved—human or other—and the complexity of the operation. Some operations may require a detailed analysis to determine if additional controls are necessary. An analysis is not required for carcinogens kept in storage if the reactive and physical hazards (e.g., flammability) and storage concerns (e.g., leaks due to corrosion of containers) are adequately addressed.

Work procedures are required for certain activities involving carcinogens. Work with carcinogens beyond the scale and controls specified on the governing Hazard Assessment and Control form or in the safety plan are reviewed by the ES&H Team industrial hygienist and documented in a revised hazard assessment. Hazard Assessment and Control forms are described in Document 11.1, “Personal Protective Equipment,” in the ES&H Manual (LLNL 2000i).

An evaluation of the waste stream would be conducted prior to the start of operations to determine if the waste to be generated needs to be managed as hazardous. The State of California regulates 16 carcinogens as hazardous wastes if any are present in excess of 0.001 percent by weight (10 parts per million). In addition, other substances that have “...been shown through experience or testing to pose a hazard to human health or environment because of its carcinogenicity” would be managed as hazardous waste. The ES&H Team environmental analyst would provide assistance in this determination. If the waste is determined to be hazardous, it would be managed and handled in accordance with Document 36.1, “Waste Management Requirements,” in the ES&H Manual.

Employees working with carcinogenic compounds receive training in accordance with Document 14.2, “LLNL Chemical Hygiene Plan for Laboratories,” and Document 10.2, “LLNL Health Hazard Communication Program,” in the ES&H Manual (LLNL 2000i).

Non-ionizing Radiation

The ES&H Manual provides guidance to ensure that non-ionizing radiation sources are identified and posted, users are properly trained to work with and around these sources, and measurements are taken to evaluate worker exposures. Controls to mitigate hazards would be implemented when surveys indicate that exposures can exceed acceptable limits. Examples of these potential hazards include:

- Static magnetic and electric fields
- Extremely low-frequency fields with frequencies below 300 hertz, including powerline fields at 60 hertz
- Radio-frequency fields and radiation with frequencies below 300 megahertz
- Microwave radiation with frequencies between 300 megahertz and 300 gigahertz

Engineered controls (e.g., shielding and isolation) are used to restrict exposure whenever practical. Signs complying with good industrial practice, as specified in Document 12.1, "Access Control, Safety Signs, Safety Interlocks, and Alarm Systems," in the ES&H Manual, are posted conspicuously inside and at all entrances to designated potential hazards areas.

Anyone who may reasonably expect to be exposed to fields or radiation emitted by the equipment producing the types of hazards listed above is required to take Course HS4370, "Fields and Waves." This web-based course covers the health effects of radio frequency/microwave radiation and fields and static magnetic fields (LLNL 2000i).

Lasers

LLNL uses many types of lasers, from small lasers used in a laboratory or the field, to large lasers, such as the NIF. Work standards for the safe operation of lasers and laser systems at LLNL follow the recommendations of ANSI Z136.1-2000, "American National Standard for Safe Use of Lasers" (ANSI 2000) and ANSI Z136.2-1997 "American National Standard for Safe Use of Fiber Optic Communication Systems Utilizing Laser Diode and LED Sources (ANSI 1997)." Examples of lasers and laser systems that are used at LLNL may include:

- Commercially available lasers used as part of an experiment or laser development
- LLNL-designed or LLNL-built lasers or laser systems
- Applications of any laser or laser system that are determined to be hazardous by the LLNL Laser Safety Officer, Hazards Control Department, or directorate management following an inspection, evaluation, or review, based on an intended use or application at LLNL
- Commercially available lasers that have been modified, assembled, or incorporated into a device built by LLNL

Using any laser involves exposure to varying degrees of hazards. Most lasers at LLNL can injure the eyes of those who look directly into the beam or its specular, mirror-like reflection. In addition, diffuse reflections created by some high-power laser beams can cause permanent eye damage. High-power laser beams can also burn exposed skin, ignite flammable materials, and heat materials so that they release hazardous fumes, gases, debris, or ionizing and non-ionizing radiation.

The most common hazard when working with lasers is eye injury. To prevent such an injury, workers must avoid looking directly into the laser beam or its specular reflections. This rule must be followed regardless of the protective eyewear worn or the type of hazard classification of laser unless specifically authorized in an operational safety plan or integrated work sheets/safety plan.

The classification of lasers and laser systems is based on the capability to cause injury. Class 1 and Class 2 are considered low-hazard lasers. Class 3a lasers are considered medium-hazard lasers. Class 3b and 4 lasers are considered high-hazard lasers and require more stringent controls.

Equipment and optical apparatus required for producing and controlling laser energy introduce other hazards, including high voltage, high pressure, cryogenics, noise, additional radiation, flammable materials, laser dyes and solvents, and toxic fluids.

Prior to the initial use of a laser or laser system, the responsible individual conducts pre-work planning. Steps to be conducted include:

- Review the proposed project.
- Complete a hazard analysis.
- Select the necessary controls to minimize exposure.
- Identify the work procedures to be followed.
- Identify the personnel who will be conducting the operation and the materials and hardware to be used.

The level of detail for each step depends on the proposed activity's complexity and degree of risk. Because many controls for lasers are case-dependent, early involvement of the area ES&H Team is essential. The original project decisions may have to be modified after further analysis. These pre-job reviews are typically performed using the integration work sheet process. Pre-work planning, using the integration work sheet, encompasses the specific hazards of building up a system, including initial laser and optical alignments, connections to power, pressurized systems, etc. Appendix B of Document 20.8, "Lasers," and Document 3.4, "Preparation of Work Procedures," in the ES&H Manual (LLNL 2000i) provides guidance for considerations in writing a beam-alignment procedure.

Many hazards other than laser radiation can be found in the laser area. The responsible individual must adequately control the hazards to prevent injury while working with lasers. Some of these nonlaser hazards are discussed in the following sections.

Dyes and Solutions

Dye lasers normally use a lasing medium that comprises a complex, fluorescent, organic dye dissolved in an organic solvent. Animal experimentation has shown these dyes to vary greatly in toxicity and carcinogenicity, and several have been found to be mutagens. In many instances, the solvent in which the dye is dissolved plays a major role in the solution's hazards. Most suitable dye solvents are flammable and toxic if inhaled, ingested, or absorbed through the skin.

To protect workers, the public and the environment, dye lasers are sealed systems that are only opened for maintenance purposes; e.g., to replace spent dye. The handling of the dyes is performed by trained personnel working under formal procedures that include the use of appropriate protective equipment.

Electrical Equipment and Systems

The responsible individual ensures that the installation, operation, and maintenance of electrical equipment and systems conform to the standards in Document 16.1, "Electrical Safety," in the ES&H Manual. Laser tables are always electrically connected to the building ground. Because interlock switches are energized from a different source than the equipment they control, an interlock switch is energized even if the laser equipment is not energized.

Gases Used in Lasers

When toxic gases are used as a lasing medium, exhaust ventilation is needed to remove gases that could escape into occupied areas. Conditions warranting ventilation at system connections could be filling, purging, or recharging. Document 14.3, "Toxic, Corrosive, or Reactive Gases," and Document 12.2, "Ventilation," of the ES&H Manual (LLNL 2000i) address applicable requirements for local exhaust ventilation.

Hazardous Materials

Adequate controls are used to prevent laser beams and strong reflections from impinging on combustible materials, explosives, highly flammable liquids or gases, or substances that decompose into highly toxic products under elevated temperatures.

Non-ionizing Radiation

Electromagnetic fields and radiation may be generated by laser systems or support equipment. Objects, when struck and vaporized by laser beams, can emit noncoherent optical radiation.

If indicated by the pre-work planning review, integrated worksheets, or operational or facility safety plans may be required for laser operations. Operational safety plans may include or reference plan-view drawings that may show the locations of the safety interlock systems. The drawings show the location of interlock sensors, such as door switches or floormat sensors, laser shutters, or power supplies controlled by the interlock system, status displays, panic buttons, and interlock system controllers.

All operators of lasers or laser systems are required to read the safety instructions provided by the equipment manufacturer. In addition, laser experimenters who operate Class 3b, or 4 lasers, or Class 1 laser systems containing embedded Class 3b or 4 lasers, except for commercial instruments that are only serviced by vendor representatives, are required to:

- Receive a thorough review of the laser equipment to be used from the responsible individual. The payroll or program management organizations may require further training.
- Successfully complete Course HS5200-CBT.
- Read Document 20.8, “Lasers,” and any relevant operational safety plans and work procedures.

Noise

Exposure to excessive levels of noise can result in permanent hearing loss, acuity, development of tinnitus (i.e., ringing of the ears), a possible increase in blood pressure, and stress-related problems. Noise may also cause annoyance or difficulty in communicating or working effectively and safely. Requirements for noise reduction, monitoring, and personnel protection are contained in Document 18.6, “Hearing Conservation.” LLNL adopted the American Conference of Governmental Industrial Hygienist threshold limit values of 85 A-weighted decibels (dB[A]) for noise instead on the Occupational Safety and Health Administration permissible exposure limit of 90 dB(A), which is more protective. The remaining parts of the Occupational Safety and Health Administration regulation 29 CFR §1910.95 were adopted. LLNL’s Hearing Conservation Program involves:

- Identification of exposed personnel (monitoring)
- Implementation of noise-reducing engineered and administrative controls
- Audiometric testing (baseline and annual)
- Training
- Use of hearing protectors (plugs, ear muffs)

LLNL uses both engineering and administrative controls to limit noise exposure. The best way to limit exposure is to alter the noise-producing equipment or change the environment to reduce noise levels. Examples include replacing old, noisy equipment; increasing sound dampening around noisy equipment; and improving muffler design. Engineered controls are formally considered before other types of controls are implemented.

Administrative controls for limiting noise exposure include:

- Performing noise measurements to identify areas or specific operations that produce excessive noise or to evaluate a worker's exposure to noise throughout an 8-hour day. The results of the measurements are used to determine which, if any, controls are appropriate to reduce worker exposure to noise.

- Altering work schedules. An employee scheduled to work on several pieces of noisy equipment should perform the noisy tasks over several days so that the average exposure each day does not exceed the permissible limit.

- Posting caution labels or signs on equipment or in areas where it has been determined that noise levels may exceed 85 dB(A). These signs notify the worker of a potential noise hazard and specify the conditions under which hearing protectors are recommended or required. Caution labels and signs are particularly important where workers' duties require them to move among different locations or to use a variety of tools. The purpose and meaning of the signs are included in the training aspect of LLNL's Hearing Conservation Program.

- Conducting medical surveillance examinations to monitor the hearing acuity of workers exposed to noise levels exceeding the established limits. Medical surveillance is not routinely required for workers who are exposed to nuisance noise. The Health Services Department generally performs medical surveillance only for LLNL workers. Non-LLNL employees receive medical surveillance through their employer.

LLNL workers exposed to noise above the adopted criteria are required to meet all the requirements of 29 CFR §1910.95, which include annual training on the health effects of noise exposure and instructions on how to fit and wear hearing protectors and a baseline exam and annual followup audiometric testing.

San Joaquin Valley Fever

Anyone who works at or visits Site 300 may be exposed to an organism that causes Valley Fever (coccidioidomycosis), a respiratory infection common throughout the San Joaquin Valley. All LLNL employees assigned to Site 300 are offered a skin test to assess their susceptibility to the organism. The test, subject to availability of the antigen, is currently unavailable and may remain unavailable beyond 2003. San Joaquin Valley Fever is endemic throughout the San Joaquin Valley and other areas of California, Arizona, and New Mexico. Certain groups (i.e., African Americans, Asians, Filipinos, Hispanics, immuno-suppressed persons, pregnant women, and unborn children) are at risk for developing the disseminated form of San Joaquin Valley Fever; i.e., the organism may spread beyond the lungs if an individual at risk becomes ill with San Joaquin Valley Fever. An estimated 50,000 to 100,000 persons develop symptoms of Valley Fever each year in the U.S., with 35,000 new infections per year in California alone. The incubation period is 10 to 30 days and the incidence is about 1 out of 100,000 people. Less than 10 percent of infections progress to more severe illnesses, and in rare cases the fungus moves outside the lungs to the muscles, bones, or skin. At its worst, this disease can cause a form of meningitis—leading to between 50 and 100 deaths per year (Valley Fever 2003a, 2003b).

The risks associated with this endemic hazard are discussed in the required Site 300 training. The Health Services Department is available to provide counseling for individuals. Subcontractors and other non-LLNL organizations providing workers at Site 300 are notified of potential San Joaquin Valley Fever hazards in the workplace. Employees, consultants, or other individuals who visit Site 300 briefly are not informed on an individual basis of the possibility of exposure to San Joaquin Valley Fever. However, the safety training required for unescorted Site 300 entrance discusses the hazards of San Joaquin Valley Fever. In addition, signs stating the risks of exposure are placed at or near all entrances to Site 300, and information is available at the site's medical facility (LLNL 2000i).

Biological Materials

Biological operations often involve work with hazardous materials. Some individuals may have increased susceptibility to biohazards due to preexisting diseases, use of medications, compromised immunity, pregnancy, or breast-feeding. These factors are addressed as part of the hazard assessment described in Document 2.2, "Managing ES&H for LLNL Work," in the ES&H Manual (LLNL 2000i).

Guidance documents, such as those listed below, are often used to determine the level of exposure to biological hazards.

- Center for Disease/National Institute of Health, Classification of Human Etiologic Agents on the Basis of Hazard http://www4.od.nih.gov/oba/rac/quidelines (CDC/NIH n.d.)

- Center for Disease/National Institute of Health, BioSafety in Microbiological and Biomedical Laboratories (CDC/NIH 1993)

- National Cancer Institute, BioSafety Manual for Research Involving Oncogenic Viruses (NCI 1974)

LLNL activities are restricted to BioSafety levels (BSL)-1 and -2, as defined by Center for Disease/National Institute of Health. Activities that require BSL-3 precautions are permitted only in a BSL-3 facility.

At LLNL, biological operations include the following:

Healthcare and Emergency Response

The biohazards involving human tissue and human body fluids and encountered in caring for ill or injured people have been determined by the Occupational Safety and Health Administration to have the potential for contaminating workers with bloodborne pathogens, including but not limited to, the Hepatitis B virus, Hepatitis C virus, and the human immunodeficiency virus. Requirements and guidance for dealing with bloodborne pathogens can be found in Document 13.2, "Exposure Control Plan: Working Safely with Blood and Bloodborne Pathogens," and Document 36.1, "Waste Management Requirements," in the ES&H Manual (LLNL 2000i).

Laboratory Research Operations

Research operations may involve work with specific microbial (i.e., risk group) agents, human tissue or body fluids, human or primate cell culture lines, or animals. Work with human or primate cell culture lines poses a hazard because the presence of latent viruses may exist incidentally or deliberately from experimental infections. Primary and permanent human or animal cell lines from nonlymphoid cell lines should be regarded as carrying low-hazard viruses unless known to be infected with a more hazardous agent. All primate cell lines derived from lymphoid cells, primate tumor tissue cell lines, primate cell lines exposed to or transformed by a primate oncogenic virus, primate cell lines contaminated with mycoplasma, and permanent human lymphocyte cell cultures are assumed to harbor moderate or higher hazard agents.

Plant Engineering Maintenance and Grounds-keeping Activities

Sewage workers, plumbers, electricians, and other tradespersons, as well as janitors and gardeners, may come into contact with chemicals, human body fluids, or other potentially contaminated materials. Hazards to plant engineering maintenance and grounds workers include exposure to biological or chemical agents that normally may be present in the environment such as wild animals or fungal spores. Hazards may be contained in animal vectors, tissues, fluids, carcasses, or droppings.

Environmental Surveillance

Livermore Site and Site 300 drinking water may have radiological, physical, chemical, and biological contamination, such as low or high pH, increased residual chlorine level, bacteria, and fecal coliforms (e.g., *E. coli*). The sewer treatment process at Site 300 has the potential for introducing fecal coliform contamination from the sewer pond to the groundwater.

Facility Restoration

When replacing water-damaged materials (e.g., sheetrock, ceiling tiles, rugs, and siding), workers may be exposed to toxic fungal agents or their metabolites. Unoccupied or unused buildings may contain rodents or birds and their droppings, as well as poisonous snakes, insects, or spiders. The process of decontaminating facilities that have been used for biological research or other work involving animals or human biological fluids may expose workers to biological agents or the decontaminating agent.

Waste Disposal Operations

Workers who package and handle waste containing biological materials may be exposed to biohazards such as microbial agents and human or animal fluids or tissues if such materials are not properly handled and packaged.

Shipping and Transportation

Shipping or transport of biological materials, including microbial agents, human or animal fluids or tissues, animals, or biological waste, may result in worker exposure because of damaged shipping containers, improper packaging, or mishandling.

Animal Handling

Research with animals poses hazards to the animals and the handler. Hazards include allergic responses and illnesses from direct or indirect exposure to infectious agents and infectious test agents found in animal tissues, fluids, carcasses, or droppings. Exposure to such hazards may occur through dust inhalation, bites, scratches, handling cages, contact with waste materials, or direct contact with animals.

Biological Operations

Through implementation of ISMS processes, LLNL attempts to prevent or mitigate the hazard(s) associated with biological operations and work involving biohazardous agents and materials. Three methods of mitigation are used as discussed in the text box below.

Engineered controls—These include facility design requirements, such as high-efficiency particulate air filters, interlocks, and negative airflow units, and safety equipment, which include mechanical aids such as tongs and tweezers, dead air boxes, sharps containers, laboratory-type fume hoods, biological safety cabinets, also referred to as biosafety cabinets, shielding, safety centrifuge cups, and special shipping containers for transporting biological materials and animals.

Administrative controls—These include the hazard review process and the use of procedures and operational controls for the performance of work.

Personal protective equipment—Equipment includes gloves, coats, gowns, shoe covers, safety shoes, boots, respirators, face shields, and safety glasses or goggles. Personal protective equipment is only used as supplemental protection if there is still a residual risk of exposure after engineered and administrative controls are implemented.

Multiple safety standards have been established to ensure that proper facilities and procedures are employed while working with biological materials with varying degrees of potential hazard. All work on biological materials is conducted in appropriate facilities, such as the Biomedical Sciences Buildings and the Health Services Clinic, according to the potential hazard.

BSL-1 is suitable for work involving well-characterized agents not known to cause disease in healthy adult humans, and of minimal potential hazard to laboratory personnel and the environment. The laboratory is not necessarily separated from the general traffic patterns in the building. Work is typically conducted on open bench tops using standard microbiological practices. Special containment equipment or facility design is not required nor generally used. Laboratory personnel have specific training in the procedures conducted in the laboratory and are supervised by a scientist with general training in microbiology or a related science (NNSA 2002a).

BSL-2 is similar to BSL-1 and is suitable for work involving agents of moderate potential hazard to personnel and the environment. It differs in that laboratory personnel have specific training in handling pathogenic agents and are directed by competent scientists, access to the laboratory is limited when work is being conducted, extreme precautions are taken with contaminated sharp items, and certain procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment (NNSA 2002c).

BSL-3 is applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents which may cause a serious or potentially lethal disease as a result of exposure by the inhalation route. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents, and are supervised by competent scientists experienced in working with these agents. All procedures involving the manipulation of infectious materials are conducted within biological safety cabinets or other physical containment devices, or by personnel wearing appropriate personal protective clothing and equipment. LLNL has special engineering and design features. It is recognized, however, that many existing facilities may not have all the facility safeguards recommended for BSL-3, such as access zone, sealed penetrations, and directional airflow, etc. In these circumstances, acceptable safety may be achieved for routine or repetitive operations (e.g., diagnostic procedures involving the propagation of an agent for identification, typing, and susceptibility testing) in BSL-2 facilities. However, the recommended standard microbiological practices, special practices, and safety equipment for BSL-3 must be rigorously followed. The decision to implement this modification of BSL-3 recommendations should be made only by the laboratory director (NNSA 2002c).

Additional guidelines have been developed for handling laboratory animals and research activities involving the use of clinical specimens, such as human blood. Employees working with potentially pathogenic micro-organisms, human cells, or other samples that may contain infectious agents, have their blood serum sampled by Health Services as a baseline for future assay in the event of accidental exposure (LLNL 2000i).

Occupational Safety

Occupational safety was evaluated through a review of occupational injury and lost workday case rate data from 1996 through 2001. Occupational illness/injury case rates are recorded as the number of cases per 200,000 hours, or approximately 100 person-years worked. In comparison to other DOE research contractors, LLNL ranks 19 of 27 for the rates of lost or restricted workdays (DOE 2002l).

Six-Year Trend Data (1996–2001)

Table C.3.2–2 lists recordable and lost/restricted workday cases and case rates for the years 1996 through 2001.

TABLE C.3.2–2.—*Summary of Occupational Safety and Health Administration Log Injury/Illness Data*

Calendar Year	Recordable Cases	L/RWD Cases	Recordable Case Rates	L/RWD Case Rates
1996	509	204	6.9	2.8
1997	530	198	7.3	2.8
1998	452	144	6.1	1.9
1999	349	98	4.7	1.3
2000	360	121	4.9	1.7
2001	309	107	4.3	1.5
2002	234	73	3.0	0.9

L/RWD = lost/restricted workday.

The following trends for occupational injury were identified for LLNL. The total recordable case rates per 200,000 hours worked ranged from 7.3 in 1997 to 3.0 in 2002 compared to DOE values of 3.5 for 1996 to 2.2 for 2002 (DOE 2002f, LLNL 2002ck, LLNL 2003u). The lost/restricted case rates per 200,000 hours worked ranged from 2.8 in 1996 and 1997 to 0.9 in 2002 compared to DOE values of 1.7 for 1996 to 0.9 for 2001 (DOE 2002f, LLNL 2003u).

The total number of recordable injuries that require medical attention beyond first aid and are reported to DOE was reduced from a high of 530 in 1997 to 234 in 2002. Of these injuries, overexertion (e.g., muscle strains, back strains) contributed 40 percent, wounds contributed 20 percent, cumulative trauma (e.g., carpal tunnel syndrome) contributed 34 percent, skeletal injuries contributed 3 percent, and injuries listed as other contributed 2 percent (LLNL 2003aw, OSHA 2001).

Specific Accident Information from 1996 through 2001

In addition to occupational exposures, unusual occurrences may result in worker exposures to toxic substances and other physical hazards such as electrical shock. When certain types of incidental accidents occur, LLNL is required to document them in environmental incident and/or unusual occurrence reports, and transmit them to DOE and other state and Federal agencies when necessary. A summary of reportable occurrences at LLNL in the 6 years from 1996 through 2001, as reported in occurrence and incident reports that resulted in workers being taken to the hospital or to the Health Services Department, is listed below:

- In March 1996, an employee crossing West Inner Loop Road near Building 271 was struck by a pickup truck driven by a subcontractor. The employee was thrown approximately 50 feet and landed beside the roadway. The employee suffered serious injuries and was taken to Eden Hospital Trauma Center by California Shock Trauma Air Rescue (CALSTAR).

- In June 1996, a subcontractor electrician installing electrical components on the outside wall of Building 121 caused an electric arc and flash by accidentally contacting the energized bus. The arc damaged a section of the electric panel and the flash caused a first-degree burn on the left forearm of one of the electricians. The electrician was taken to a local hospital, observed for 2 hours and released.

- In August 1996, a participating guest received an electrical shock while working with a photo-multiplier tube. The shock occurred when he touched the tube’s magnetic shielding.

The guest was taken to Health Services and released a half-hour later without restrictions. He suffered a minor burn to the right palm.

- In September 1996, an experimenter was disassembling some equipment located in a room that had been constructed within the highbay of Building 241 for his high pressure experiment. The employee had apparently removed the bolts that were holding up two steel plates that were 48 inches wide by 72 inches tall by 1/2 inch deep that stood vertically on the floor. The steel sheets, weighing approximately 900 pounds, fell over, knocking the employee down and pinning him. He was transported by LLNL's Fire Department to the hospital, where he underwent surgery to reconstruct his shattered right ankle, set his broken left leg, and tend to his other injuries.

- In September 1996, a Human Resources employee was returning to LLNL from an offsite Bay Area Apprenticeship Meeting in Oakland, California, when they were involved in a single-car automobile accident. The employee was transported by ambulance to Eden Hospital in Castro Valley, California, for observation.

- In November 1996, a safeguards and security employee in the locks and keys group was exposed to a laser beam that was being reflected off a target. The laser, a Spectra Physics Model 127 HeNe, emits 30 megawatts, and the estimated reflection was 8 percent of the total power. The employee was taken to Health Services where he indicated he had some "after image" which was fading. The employee was sent to an ophthalmologist for an eye examination where it was determined that no permanent eye damage had occurred.

- In August 1996, a sheet metal worker fell through the fiberglass ceiling of Room 1203 in Building 231, approximately 7 feet and 6 inches to the cement floor, when the wooden beam he was walking on moved. The employee was taken to Valley Care in Pleasanton, California, where he was x-rayed and CAT-scanned. No internal injuries or broken bones were found and the employee returned to work 2 days later.

- In May 1996, an employee in the Plating Shop was pouring Ebonol C, known as sodium chlorite/sodium hydroxide, powder into a de-ionized water bath when the bath erupted violently, spewing hot caustic solution into the air, burning himself and another employee working 10 feet away. Both employees were treated at the medical facility and returned to work.

- In March 1997, an employee was meeting a vendor at the LLNL south cafeteria. As she was walking across the parking lot to enter the building, she caught her toe on the raised cement edge of a planter next to the building. She fell and landed on her left arm. The employee was diagnosed with a torn rotator cuff in her left shoulder. Surgery was required.

- In April 1997, a contract (non-LLNL) employee performing routine construction work fell approximately 6 feet from a 10-foot ladder, landing on his feet, falling backwards, and coming to rest on his back. The worker was conscious and alert but complained of pain. He was airlifted to Eden Hospital in Castro Valley. The worker was found to have a fracture of the "L-4" vertebra and was hospitalized.

- In April 1997, a 1995 General Service Area-leased Ford pick-up truck was being backed up to a turn-around area on a fire road at Site 300, several hundred yards west of the small arms firing range in the southwestern portion of the site. The driver's side rear wheel came close to the shoulder of the fire trail. At that time, the shoulder and supporting soil gave way, dropping the right rear of the vehicle off the trail to the hillside slope. The vehicle continued to slide, then slowly rolled 1-1/2 times, landing on its cab 15 to 25 feet below the trail. The driver was taken to Tracy (Sutter) Memorial Hospital, x-rayed, and released.

- In May 1997, in Room 338 of Building 391, an electrician was investigating an interruption to a capacitor cycling operation. The electrician discovered a charged capacitor while ground hooking the system. A resulting arc noise occurred, causing a companion worker to experience ear pain and discomfort. Health Services referred the affected individual to an ear, nose, and throat specialist where it was determined that he had ruptured an eardrum.

- In July 1997, an employee was in the area northwest of Building 190 when he tripped or lost his balance near a small drainage culvert and fractured his ankle/leg. The injured employee was transported to a nearby offsite hospital. Surgery was required to repair the fractured ankle/leg.

- In September 1997, a government van driven by a security escort and an Advancement and Independence for the Disabled Employment employee, who was riding a LLNL bicycle, were involved in a collision onsite. The bicycle rider was transported by helicopter to Eden Hospital for treatment and observation.

- In June 1998, a contractor steel worker received lacerations to his head when his hard hat was pinched between a steel beam and the outrigger of a mobile crane when a steel truss section was accidentally lowered onto that beam. The injured worker was given first aid at the scene by his foreman, by LLNL emergency response personnel, and subsequently transported to Eden Trauma Center, where he was examined, treated, and released.

- In July 1998, a Human Resources employee on a bicycle made a sudden stop at the intersection of Inner Loop Road. In doing so, the employee placed both feet on the ground, resulting in the twisting of her ankle while slipping and falling from the bike. The employee was transported to Valley Care Hospital by the LLNL Fire Department. X-rays were taken, reflecting a compound fracture in her right ankle.

- In August 1998, a forklift driver drifted off the paved road onto the shoulder. When he hit a dip in the road, the forklift became uncontrollable and he lost control of the vehicle. The driver was not wearing a seatbelt and so was thrown from the vehicle and injured when his head hit an overhead guard. The employee was transported to Eden Hospital by ambulance. He was admitted overnight for observation and released the next morning.

- In August 1998, a protective force officer lost control of his vehicle, resulting in a single-vehicle roll-over accident with injury. The officer was transported to John Muir Hospital, Walnut Creek, California, via CALSTAR.

- In August 1998, an employee fell from his personal bicycle. He had exited a CAIN security booth on bike and lost his balance as he was mounting it, falling and fracturing his hip. The individual was transported to Valley Care Hospital, was admitted, and underwent surgery.

- In December 1998, a scientist was working alone in a Building 194 laser laboratory, Room 1117B. He was struck by a stray laser beam that came from a polarizer deflecting a beam from the plane of the table. The scientist received an injury to his right eye. He was taken to LLNL Health Services, where he was examined and directed to Valley Care Hospital in Pleasanton, where he was referred to an ophthalmologist. Further evaluation by a retinal specialist revealed broken blood vessels in the eye. The physicians concluded there would not be permanent eye damage.

- In May 1999, a mechanical technician received a momentary electrical shock when he contacted an energized exposed electrical conductor. The employee was taken to onsite Health Services for evaluation and returned to work.

- In August 1999, an employee reported a laser eye injury that he had in fact sustained in October 1998. The affected employee received a medical examination and consultation with medical personnel.

- In December 1999, five workers suffered headaches after being exposed to fumes from an adhesive used to glue sheets of foam to the inside of wood shipping crates. All involved individuals were sent to Health Services for evaluation and subsequently returned to work without restriction.

- In January 2000, a construction worker at the NIF site was injured when rebar that he was bending suddenly broke, causing him to lose his balance and fall. He was taken by ambulance to the hospital emergency room and after medical treatment was released without restriction.

- In January 2000, a construction worker in Switchyard 2 of the NIF site was injured when a 42-inch-diameter heating, ventilation, and air conditioning duct swung down and hit him. The worker was knocked down and complained of back pain. He was air lifted by helicopter to a local hospital where he was admitted.

- In March 2000, a hazardous waste technician was processing laboratory waste from the Biology and Biotechnology Research Program at the Hazardous Waste Management yard, when one of at least two hypodermic needles penetrated the bag and stuck the technician in his arm. The technician was transported to Health Services where he was treated and released.

- In April 2000, plant engineering laborers in the Building 431 high bay were moving a portable tent covered with heavy plastic sheeting used for enclosing laser experiments. As they were moving the frame to relocate the portable tent, a piece of plywood, measuring 4 feet wide by 6 feet long by 3/4 inches thick, fell approximately 12 feet, striking a laborer in the upper back and neck area. The employee was sent to LLNL Health Services, and was then sent to an outside medical facility for x-rays. It was determined that he had sustained a fractured vertebra.

- In May 2000, a government vehicle and private vehicle collided at an intersection near the LLNL East Gate. The LLNL Fire Department responded to the scene and transported the driver of the government vehicle to the LLNL Health Services Department. The individual was then transported to the Valley Care Medical Facility.

- In October 2000, an employee traveling on a bicycle to Building 177 fell from his bicycle, landing on his tailbone, bumping his head, and scraping an elbow. The victim was transported to Valley Care Hospital where he was held for observation, diagnosed with a fractured L-1 vertebra, and released the same day.

- In November 2000, a security department protective service officer was attempting the 40-yard dash from a prone position, as required by the DOE physical fitness standard. The officer completed the required dash and was approximately 15 feet past the finish line when he fell face first onto the pavement. The LLNL Fire Department responded and assisted the officer who was transported to Eden Hospital in Castro Valley via CALSTAR.

- In April 2001, there was an unanticipated release of a gas cylinder in Building 511 containing hydrogen fluoride resulting from reaction of rhenium hexafluoride with moisture in the air. This release resulted in the potential exposure of five workers to hydrogen fluoride gas. The workers were transported to LLNL Health Services because of possible chemical inhalation, and then transported to Valley Care Hospital in Pleasanton. They were released with no ill effects noted (DOE 2003c).

C.3.3 Radiation Exposure Risk

High-level exposure to radiation is referred to as ‘acute’ exposure. The effects of such exposure usually appear quickly and can range from nausea (exposure of at least 50 rem to the whole body) to death within hours or days (exposure of at least 2,000 rem to the whole body) (EPA 2003f). Radiation exposure experienced by individuals at LLNL (<5 rem for workers, <0.0001 rem for the maximally exposed member of the public) can be characterized as low-level radiation. The most significant potential health effect from low-level radiation is the induction of latent cancer fatalities. Such effects are characterized by their stochastic nature. That is, exposure to low-level radiation results in a possibility of the formation of a latent cancer; as the dose increases the probability of the effect increases, although the severity does not. The effects are referred to as “latent” because the cancer may take many years to develop. Low-level radiation may also cause nonfatal cancers and genetic disorders.

The Interagency Steering Committee on Radiation Standards (Lawrence 2002) recommended a risk estimator of 0.0006 excess fatal cancers per person-rem of dose in order to assess health effects to the public and to workers. The health risk estimators for nonfatal cancers and genetic disorders is one-third that of a cancer fatality.

The radiation exposure risk estimators are denoted as excess because they result in fatal cancers above the naturally occurring annual rate, which is 171.4 per 100,000 population nationally and 161.7 per 100,000 population for California (Ries et al. 2002). Thus, approximately 11,000 fatal cancer deaths per year would be expected to naturally occur in the approximately 7 million people surrounding LLNL. The doses to which they are applied is the effective dose equivalent, which weights the impacts on particular organs so that the dose from radionuclides that affect different organs can be compared on a similar (effect on whole body) risk basis. All doses in this document are effective dose equivalent unless otherwise noted.

The risk of fatal cancer to an individual is determined by multiplying the appropriate risk estimator by the total dose to that individual. For example, the risk of a fatal cancer to the offsite maximally exposed individual (MEI) at the Livermore Site for the No Action Alternative is 1.8×10^{-7} per year of exposure (0.0006 fatal cancers/person-rem × 0.299 millirem per year × 10^{-3} rem per millirem). The number of excess fatal cancers that will be experienced by a population is determined by multiplying the same risk estimator by the total dose to that population. For example, the calculated number of excess fatal cancers to the worker population for the No Action Alternative would be 0.053 per year of operation (0.0006 fatal cancers/per person-rem × 89 person-rem per year). Since the calculated number of excess fatal cancers is much less than one, it is unlikely that any such cancers will be seen in the worker population from one year of operation. There is the possibility of an excess fatal cancer to a worker sometime during that worker's lifetime as a result of operation over an extended period (i.e., many years). A summary of doses and corresponding risks for individuals and populations is presented in Table C.3.3–1.

TABLE C.3.3–1.—*Summary of Doses and Corresponding Risks*

	No Action Alternative		**Proposed Action**		**Reduced Operation Alternative**	
Individuals	**Dose (mrem/yr)**	**Risk of Cancer Fatality**	**Dose (mrem/yr)**	**Risk of Cancer Fatality**	**Dose (mrem/yr)**	**Risk of Cancer Fatality**
Livermore Site MEI	0.30	1.8×10^{-7}	0.33	2.0×10^{-7}	0.22	1.3×10^{-7}
Site 300 MEI	0.055	3.3×10^{-8}	0.055	3.3×10^{-8}	0.054	3.3×10^{-8}
LLNL Involved worker	< 2,000	1.2×10^{-3}	< 2,000	1.2×10^{-3}	< 2,000	1.2×10^{-3}
Populations	**Dose (person-rem/yr)**	**Number of Cancer Fatalities**	**Dose (person-rem/yr)**	**Number of Cancer Fatalities**	**Dose (person-rem/yr)**	**Number of Cancer Fatalities**
Livermore Site offsite	1.8	0 (1.1×10^{-3})	1.8	0 (1.1×10^{-3})	1.8	0 (1.1×10^{-3})
Site 300 offsite	9.8	0 (5.9×10^{-3})	9.8	0 (5.9×10^{-3})	9.8	0 (5.9×10^{-3})
LLNL Involved worker	89	0 (0.053)	93	0 (0.055)	38	0 (.023)
Noninvolved worker	0.14	0 (8.4×10^{-5})	0.14	0 (8.4×10^{-5})	0.13	0 (7.8×10^{-5})

Note: Number of cancer fatalities calculated in parentheses; a value much less than 1, e.g., 5.9×10^{-3} implies no cancer fatalities.
Risk of cancer fatality and number of cancer fatalities are per year of operation.
LLNL = Lawrence Livermore National Laboratory; MEI = maximally exposed individual; mrem/yr = millirems per year.

MEI and offsite population dose were calculated using the CAP88 computer model (CAP88-PC 2000), as described in Section C.4.2.2. Noninvolved worker doses were calculated in a similar manner as the offsite population doses; the exposure of spatially distributed onsite workers to major site releases was estimated using the CAP88 computer model. Involved worker doses were projected based on recent continuing operations and projections of specific additional operation impacts on involved workers.

C.3.4 Combined Risks

In assessing the safety of an operation it is important to compare the harm that may be caused by ionizing radiation with that caused by other agents (e.g., chemicals). The International Commission on Radiological Protection considers that any formal solution for adding the effects are impossible since "the various harmful effects of radiation are not only different in kind, but are likely to be regarded as of different importance by different individuals." Furthermore, radiation in combination with other physical and chemical agents may exhibit additive, synergistic, or even antagonistic effects depending on the agents and the conditions of exposure. Similarly, human exposure to carcinogenic chemicals in combination with other noncarcinogenic chemicals may result in additive, synergistic, or antagonistic effects, depending on the chemicals and the conditions.

In general, whole-body radiation appears to be carcinogenic for many, if not most, tissues of the body whereas specific carcinogenic chemicals typically induce cancers in a comparatively small number of target tissues. The cancers developed by both radiation and chemical carcinogens are indistinguishable from those induced by other causes, and their induction can only be inferred on statistical grounds.

Because of these limitations and the low probabilities of health effects associated with the operation of LLNL, no attempt was made to combine the risks from ionizing radiation with those from other agents.

C.4 PUBLIC HEALTH

Measures would be taken to minimize exposures to the public that might occur from operations at LLNL. All releases would be limited to comply with the regulatory requirements of DOE Orders and with Federal laws and regulations identified in Section C.1. There are no significant sources of external radiation exposure to the public from site operations at LLNL.

Radionuclide releases are minimized through engineering (e.g., high-efficiency particulate air filters, tritium removal systems, and water discharge retention tanks) and administrative (e.g., worker training, inventory limits) controls. Releases to the sewer system are minimized by engineering controls such as retention tanks and blocking connections to sewer drains, and administrative controls such as limiting inventories, worker training, and posting notices on sinks that discharge directly into the sewer system.

Under normal operations, air is the only pathway that poses a potential for health impacts to the public from radionuclide emissions. Other pathways are incomplete in that either the transport pathway (the environmental medium by which a contaminant is moved, e.g., water, soils) or the exposure pathway (e.g., drinking water, dermal contact with soil) is not viable. The specific resource sections, Section 4.10, Air Quality, and Section 4.11, Water, describe the existing conditions of the environmental media.

The major radionuclide contributor to dose from the Livermore Site is tritium. None of the Livermore Site facilities monitored for gross alpha and beta had emissions above minimum detectable limits in the most recent year from which results are available (2002) (LLNL 2003l). At Site 300, practically all contributions to dose are from depleted uranium.

C.4.1 Environmental Monitoring

Although LLNL's mission has been fundamentally one of scientific research, as an institution it has been ever mindful of its responsibilities for protecting the ES&H of its employees, the environment, and members of the public. As stated in the ES&H Manual, "it is the Laboratory's ES&H policy to perform work in a manner that protects the health and safety of employees and the public, preserves the quality of the environment, and prevents property damage. The environment, safety, and health are to be priority considerations in the planning and execution of all work activities at LLNL. Furthermore, it is the policy of LLNL to comply with applicable ES&H laws, regulations, and requirements."

To verify that LLNL is meeting these requirements, LLNL currently monitors the ambient air, water, and soil, and air and liquid effluents, as well as vegetation and products, for numerous radiological and nonradiological materials. LLNL complies with all Federal, state, and local environmental permitting requirements, including those imposed by listing as a Superfund site on the National Priorities List (LLNL 2003l).

The purpose of this section is to provide an overview of the environmental monitoring program conducted by LLNL. The Environmental Protection Department conducts an extensive program of effluent and surveillance monitoring of all environmental media (i.e., air, soil, surface water, groundwater, rain, sewage, foodstuffs, and direct radiation) and evaluates the impacts from LLNL operations on the environment and public health.

The program activities are mandated by the Federal *Clean Water Act*, National Emissions Standards for Hazardous Air Pollutants (NESHAP) regulations, parallel state and local regulations, as well as DOE directives. The principal activities include:

- Establishing and maintaining monitoring networks, sampling locations, and methods and procedures for data collection
- Collecting and analyzing environmental monitoring samples
- Maintaining and operating the sewer monitoring system
- Determining compliance with environmental laws and regulations governing NESHAP emissions and discharges of water and wastewater to the environment
- Assessing risks to the environment and the public from LLNL operations
- Documenting the results of the environmental monitoring effort in the annual environmental report

There is a comprehensive environmental monitoring program to assess the effectiveness of effluent control measures, to assess compliance with applicable environmental regulations, and to estimate the impact of operations on the environment. The environmental monitoring programs are conducted in accordance with DOE guidance. All environmental media that could be impacted by LLNL operations are monitored. LLNL maintains a comprehensive environmental monitoring program to evaluate compliance with local, state, and Federal laws and regulations and to ensure that human health and the environment are protected from site emissions. Air and sewage effluent, surface water, rain, groundwater, soil, vegetation, and foodstuff samples are collected and analyzed. The results are reported annually to DOE, Federal, state, and local regulatory authorities. Table C.4.1–1 illustrates the breadth of the radiological monitoring program. The table is not meant to be all-inclusive. During 2002, 11,877 samples were taken and 212,689 analytes were tested (LLNL 2003l). Further details of the monitoring system and results can be found in the Site Annual Environmental Report (LLNL 2003l).

Figure C.4.1–1 presents historical trends for the monthly 24-hour composite sample results from 1994 through 2002 for eight of the nine regulated metals; cadmium is not presented because it is typically not detected. All of the monthly 24-hour composite samples were in compliance with the permit discharge limits for the sewer monitoring system. As noted in both 2000 and 2001, arsenic continues to show on occasional elevated concentration, although it never exceeds 20 percent of the effluent pollutant limit. Both silver and lead each exhibit a single elevated monthly concentration during calendar year 2002; but neither exceeds 50 percent of their respective effluent pollutant limits. The other metals have no discernible trends in their concentrations (LLNL 2003l).

Effluent and Air Monitoring

Two types of air monitoring are performed. Air effluent monitoring involves extracting a measured volume of air from the exhaust of a facility or process and subsequently collecting particles by filters or vapors by a collection medium. As of 2002, LLNL operated 77 air effluent sampling systems at 7 facilities at the Livermore Site and 1 system at Building 801A at Site 300. LLNL reassesses the need for effluent monitoring annually or more often if warranted by new or modified operations. In addition, the U.S. Environmental Protection Agency requires that air effluents be monitored if the potential for offsite dose is greater than 0.1 millirem per year (1 percent of regulatory limit). Some facilities use real-time alarm monitors at discharge points to provide faster notification in the event of a radioactivity release; these alarms are not included in the above sampling system total. The monitoring results are used in calculating dose to offsite individuals to demonstrate compliance with regulations and to ensure protection of human health and the environment. Facilities that are not monitored are still considered in the dose calculations by considering their radionuclide inventories, release fractions, and emission control factors.

TABLE C.4.1–1.—*Environmental Radiological Monitoring Program*

Medium	Location	Analyte	Sampling Locations
Air effluent	Livermore Site	Gross alpha, beta	69 monitors
		Tritium (total, gaseous, water vapor)	8 monitors
Ambient air	Livermore Site	Gross alpha, beta, gamma, plutonium-239+240, uranium-235, uranium-238, beryllium	6 sites
		Gross alpha, beta, plutonium-239+240	1 site
		Tritium	6 sites
	Livermore Valley	Tritium	1 site
		Gross alpha, beta, plutonium-239+240, tritium	5 sites
		Gross alpha, beta, plutonium-239+240	4 sites
	Site 300	Gross alpha, beta, gamma, uranium-235, uranium-238, plutonium-239+240, beryllium	3 sites
		Gross alpha, beta, gamma, uranium-235, uranium-238, plutonium-239+240	4 sites
		Gross alpha, beta, uranium-235, uranium-238, Tritium	1 site
	Tracy	Gross alpha, beta, uranium-235, uranium-238, beryllium	1 site
Sewage	Livermore Site	Tritium, alphas, betas, pH, metals, others	Sewage Monitoring Station
		pH	Upstream pH Monitoring Station
		As applicable	33 water retention tanks
Stormwater	Livermore Site	Gross alpha, gross beta, tritium, plutonium, metals water quality parameters, fish bioassay, others	10 locations + construction sites
	Site 300	Gross alpha, gross beta, tritium, uranium, explosives, metals, water quality parameters, others	9 locations + construction sites
Rainfall	Livermore Site	Tritium	7 sites
	Livermore Valley	Tritium	10 sites
	Site 300	Tritium	2 sites
	Site 300 offsite	Tritium	1 site
Retention basin	Livermore Site	Gross alpha, gross beta, tritium, metals, water quality parameters, fish bioassay, others	4 sites + vertical profiles
Others (drinking water sources, swimming pool, etc.)	Livermore Site	Gross alpha, gross beta, tritium	2 sites
	Livermore Valley	Gross alpha, gross beta, tritium	10 sites
	Site 300	Gross alpha	2 sites
Groundwater	Livermore Site	Gross alpha, gross beta, specific isotopes (e.g., americium-241, plutonium isotopes, radon-222, tritium, uranium isotopes), metals, inorganic and organic chemicals, etc.	~25 onsite and 10 along perimeter
	Livermore Valley	Same as above	23
	Site 300	Gross alpha, gross beta, uranium, tritium, organics, nitrate, etc.	20+ surveillance wells and numerous compliance wells
	Site 300 offsite	Same as above	12

TABLE C.4.1–1.—*Environmental Radiological Monitoring Program (continued)*

Medium	Location	Analyte	Sampling Locations
Soil and sediments	Livermore Site	Gamma emitting radionuclides (e.g., thorium-232), plutonium, tritium (sediments), metals, organics, PCBs (vadose zone)	6 each surface soil, sediment, vadose zone
	Livermore Valley (soil only)	plutonium and gamma emitting nuclides (e.g., thorium-232)	13
	Site 300 (soil only)	Gamma emitting radionuclides, uranium, beryllium	14
Vegetation	Livermore Site	Tritium	7 sites
	Livermore Valley	Tritium	7 sites
	Site 300	Tritium	4 sites
Wine	Livermore Valley	Tritium	12 store purchased bottles
External radiation	Livermore Site	Gamma radiation (using TLDs)	14 sites along perimeter
	Livermore Valley	Same as above	22 sites
	Site 300	Same as above	9 perimeter + 4 interior locations
	Site 300 offsite	Same as above	2 sites
	Tracy	Same as above	2 sites

Source: LLNL 2003l.
PCBs = polychlorinated biphenyls; TLDs = thermoluminescent dosimeter.

Ambient air monitoring and effluent monitoring use air extraction and collection media for sampling particulates and vapors, respectively. All monitors are continuous, with particulate samples collected weekly and tritium samples biweekly. Fourteen Livermore Site samplers surround the site, with five additional internal site locations to sample diffuse (i.e., from soil and water) releases. Livermore Valley sites are located in all directions from the Livermore Site. The Site 300 network consists of nine samplers around the site and near firing tables, with an additional site in downtown Tracy.

LLNL performs continuous air effluent sampling of atmospheric discharge points at several facilities. LLNL assesses air effluent emissions from facility operations to evaluate compliance with local, state, and Federal regulations and to ensure that human health and the environment are protected from hazardous and radioactive air emissions. Enforcement authority of the *Clean Air Act* regulations for nonradiological air emissions has been delegated to the local air districts including the Bay Area Air Quality Management District (BAAQMD) for the Livermore Site and the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) for Site 300. Applicable regulations and permitting requirements are contained in BAAQMD Regulations 1-12 for the Livermore Site and SJVUAPCD Rules 1010 through 9120 for Site 300.

The Livermore Site currently emits approximately 109 kilograms per day of criteria air pollutants; e.g., nitrogen oxides, sulfur oxides, particulate matter (PM_{10}), carbon monoxide, and lead, as defined by the *Clean Air Act*. The largest sources of criteria pollutants at Livermore Site are surface coating operations, internal combustion engines, solvent operations, and, when grouped together, oil and natural gas-fired boilers (see Table C.4.1–2).

TABLE C.4.1–2.—*Lawrence Livermore National Laboratory Nonradioactive Air Emissions, 2002*

	Estimated Releases (kg/day)	
Pollutant	**Livermore Site**	**Site 300**
Organics/volatile organics	16	0.23
Nitrogen oxides	67	1.1
Carbon monoxide	17	1
Particulates (PM_{10})	6.1	0.09
Sulfur oxides	2.8	0.07

kg/day = kilograms per day.

When comparing the estimated releases from exempt and permitted sources of air pollutants at the Livermore Site with daily releases of air pollutants for the entire Bay Area, LLNL emissions are very low. For example, the total emissions of nitrogen oxides released in the Bay Area for 2002 were approximately 8.3×10^4 kilograms per day, compared with an estimate for LLNL releases of 67 kilograms per day for the Livermore Site or 0.08 percent of total Bay Area emissions from stationary sources. The BAAQMD estimate for reactive organic emissions was 9.8×10^4 kilograms per day for 2002, versus the Livermore Site's estimated releases of 16 kilograms per day or 0.02 percent of total Bay Area emissions from stationary sources.

Certain operations at Site 300 require permits from SJVUAPCD. The total estimated air emissions from operations, permitted and exempt air sources, at Site 300 during 2002 are given in Table C.4.1–2. The largest sources of criteria pollutants at Site 300 include internal combustion engines, boilers, a gasoline-dispensing operation, open burning, paint spray booths, drying ovens, and soil-vapor-extraction operations.

Nonradioactive air effluents are very small compared with emissions in surrounding areas, are well below standards, and are not a threat to the environment or public health.

The primary nonradiological effluent monitored at LLNL is beryllium. Livermore Site beryllium monitoring continued in 2002 at all except one perimeter locations. To satisfy beryllium reporting requirements and determine the effects of LLNL's beryllium operations, LLNL conducted a technical assessment of the beryllium monitoring locations at Site 300 in 1997. Although there is no requirement to sample for beryllium at Site 300, LLNL has decided, as a best management practice, to continue beryllium monitoring at three locations onsite and at one location in the city of Tracy.

The concentrations of beryllium at both sites can be attributed to resuspension of surface soil containing naturally occurring beryllium. Local soils contain approximately 1 part per million of beryllium, and the air of the Livermore area and the Central Valley typically contains 10 to 100 micrograms per cubic meter of particulates. Using a value of 50 micrograms per cubic meter for an average dust load and 1 part per million for beryllium content of dust, a conservative airborne beryllium concentration of 50 picograms per cubic meter can be predicted. The overall annual medians for the Livermore Site and Site 300 are 9.6 picograms per cubic meter and 9.0 picograms per cubic meter, respectively. These data are lower than predicted, well below standards, and do not indicate the presence of a threat to the environment or public health (LLNL 2003l).

Sewage Sampling

LLNL tightly controls its discharges to the sanitary sewer. LLNL operates under two wastewater discharge permits issued by the Livermore Water Reclamation Plant. They are the general site-wide permit and the groundwater discharge permit. The general site-wide permit is the most comprehensive, covering all discharges except groundwater.

LLNL's sanitary sewer concerns in the past have involved radioactive waste, organic compounds, metals, and pH. Radioactive waste containing tritium is especially tightly controlled because it cannot be treated; pH is the most common and ongoing problem. LLNL recognizes that any discharge to the sewer can be a potential problem. Even seemingly insignificant amounts of chemicals and metals in wastewater can pose a hazard to unsuspecting LLNL and Livermore Water Reclamation Plant employees working on the sewer system or at the treatment plant. Contaminated water can cause direct harm to the environment, upset the city of Livermore's treatment plant operations, and cause a violation of the discharge limits that LLNL is required to meet.

ES&H Team and Water Guidance and Monitoring Group environmental analysts provide support for determining whether new waste streams can be safely discharged to the sanitary sewer.

Reducing the likelihood of prohibited discharges requires that LLNL's waste stream be tightly managed. All LLNL employees working in operations that produce wastes with regulated constituents are responsible for managing their discharges to the sanitary sewer system. The primary focal points of effective waste stream management are pollution prevention; site discharge limits and points where compliance determinations are made; and treatment, control, and maintenance options.

Effective source reduction, reuse, and recycling are the three mechanisms that drive the pollution prevention efforts at LLNL. The optimal approach is that pollution prevention efforts should be focused on material substitutions so the wastewater generated is no longer regulated, or processes should be changed so less or no wastewater is generated.

Employees and organizations that generate any pollutant regulated under the sanitary sewer discharge permit and that are interested in pollution prevention are require to contact their program or facility pollution prevention representative, or their ES&H Team environmental analyst. These individuals provide assistance in determining whether waste stream minimization or segregation techniques would be helpful for a particular process. Pollution prevention remedies can include using less hazardous chemicals, minimizing rinsewater, installing filtration units, converting to alternative processes, and many other approaches.

Specific discharge limits for regulated contaminants are identified in the ES&H Manual, Appendix B of Document 32.4, "Discharges to the Sanitary-Sewer System," (LLNL 2000i). This appendix shows only the most common types of potential discharges from LLNL along with the applicable regulatory limits. The effluents and constituents highlighted in Appendix B of Document 32.4 include metals, the total toxic organic content of discharges, and Federal standards for pollutants regulated under the metal finishing and electrical and electronic component categories. The list is not comprehensive but identifies the more common substances that are regulated. Other constituents of concern to the Livermore Water Reclamation Plant, but not hazardous (e.g., biological oxygen demand and total dissolved solids), may be evaluated by the Waste Guidance and Monitoring Group environmental analyst on a case-by-case basis to determine acceptability for release. Of particular interest may be tanks with residual solvents.

LLNL's most common and ongoing problem related to sanitary sewer discharges has been compliance with the allowable pH range. The pH levels of all discharges to the sanitary sewer from individual processes at LLNL must be between 5 and 10. Wastewater with a pH of less than 2 or greater than 12.5 is a hazardous waste by regulatory definition and must be treated by the RHWM Division. To provide more controls on discharge pH management, warning labels with contact information are posted on every sink and retention tank onsite to maximize employee awareness.

Water may not be added to a waste stream solely for the purpose of diluting the waste. The city of Livermore's Municipal Code specifies that "No user shall ever increase the use of process water or, in any way, attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance with the limitations contained in the Federal Categorical Pretreatment Standards, or in any other pollutant-specific limitation developed by the city or state," (Livermore Municipal Code §13.32.130).

LLNL is the single largest source of sanitary sewage processed by the Livermore Water Reclamation Plant. LLNL's collection system handles sewage from both the Livermore Site and from Sandia National Laboratories/California. Together, LLNL and Sandia National Laboratories/California produce an average of 250,000 gallons of sewage each day. After treatment, wastewater is discharged into San Francisco Bay and sludge is disposed of in local landfills. Because of the many industrial processes performed at LLNL and Sandia National Laboratories/California, and the wide range of hazardous and radioactive materials handled, the two facilities have the potential to adversely affect operations of the treatment plant. To prevent such occurrences, LLNL has developed comprehensive sewer discharge control and monitoring programs.

LLNL operates retention tank systems to collect wastewater that may contain constituents in excess of sanitary sewer discharge limits, store it temporarily until an appropriate disposal method is determined, and possibly treat the wastewater if it is outside sewer discharge limits or is hazardous waste. Waste Guidance and Monitoring Group assists in obtaining required permits for retention tank systems, interfacing with regulators, reviewing new designs, overseeing proper installation, operating systems properly, testing systems, and preparing required reports.

LLNL performs two types of monitoring: compliance monitoring and surveillance monitoring. Compliance monitoring is performed at specified frequencies for those constituents required by permit or law. Compliance monitoring is established to verify that LLNL's discharges are consistent with the two types of discharge limits established in the wastewater discharge permit: general prohibitions that are designed to protect the Publicly Owned Treatment Works but do not target specific pollutants and have no numerical limits and specific prohibitions that target individual pollutants and usually have a numerical limit.

Sampled wastewater is released from retention tanks only after analytical laboratory measurements show pollutant levels within discharge limits. In 2002, there were 33 water retention tank systems in use at the Livermore Site, with additional collection units at Site 300. If pollutant levels exceed limits, the wastewater is either treated to levels within limits or shipped to offsite treatment or disposal facilities. The sewer monitoring station continuously collects samples for metals, radioactivity, toxic chemicals, and water-quality parameters. If concentrations above warning levels are detected, an alarm registers and the flow is diverted to the sewer diversion facility. All alarms are evaluated and appropriate actions taken. In addition, LLNL monitors pH at the upstream pH monitoring station. This upstream monitoring allows for earlier detection of problems and diversion if necessary. Diverted sewage is either treated to meet discharge limits or shipped offsite for disposal.

Under its permit, LLNL is required to monitor its sanitary sewer effluent for flow, pH, radioactivity, and regulated metals. LLNL also collects and analyzes samples for all other regulated constituents, such as organic compounds and biological oxygen demand.

The second type of monitoring, surveillance monitoring, is performed by LLNL at intervals for a range of contaminants of potential concern in response to DOE orders.

Table C.4.1–3 presents monthly average concentrations for all regulated metals in LLNL's sanitary sewer effluent for 2002. The averages were obtained by flow-proportional weighting of the analytical results for the weekly composite samples collected each month. Each result was weighted by the total flow volume for the period during which the sample was collected. The results are generally typical of the values seen from 1994 to 2001. Figure C.4.1–1 presents historical trends for monthly 24-hour composite sample results from 1994 through 2002 for eight of nine regulated metals (cadmium is usually not detected). These historical trends are typically well below their respective effluent pollutant limits.

The concentrations measured in the routine analysis of LLNL sewage samples collected once a week (7-day composite sample) and once a month (24-hour composite samples) are presented for eight of nine regulated metals as a percentage of the corresponding effluent pollutant limit in Figure C.4.1–2; cadmium results are not presented because the metal was not detected above the practical quantitation limit of 0.005 milligrams per liter in any of the weekly or monthly samples. The effluent pollutant limit is equal to the maximum pollutant concentration allowed per 24-hour composite sample, as specified by the LLNL wastewater discharge permit. When a weekly sample concentration is at or above 50 percent of its effluent pollutant limit, all daily (24-hour composite) samples collected in the Safety Management System corresponding to the weekly sample period must be analyzed to determine if any of their concentrations are above the effluent pollutant limit. Two elevated monthly concentrations, silver at 50 percent of its effluent pollutant limit in April and lead at 30 percent of its effluent pollutant limit in August, are shown in Figure C.4.1–2. In addition, five weekly concentrations (Figure C.4.1–2) are at or above 50 percent of their respective effluent pollutant limits.

The elevated arsenic values, reported at 67 percent of the effluent pollutant limit for the weeks of June 5–12 and June 12–17, can be attributed to an analytical artifact resulting from matrix interface. The actual arsenic concentrations for those two weeks were reported as <0.04 milligrams per liter, a factor of 20 greater than the typical practical quantitation limit for arsenic of 0.002 milligram per liter. Lead concentrations in daily samples from the week of August 1–7, 2002, show two samples (August 3 at 0.226 milligram per liter and August 6 at 0.208 milligram per liter, representing effluent collected during the prior 24-hour periods) exceeding the 0.2-milligram-per-liter permitted discharge limit for lead. In October 2002, the Livermore Water Reclamation Plant issued a warning notice as a result of these exceedances of the effluent pollutant limit for lead. No corrective action was suggested or required, because LLNL had demonstrated a return to compliance and that sufficient measures had been taken to investigate this inadvertent discharge. The results of similar analyses showed no chromium concentrations in the August 1–7 daily samples, or lead concentrations in the November 21–27, 2002, daily samples above their respective effluent pollutant limits. Although each of these incidents was reported to the Livermore Water Reclamation Plant, none represented a threat to the integrity of the Livermore Water Reclamation Plant operations (LLNL 2003l).

Detections of anions, metals, and organic compounds and summary data concerning other physical and chemical characteristics of the sanitary sewer effluent are provided in Table C.4.1–4. All analytical results are provided in the Data Supplement, Table C.4.1–4. Although monthly (24-hour) composite samples were analyzed for hydroxide alkalinity, beryllium, and cadmium, these analytes were not detected in any sample taken during 2002 and are not presented in Table C.4.1–4. Similarly, analytes not detected in any of the 2002 monthly grab samples are not listed in Table C.4.1–4. These monthly monitoring results for physical and chemical characteristics of the LLNL sanitary sewer effluent are typical of those seen in previous years.

Table C.4.1–3 presents monthly average concentrations and summary statistics for all regulated metals monitored in LLNL's sanitary sewer effluent. The annual median concentration for each metal is shown and compared to the discharge limit. In 2002, the median concentration of monthly average values remained essentially unchanged from the corresponding 2001 values for all nine regulated metals. Medians of the monthly average concentration were less than 10 percent of the limits for all but copper, lead, and zinc, which were at 17 percent, 11 percent, and 13 percent, respectively.

Although median values of monthly average metal concentrations have remained well below discharge limits (see Table C.4.1–3) and only one monthly (24-hour) composite sample showed any regulated metal above one-third of the respective effluent pollutant limit; i.e., silver was detected in the April monthly composite at 0.10 milligram per liter or 50 percent of its effluent pollutant limit, three weekly metal sample concentrations were identified for additional analyses based on 7-day composite results at or near the action limit (see Figure C.4.1–2). As discussed above, the two elevated weekly arsenic values can be attributed to an analytical artifact. Action limit investigations examined a weekly sample in August; i.e., for chromium and lead at 69 percent and 55 percent of their respective effluent pollutant limits, and a weekly sample in November; i.e., for lead at 50 percent of its effluent pollutant limit. The daily samples that correspond to the appropriate 7-day composite sampling periods were submitted to an offsite contract analytical laboratory for analysis.

Table C.4.1–4 presents summary results and statistics for monthly monitoring of physical and chemical characteristics of LLNL's sanitary sewer effluent. The results are generally similar to typical values seen in previous years for the two regulated parameters (cyanide and total toxic organics) and all other nonregulated parameters. Cyanide was detected only in the January 2002 semiannual sample (at 0.024 milligram per liter, which is below the 0.04-milligram-per-liter permit limit). This constituent was below analytical detection limits (0.02 milligram per liter) in both the second semiannual (July 2002) sampling and the annual (October 2002) joint LLNL/Livermore Water Reclamation Plant cosampling events. The monthly total toxic organics values ranged from less than 0.010 milligram per liter to 0.10 milligram per liter (median was 0.039 milligram per liter), well below the total toxic organics permit limit of 1.0 milligram per liter. In addition to the organic compounds regulated under the total toxic organics standard, seven nonregulated organics were also detected in LLNL's sanitary sewer effluent: four volatile organic compounds (2-butanone, acetone, Freon 113, and styrene) and three semivolatile organic compounds (benzoic acid, benzyl alcohol, and m- and p-Cresol).

TABLE C.4.1–4.—*Monthly Results for Physical and Chemical Characteristics of the Lawrence Livermore National Laboratory Sanitary Sewer Effluent, 2002[a] (continued)*

	Detection Frequency [b]	Minimum	Maximum	Median	IQR
Grab Sample Parameter					
Semivolatile organic compounds (µg/L)					
Benzoic acid	10 of 12	<10	110	21	39
Benzyl alcohol	10 of 12	<2	1900	12	49
Bis(2-ethylhexyl)phthalate	10 of 12	<5	32	8.1	4.7
Butylbenzylphthalate[f]	2 of 12	<2	9.4	<2	[c]
Diethylphthalate[f]	3 of 12	<2	16	<2	[c]
Diethylphthalate[f]	12 of 12	6.2	35	21	15
Phenanthrene[f]	1 of 12	<2	2.3	<2	[c]
Phenol[f]	7 of 12	<2	29	2.8	[c]
m- and p-Cresol	11 of 12	<2	450	19	26
Total cyanide (mg/L)[g]	1 of 3	<0.02	0.024	[f]	[d]
Oil and grease (mg/L)[h]	8 of 8	12	37	28	17
Volatile organic compounds (µg/L)					
1,2-Dichloroethene[f]	1 of 12	<0.5	0.58	<0.5	[c]
1,4-Dichlorobenzene[f]	1 of 12	<0.5	0.67	<0.5	[c]
2-Butanone	1 of 12	<20	52	<20	[c]
Acetone	12 of 12	140	560	310	190
Bromoform[f]	1 of 12	<0.5	0.87	<0.5	[c]
Chloroform[f]	12 of 12	5.7	17	11	3.9
Freon 113	1 of 12	<0.5	0.16	<0.5	[c]
Methylene chloride[f]	3 of 12	<1	3.5	<1	[c]
Styrene	1 of 12	<0.5	0.59	<0.5	[c]
Toluene[f]	2 of 12	<0.5	0.67	<0.5	[c]

Source: LLNL 2003l.

[a] The monthly sample results plotted in Figure C.4.1–2 are not reported in this table.

[b] The number of times an analyte was positively identified, followed by the number of samples that were analyzed (generally 12, one sample for each month of the year).

[c] When the detection frequency is less than or equal to 50 percent, there is no range, or there are fewer than four results for a sample parameter, then the interquartile range is omitted.

[d] Sampling for this parameter is required on a semiannual rather than a monthly basis.

[e] When there are fewer than four results for a sample parameter, the median is not calculated.

[f] Priority toxic pollutant parameter used in assessing compliance with the total toxic organic permit limit of 1 milligrams per liter (1000 picos per liter) issued by the Livermore Water Reclamation Plant.

[g] Sampling for this parameter is required on a semiannual (January and July) rather than a monthly basis. An additional sample was taken I October during the annual co-sampling event with the LWRP.

[h] The requirement to sample for oil and grease has been suspended until further notice based on the LWRP letter of April 1, 1999. LLNL collects these samples (four per day) semiannually as part of the source control program.

IQR = Interquartile range; mg/L = milligrams per liter; µg/L = micrograms per liter; LWRP = Livermore Water Reclamation Plant; LLNL = Lawrence Livermore National Laboratory.

In 2002, the Safety Management System continuous monitoring system detected six inadvertent discharges outside the permitted pH range of 5 to 10. Four of these events, one with a pH below 5 and three with a pH above 10, were completely captured by the sewer diversion facility. The other two events, both with a pH below 5, occurred off-hours when the upstream pH monitoring station was offline. As a result, two front-end volumes (small quantity) of low pH sanitary effluent were released to the Livermore Water Reclamation Plant system before a diversion to the sewer diversion facility could be made. The Livermore Water Reclamation Plant was immediately notified of both low pH discharges; however, neither incident represented a threat to the integrity of the operations of the Livermore Water Reclamation Plant, nor were these events considered enforceable exceedances of permit conditions. The lowest pH recorded for effluent contained in the first release, February 9, 2002, was 4.6; the second release, October 13, 2002, contained effluent with a pH as low as 4.96.

Monitoring results for 2002 reflect an effective year for LLNL's sewerable water discharge control program and indicate no adverse impact to the Livermore Water Reclamation Plant or the environment from LLNL sanitary sewer discharges. Overall, LLNL achieved greater than 99 percent compliance with the provisions of its wastewater discharge permit (LLNL 2003l).

Water Monitoring

In accordance with Federal, state, and internal requirements, LLNL monitors surface water quality at and around the Livermore Site, surrounding regions of the Livermore Valley and Altamont Hills, and Site 300. Specifically in the Livermore vicinity, LLNL monitors reservoirs and ponds, the Livermore Site swimming pool, the Drainage Retention Basin, rainfall, tap water, stormwater runoff, and receiving waters. At Site 300 and its vicinity, surface water monitoring encompasses rainfall, cooling tower discharges, drinking water system discharges, stormwater runoff, and receiving waters.

In addition to surface water, LLNL also regularly samples and analyzes groundwater in the Livermore Valley and in the Altamont Hills. LLNL maintains compliance and surveillance groundwater monitoring programs to comply fully with environmental regulations, applicable DOE orders, and the requirements of the Groundwater Protection Management Program. The objectives of the groundwater monitoring programs are to measure compliance with waste discharge requirements and postclosure plans (compliance monitoring) and to assess the impact, if any, of LLNL operations on groundwater resources (surveillance monitoring).

DOE O 5400.1 requires all DOE facilities to prepare a Groundwater Protection Management Program that describes the site's groundwater regime, areas of known contamination, remediation activities, programs to monitor groundwater, and means to monitor and control potential sources of groundwater contamination. Considerable remediation monitoring of groundwater is carried out under CERCLA restoration efforts.

A wide range of analytes is monitored to assess the impact, if any, of current LLNL operations on local groundwater resources. Because surveillance monitoring is geared to detecting substances at very low concentrations in groundwater, it can detect contamination before it significantly affects groundwater resources. Wells at the Livermore Site, in the Livermore Valley, and at Site 300 in the Altamont Hills are included in LLNL's surveillance monitoring plan. Historically, the surveillance and compliance monitoring programs have detected elevated concentrations of various metals, nitrate, perchlorate, and uranium-238 in groundwater at Site 300. Subsequent CERCLA studies have linked several of these contaminants, including uranium-238, to past operations, while other contaminants are the objects of continuing study. Present-day administrative, engineering, and maintenance controls at both LLNL sites are specifically tailored to prevent accidental releases of chemicals to the environment.

The Compliance Groundwater Monitoring Program at Site 300 complies with numerous Federal and state controls. Compliance monitoring of groundwater is required at Site 300 in order to satisfy state-issued permits associated with closed landfills containing solid wastes and with continuing discharges of liquid waste to surface impoundments, sewage ponds, and percolation pits. Compliance monitoring is specified in Waste Discharge Requirement orders issued by the Central Valley Regional Water Quality Control Board and in landfill closure and post-closure monitoring plans (LLNL 2003l).

Stormwater

Stormwater is monitored to demonstrate compliance with permit requirements and to ensure contamination prevention. Stormwater is sampled at least twice a year and visually inspected more often. Stormwater is sampled for radioactivity; metals; various water quality parameters, such as dissolved oxygen, pH, and total dissolved solids; toxic chemicals; and polychlorinated biphenyls (PCBs). Site 300 sampling includes explosives and related chemicals, such as ammonia. Stormwater is sampled both upstream and downstream of both LLNL sites. Run-on to the Livermore Site includes runoff contamination from other sources, such as agricultural land and parking lots. Site 300 stormwater sampling targets specific industrial areas from which the stormwater originates on the site. Runoff from construction projects is also sampled. Construction site stormwater sampling results indicate that the NIF construction site is not contributing PCBs to stormwater runoff as a result of construction activities (LLNL 2003l).

Rainfall

Emissions from the tritium facility are the primary activity at LLNL with the potential to impact rainwater quality. Rainfall is collected in elevated stainless steel buckets and measured for tritium activity (LLNL 2003l).

Drainage Retention Basin

The Drainage Retention Basin flow is from stormwater and treated groundwater. There are four locations within the basin that are sampled; two locations include vertical profiles in order to ensure discharge limit compliance. Grab samples are taken to measure radioactivity, metals, and water quality parameters. Field measurements of some water quality parameters, such as dissolved oxygen and transparency, are also performed. There is no evidence of adverse environmental impacts resulting from releases from the Drainage Retention Basin. Because of the frequent dry season discharges that occurred from the Drainage Retention Basin, discharges from groundwater treatment facilities, and the wetter rainfall years that occurred from 1997 through 1999, wetland vegetation has increased both upstream and downstream of the Drainage Retention Basin. The federally listed threatened California red-legged frog has colonized these wetland areas (LLNL 2003l).

Cooling Towers

During 2002, the monitoring results for flow, pH, and total dissolved solids from both primary cooling towers show only one value (the total dissolved solids value for the fourth quarter) above the previously established Waste Discharge Requirements 94-131 limits. Because blowdown flow from the cooling towers does not reach Corral Hollow Creek, it is unlikely to have a negative impact on the receiving water. (LLNL 2003l).

Arroyo Las Positas Maintenance Project

Discharges of diverted water related to the Arroyo Las Positas maintenance project did not adversely affect receiving water quality. No receiving water quality criteria were exceeded throughout the duration of the project (LLNL 2003l).

Groundwater

Groundwater is monitored to assess any impact LLNL operations might have on groundwater resources and to measure compliance with discharge requirements and postclosure plans. Surveillance monitoring is geared to detecting substances at very low concentrations so that contamination can be detected before significant impacts occur. Various aquifers are sampled, although surveillance in the uppermost (first impacted) aquifer at each well is the primary focus. Onsite surveillance wells are situated downgradient from and as near as possible to potential release locations.

The overall impacts of Livermore Site and Site 300 operations on offsite groundwaters are minimal. With the exception of volatile organic compounds being remediated under CERCLA at both sites, current LLNL operations have no measurable impacts on groundwaters beyond the site boundaries. Groundwater monitoring at the Livermore Site and in the Livermore Valley indicates that LLNL operations have minimal impact on groundwater beyond the Livermore Site boundary.

During 2002, neither radioactivity nor concentrations of elements or compounds detected in groundwater from any offsite monitoring well were confirmed as exceeding primary drinking water maximum contaminant levels. The maximum tritium activity measured offsite in the Livermore Valley was 92 picocuries per liter, in well 11B1.

Of the Livermore Site monitoring wells, no inorganic data exceeded primary maximum contaminant levels with the exceptions of chromium in monitoring well W-373 and nitrate in monitoring well W-1012. Hexavalent chromium in groundwater in the vicinity of monitoring well W-373 is being removed at Treatment Facilities B and C and concentrations are steadily decreasing.

The LLNL Groundwater Project reports on the treatment of groundwater in the vicinity of the treatment facilities. Concentrations of nitrate in groundwater samples collected from well W-1012 throughout 2002 exceeded California's maximum contaminant levels of 45 milligrams per liter. Nitrate above the maximum contaminant levels has not migrated offsite. LLNL continues to monitor nitrate concentrations at this well and at monitoring well W-571, which is offsite and about 350 meters downgradient from well W-1012. Measurements of arroyo sediments made in 2002 indicate no potential for adverse impacts to groundwater through the arroyos that cross the Livermore Site.

Groundwater monitoring at Site 300 and adjacent properties in the Altamont Hills shows minimal impact of LLNL operations on groundwater beyond the site boundaries. Within Site 300, the chemicals detected in groundwater beneath the explosives process area will not migrate offsite. Plans to remediate trichloroethylene, explosive compounds such as hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), perchlorates, and nitrate are being implemented under CERCLA auspices. Additionally, LLNL is investigating the distribution and origins of arsenic and zinc in this area. Volatile organic compounds, primarily the solvent trichloroethylene, have been released historically to shallow groundwater at numerous locations at Site 300. With the exception of a small plume in the General Services Area that extends minimally offsite along Corral Hollow Road, all of the trichloroethylene-bearing groundwater is onsite. The plume extending offsite from the Eastern General Services Area is being drawn back to the site by pumping, and the trichloroethylene is being removed from the groundwater. LLNL is investigating various remedial methods to remove depleted uranium from the groundwater adjacent to several source areas within Site 300. Tritiated water has been released to groundwater from several landfills and a firing table in the northwestern part of Site 300. The boundaries of the slowly moving tritiated water plumes lie entirely within the site. CERCLA modeling studies indicate that, given tritium's short half-life of 12.3 years and the relatively slow rate of groundwater flow (5 to 15 meters per year), the activity of the released tritiated water will decrease to several orders of magnitude below the maximum contaminant levels of 20,000 picocuries per liter before it can reach a site boundary and migrate offsite (LLNL 2003l).

Soil Monitoring

The soil and sediment surveillance monitoring performed at LLNL includes work in three areas: surface soil in the Livermore Valley and at Site 300, sediment at the Livermore Site, and vadose zone soils at the Livermore Site. Soil is weathered material, mainly composed of disintegrated rock and organic material that sustains growing plants. Soil can contain pollutants originally released directly to the ground, to the air, or through liquid effluents. DOE guidance for environmental monitoring states that soil should be sampled to determine if there is a measurable, long-term buildup of radionuclides in the terrestrial environment and to estimate environmental radionuclide inventories. The guidance recommends monitoring for radionuclides specific to a particular operation or facility as well as those that occur naturally. Particulate radionuclides are of major interest in the LLNL soil monitoring program because airborne particulate releases are the most likely pathway for LLNL-induced soil contamination.

Sediments are defined as finely divided, solid materials that have settled out of a liquid stream or standing water. The accumulation of radioactive materials in sediments could lead to exposure of humans through ingestion of aquatic species, sediment resuspension into drinking water supplies, or inhalation of dust particles or as an external radiation source. However, the Livermore Site and Site 300 do not have habitats for aquatic species that are consumed by people, nor do they have surface drainage that directly feeds drinking water supplies. Vadose zone soils are sampled to provide information on dissolved constituents in infiltrating water. Sampling locations are chosen based on known contamination or the potential to be affected by LLNL operations. For example, Site 300 locations include sampling around firing tables.

Soils in the vadose zone, the region below the land surface where the soil pores are only partially filled with water, are sampled in arroyo channels at the Livermore Site as part of the Groundwater Protection Management Program. Infiltration of natural runoff through arroyo channels is a significant source of groundwater recharge, accounting for an estimated 42 percent of resupply for the entire Livermore Valley groundwater basin. Soils in the shallow vadose zone are collected and analyzed to provide information about possible constituents that may be dissolved as runoff water infiltrates through the arroyo to the groundwater.

Surface soil sampling near the Livermore Site and Site 300 has been part of a continuing LLNL monitoring program designed to measure any changes in environmental levels of radioactivity and evaluate any increase in radioactivity that might have resulted from LLNL operations. These samples have been analyzed for plutonium and gamma-emitting radionuclides, such as depleted uranium, used in some explosive tests at Site 300. The inclusion of other gamma-emitting, naturally occurring nuclides (potassium-40 and thorium-232) and the long-lived fission product, cesium-137, provides background information and baseline data on global fallout from historical aboveground nuclear weapons testing. In addition, LLNL analyzes Site 300 soils for beryllium, a potentially toxic metal used at this site. Soils in the Livermore vicinity were analyzed for beryllium from 1991 to 1994. However, analysis for beryllium was discontinued at the Livermore Site in 1995, because it was never measured above background values.

Surface soil samples are collected at 19 locations in the Livermore Valley, including 6 sampling locations at the Livermore Water Reclamation Plant, an area of known plutonium contamination, and 14 locations at or near Site 300. The locations were selected to represent background concentrations (distant locations unlikely to be affected by LLNL operations) as well as areas where there is the potential to be affected by LLNL operations. Areas with known contaminants, such as the Livermore Water Reclamation Plant, are also sampled. Site 300 soil sampling locations are established around firing tables and other areas of potential soil contamination.

Sediment samples have been collected from selected arroyos and other drainage areas at and around the Livermore Site since 1988; these locations largely coincide with selected stormwater sampling locations. Sediment sampling locations have not been established at Site 300. The drainage courses at Site 300 are steep, causing flowing water to scour the drainages, which prevents the accumulation of sediment. Because of these conditions, sediment sampling at Site 300 is not warranted.

Vadose zone soil sampling has been conducted at the same selected stormwater sampling locations since 1996. Vadose zone samples were not collected in the Drainage Retention Basin because the liner for the basin prevents migration of materials to the groundwater. The collocation of sampling for these three media facilitates comparisons of analytical results. As with sediment samples, vadose zone samples are not collected at Site 300. Approximately 10 percent of locations are sampled in duplicate; two samples are collected at each location chosen for this sampling. All soil and sediment sampling locations have permanent location markers for reference.

Routine surface soil, sediment, and vadose zone soil sample analyses indicate that the impact of LLNL operations on these media in 2001 has not changed from previous years and remains insignificant. Most analytes of interest or concern were detected at background concentrations or in amounts that could not be measured above detection limits.

The concentrations of radionuclides and beryllium observed in soil samples collected at Site 300 are within the range of previous data and are generally representative of background or naturally occurring levels. The uranium-235/uranium-238 ratios that are indicative of depleted uranium occur near active and inactive firing tables at Buildings 801 and 812. They represent a small fraction of the firing table operations that disperse depleted uranium. The uranium-238 concentrations are below the National Council on Radiation Protection-recommended screening level for commercial sites of 313 micrograms per gram. Historically, some measured concentrations of uranium-238 near Building 812 have been greater than the screening level. A CERCLA remedial investigation is underway at the Building 812 firing table area to define the nature and extent of contamination. Depleted uranium has been detected in soil and groundwater in the area (LLNL 2003l).

Vegetation and Foodstuff Monitoring

LLNL has a vegetation and foodstuff monitoring program to comply with DOE guidance. This guidance states that periodic sampling and analysis of vegetation should be performed to determine if there is a measurable, long-term buildup of radionuclides in the terrestrial environment. LLNL has historically released tritium to the air during routine operations and, occasionally, by accident. Tritium is the only nuclide of interest in the LLNL vegetation and foodstuff monitoring program because tritium is the only radionuclide released from LLNL activities that occurs in detectable concentrations in vegetation and foodstuff. Tritium moves through the food chain as tritiated water and can be rapidly assimilated into plant water and then incorporated into the organic matter of plants through photosynthesis. It can contribute to human radiation dose if it is inhaled, absorbed through the skin, or ingested via vegetables, milk, and meat from animals that are exposed to a tritiated environment.

LLNL has been monitoring tritium in vegetation to some extent since 1966 and has performed vegetation sampling in the vicinity of the Livermore Site and Site 300 as part of a continuing monitoring program since 1971. The monitoring program is designed to measure changes in the environmental levels of radioactivity, to evaluate the environmental effect of LLNL operations, and to calculate potential human doses from tritium in the food chain.

In 1977, LLNL added wine to the LLNL monitoring program. Wine is the most important agricultural product in the Livermore Valley, with a retail value estimated conservatively at $140 million. Although the tritium concentrations in all wines are very low, the sampling data indicate that Livermore Valley wines contain statistically slightly more tritium than do wines from other California wine-producing regions. In the past, other foodstuffs; e.g., cow's milk, goat's milk, and honey, leading to potential doses were also monitored for tritium. At present, however, only tritium concentrations in vegetation and wine are used to assess potential ingestion doses from tritium emitted during LLNL operations, as there are no longer dairy operations near LLNL.

Very low concentrations of tritium may be found in foodstuffs grown near the Livermore Site as a result of LLNL operations. A potential ingestion dose for 2002 that accounts for contributions from tritiated water and organically bound tritium in vegetables, milk, meat, and wine would have been, realistically, less than 0.011 millirems. This estimate is a factor of 27,000 lower than an annual background dose (300 millirems) and a factor of 900 lower than the dose from a typical chest x-ray (10 millirems). Therefore, although tritium levels are slightly elevated near the Livermore Site, doses from tritium ingestion are negligible.

In general, LLNL's impacts on tritium concentrations in vegetation at Site 300 for 2002 were insignificant. With the exception of vegetation from previously identified sites of contamination, the tritium levels at Site 300 were below the limits of detection and comparable to those observed in previous years. The areas where tritium is known to be present in the subsurface soil are well delineated and localized. The calculated maximum potential annual ingestion dose from vegetation at sampling locations, based on the maximum value of 68,000 picocuries per liter, is 1.2 millirems. This dose, based on the conservative modeling assumptions described above, is theoretical, but nevertheless small, because vegetation at Site 300 is not ingested either by people or by livestock (LLNL 2003l).

External Radiation

The main source of environmental external radiation is from cosmic and terrestrial (rocks and soil) sources. External radiation impacts are from gammas. Gamma radiation is measured with thermoluminescent dosimeters.

C.4.2 Radiation Exposure to the Public

The information leading from normal LLNL radiation releases to public exposure and health impacts are described. This includes discussions of the radiological toxicity of releases, exposure assessments, and health risk characterization. The radiological releases from LLNL are at low levels, which result in doses that are orders of magnitude below regulatory concern.

C.4.2.1 *Radiological Toxicity*

Section C.3.1 contains a description of the basic terms describing radioactivity and its impacts on human health. A specific radionuclide's potential to result in dose to an organism is its radiotoxicity. This is typically reported as a dose conversion factor. The latter is the dose (rem) per unit intake (curies) for a specific exposure pathway. The dose conversion factor is based upon models of radionuclide movement within the body (for internal exposure). They include consideration of such factors as which organ individual nuclides are chemically/biologically attracted to, what the radiological and biological lifetimes in the body are, and the types and energies of the nuclide decay products.

Dose conversion factors are calculated for various organs of the body; e.g., adrenal, bladder, brain, and breast. Organs may be more susceptible to one nuclide or another; the classic example is the thyroid's sensitivity to iodine. The radiosensitivity of the organs and their consequences of irradiation differ; the chance of dying from thyroid cancer is less than that of cancer to other organs such as the pancreas. The effective dose equivalent weights the impacts on and effects of particular organs so that the dose from radionuclides that affect different organs can be compared on a similar (effect on whole body) risk basis. Each distinct exposure pathway; e.g., inhalation, ingestion, external exposure from contaminated ground, and air submersion, will have an associated effective dose equivalent. All of the effective dose equivalents can be summed over pathways and radionuclides to give an overall exposure and health impact. Effective dose equivalents are used everywhere in this document unless otherwise noted.

The radionuclides released during normal operations at LLNL that have the most impact on public health are tritium (from Livermore Site releases) and uranium (from Site 300). The dose conversion factors contained in the CAP88 computer model, used in the public exposure assessment for these radionuclides, are shown in Table C.4.2.1–1. Although gaseous tritium is relatively benign (being an inert gas), tritium as a component of tritiated water is relatively more toxic because water is biologically assimilated into the body easily. The dose conversion factors presented are for tritiated water. The exposure analysis assumes, as required by NESHAP (LLNL 2003z), that all of the tritium released is tritiated water. In 2002, 90 percent of the tritium released was in the form of tritiated water. References to tritium from normal operations should be assumed to be as tritiated water.

TABLE C.4.2.1–1.—*Dose Conversion Factors of Radionuclides Most Impacting Public Health From Lawrence Livermore National Laboratory Normal Operations*

Nuclide	Inhalation (rem/μCi)	Ingestion (rem/μCi)	Immersion in Air (rem/yr per μCi/m^3)	Ground Surface (rem/yr per μCi/m^2)
Tritium	1.3×10^{-4}	9.0×10^{-5}	0	0
Uranium-234	132	1.05	7.5×10^{-4}	8.5×10^{-5}
Uranium-235	122	1.00	0.75	0.017
Uranium-238	118	0.95	5.1×10^{-4}	6.4×10^{-5}

μCi = microcuries; m^2 = square meters; m^3 cubic meters; yr = year.
Source: CAP88-PC 2000.

C.4.2.2 *Exposure Analysis*

An exposure analysis of 2002 releases is presented as representative of LLNL. The analysis was conducted using CAP88 (CAP88-PC 2000). A more complete description of the analysis is given in the 2002 LLNL Environmental Report, Data Supplement, and the 2002 LLNL NESHAP Annual Report (LLNL 2003l, LLNL 2003z).

Sources

Small amounts of radioactivity are released into the air at the Livermore Site through stacks, vents, and diffuse releases such as soil resuspension. Tritium is the predominant radionuclide released from the Livermore Site as it relates to impacts on human health. Tritium releases have been generally decreasing over the past few years, as shown in Figure C.4.2.2–1. Table C.4.2.2–1 shows the important tritium releases from the Livermore Site. There are no measurable releases of alpha- (e.g., plutonium) and beta- (other than tritium) emitting nuclides from the Livermore Site. This is due to the use of high-efficiency particulate air filters, exhaust air systems, and other controls that prevent airborne releases of these radionuclides from operations.

Table C.4.2.2–1 also shows the important radionuclide releases from Site 300. Those releases would be as a result of firing table explosives experiments. The uranium isotope distribution follows that of depleted uranium, which was used in the tests. A much less important source of releases from Site 300 is contaminated soil resuspension.

Exposure Assessment

Air releases are, by far, the major potential source of public radiological exposures from LLNL operations. In contrast, normal releases to groundwater, surface water and sewerable water are not sources of direct public exposure because these waters are not directly consumed or used by the public. Unusual occurrences can lead to indirect exposure. For example, an accidental release of sewerage containing radioactivity could lead to offsite soil contamination and subsequent exposure by resuspension inhalation and soil ingestion. Apart from such unusual occurrences, radiological releases to air determine LLNL's dose to the public.

The *Clean Air Act* requires the U.S. Environmental Protection Agency to protect the public from exposure to airborne contaminants that are known to be hazardous to human health. The U.S. Environmental Protection Agency has established NESHAP to protect the public in this way. These regulations require the determination of the dose to the maximally exposed individual resulting from radionuclide emissions to air. The annual dose for this maximally exposed individual member of the public must not exceed 10 millirems per year (40 CFR Part 61). In addition, the dose caused by all pathways of release of radiation or radioactive material is limited to 100 millirems per year for prolonged exposure and 500 millirems per year for occasional exposure (DOE O 5400.5).

DOE facilities demonstrate compliance with NESHAP by using approved computer modeling procedures and environmental monitoring programs to calculate the dose to the public. Although other (non-NESHAP) procedures and programs are frequently used in NEPA analyses, such as an EIS, the use of NESHAP approved analyses in this case facilitates the merging of previously calculated (for NESHAP) doses to the public from numerous site sources into the overall impacts. The previous approved calculations were supplemented with new calculations, using the same approved procedures, for those releases which were either not previously calculated (e.g., from the NIF) or were significantly changing from the baseline year (e.g., the Tritium Facility).

CAP88 is a computer model, which has been approved by the U.S. Environmental Protection Agency, which satisfies the NESHAP requirements (CAP88-PC 2000). The program calculates the radionuclide concentrations in air as determined from operating and meteorological conditions. The air concentrations are converted to concentrations in foodstuffs that are produced and consumed by people in the surrounding area. The important LLNL exposure pathways are inhalation and ingestion of food produced in the area. External doses (i.e., immersion in air and exposure to ground surfaces) can be important contributors if the radionuclides released are strong gamma emitters. The predominant LLNL radionuclides released, tritium and uranium, are instead chiefly beta and alpha emitters, respectively.

LLNL performs the requisite dose analyses annually (LLNL 1999a, 2000h, 2001n, 2002bb, and 2003z). The analyses consider doses both to the maximally exposed individual and to the population (out to 50 miles from each site) as a whole. The 2002 maximally exposed individual for Livermore Site was located along the eastern site boundary, at the UNCLE Credit Union. At Site 300, the maximally exposed individual was located along the southern site boundary, at the Carnegie State Vehicular Recreation Area. At both sites, the maximally exposed individual was assumed to remain at the point of interest for 24 hours per day over the entire year.

The population dose from Livermore Site (dominated by tritium) is approximately one-third from ingestion and two-thirds from inhalation. The ingestion is a result of tritiated water being easily assimilated into plant matter. The population dose from Site 300 (dominated by uranium) is almost entirely from inhalation. All food consumed by the population surrounding LLNL was assumed to be grown there (with the exception of milk, for which no local production is indicated). The population (approximately 6.9 million people) distributions were centered at Livermore Site and Site 300, as applicable. The two populations overlap; a total LLNL populations dose would be the sum of the two site populations doses.

Every LLNL operation was modeled individually using the NESHAP methodology, as described above. The specific facility operating parameters; e.g., stack heights, were used. Each year's analysis considered that year's meteorology (as measured at onsite monitors) and releases. The radionuclide releases were based directly on sampling data from continuously monitored sources. For unmonitored facilities, potential annual emissions were determined from radionuclide usage inventories, time factors describing the fraction of time the nuclides were in use, and U.S. Environmental Protection Agency-determined physical state factors that describe the potential for release based on the physical state (i.e., solid, liquid, powder, or gas) of the radionuclide. Emission control abatement factors were also considered in calculating doses; each high-efficiency particulate air filter stage assumes 99 percent efficiency. For Site 300 explosives experiments, the very conservative assumption that all of the uranium involved in the experiment is aerosolized was made.

The dose to the maximally exposed individual from 2002 LLNL operations was 0.023 millirem at the Livermore Site and 0.021 millirem at Site 300. These values are less than 0.25 percent of the regulatory limit of 10 millirem. The population doses resulting from releases in 2002 from the Livermore Site and Site 300 were 0.5 and 2.5 person-rem, respectively. The population dose resulting from either site's releases was many orders of magnitude less than the population dose of approximately 2×10^6 person-rem from natural background.

The modeling results of tritium concentrations in air released from the Livermore Site are compared with site water vapor samplers. Annual average concentrations, which correspond to the annual dose, generally agree within a factor of 2.5. The modeling bias is on the high side. That is, most of the modeled concentrations are higher than the measurements; the average ratio of modeled to measured concentrations is 1.6.

Monitored Results

As discussed above, the CAP88 analysis (LLNL 2002ab) calculates the radiation dose from various environmental pathways. The offsite dose calculated from LLNL operations is very small. This is also reflected in the monitoring results.

Tritium air concentrations, as discussed above, were lower than those based on the CAP88 modeling. Accordingly, the monitored information implies an even lower dose than the small value reported from CAP88 calculations. With a normal breathing rate of 8,000 m^3/yr and the dose conversion factor from Table C.4.2.1–1, the highest Site 300 median uranium concentration resulted in only 0.03 millirem per year, 0.3 percent of the NESHAP limit.

Conservatively assuming an adult diet consisting exclusively of leafy vegetables containing the measured tritium concentration, as well as meat and milk from livestock fed on grasses contaminated with the same concentration, the maximum individual potential ingestion dose from tritium releases would be 0.011 millirem per year (LLNL 2003l). Although no health standards exist for radionuclides in wine, the highest detected concentration in Livermore Valley wines was less than one-half of one percent of the allowable California drinking water standard. The results of environmental radiation monitoring shows that the external radiation from both LLNL sites do not exceed natural background levels.

C.4.2.3 *Health Risk Characterization*

Section C.3.3 describes the factors used to estimate the health risk from exposure to radiation (dose). The dose from 2002 LLNL operations to the maximally exposed individual and to the population as a whole is discussed above. The risks of a cancer fatality to the maximally exposed individual from exposure to the LLNL operations are 1.4×10^{-8} and 1.3×10^{-8} per year of exposure at Livermore Site and Site 300, respectively. The risks of any health detriment (including nonfatal cancers and genetic effects) to the maximally exposed individual at the Livermore Site and Site 300 are 1.8×10^{-8} and 1.7×10^{-8} per year of exposure, respectively. These risks are orders of magnitude below typical levels of concern.

Health effects from population dose are described as total effects over the population. The number of fatal cancers to the populations surrounding the Livermore Site and Site 300 from the 2002 operations is calculated as 3.0×10^{-4} and 1.5×10^{-3} per year of exposure, respectively. These numbers, being much less than one, mean that it is very unlikely that LLNL releases will cause a cancer (or any health detriment) in the surrounding population.

Table C.4.2.3–1 gives the risk of a cancer fatality to the general public as a result of the No Action Alternative, Proposed Action, and Reduced Operation Alternative site actions, along with the above risks from year 2002 releases. Most of the dose is attributed to the nuclide releases indicated in Table C.4.2.2–1. Differences in Livermore MEI dose among the alternatives are a result of short-lived radionuclides released from the NIF. These short-lived radionuclides affect the MEI at the fenceline but decay prior to affecting the offsite population.

The two LLNL sites, Livermore Site and Site 300, are far enough apart that the MEI (located at each site's fenceline) from each does not affect the other. Therefore, a separate MEI is defined for each of the two sites. Similarly, separate collective doses to the population are noted for each of the two sites. Since there is overlap in the affected site populations, the population dose/risk can be summed and a composite dose/risk noted. The LLNL collective dose would be 7.0×10^{-3} person-rem for each of the three alternatives. All of the potential actions would result in a cancer risk below typical levels of concern.

TABLE C.4.2.3–1.—*Risk of Cancer Fatality to the General Public From Lawrence Livermore National Laboratory Operations*

		2002 Operations	No Action Alternative	Proposed Action	Reduced Operation Alternative
Livermore Site	MEI	1.4×10^{-8}	1.8×10^{-7}	2.0×10^{-7}	1.3×10^{-7}
	Population	3.0×10^{-4} [a]	1.1×10^{-3} [a]	1.1×10^{-3} [a]	1.1×10^{-3} [a]
Site 300	MEI	1.3×10^{-8}	3.3×10^{-8}	3.3×10^{-8}	3.3×10^{-8}
	Population	1.5×10^{-3} [a]	5.9×10^{-3} [a]	5.9×10^{-3} [a]	5.9×10^{-3} [a]

[a] Calculated value. Indicates that it is very unlikely that site releases would result in a cancer in the general population.
MEI = maximally exposed individual.

C.4.3 Exposures to Toxic Materials

As described in Appendix A, there are numerous chemicals present at LLNL. Occupational and environmental sampling and monitoring programs at LLNL provide a comprehensive assessment of actual exposure hazards present in both the workplace and the environs surrounding LLNL perimeters. Three potential pathways exist for toxic materials to leave the Livermore Site or Site 300 leading to possible public exposures. Exposure to airborne chemicals could result from emissions from current operations. Contaminated groundwater is not a result of current operations, but it could be a potential source of exposure, though currently no public wells are affected by contamination. The third pathway, exposure to chemicals released to the sewer, would be applicable only to treatment plant workers.

As discussed above, sampling and monitoring results for hazardous chemicals in air and effluents, groundwater, and sewerable discharges are below established regulatory limits and do not pose a significant hazard to members of the public.

Likewise, workplace and personnel monitoring during routine LLNL operations indicate that effective control measures have been implemented to protect workers. Personnel exposures to hazardous chemicals would be maintained as low as reasonably achievable and would not represent a significant risk to workers.

C.4.4 Environmental Exposures from Potential Accidents

Environmental exposures from previous incidents in which radioactive and nonradioactive materials were released into the environment are considered to be part of the actual releases as discussed above. Potential exposures from postulated releases and the resulting impacts are discussed in Appendix D. The chemicals examined in Appendix D were selected based on quantities of chemicals in single locations, the likelihood of an accident occurring, and the potential health effects associated with short-term (i.e., acute) exposures.

C.5 QUALITY ASSURANCE

This section presents the protocols used to ensure the quality of the ES&H programs at LLNL. It provides an account of LLNL activities and operations encompassing quality assurance and quality control. The protocols presented are limited to:

- The standards and regulations governing the quality of the ES&H programs (Section C.5.1)
- Protocols and procedures used to ensure quality in ES&H (Section C.5.2)
- Other organizations performing environmental inspections/appraisal at LLNL (Section C.5.3)

C.5.1 Regulations and Standards Pertaining to the Quality of Environment, Safety, and Health Programs

As discussed in Section C.1, the quality and maintenance of ES&H programs is addressed in the regulations and standards of several governmental agencies. Most private and governmental agencies must establish programs that comply with these requirements to ensure the protection of the workers, the public, and the environment.

Title 10 of CFR Section 830.120, "Quality Assurance Requirements," (10 CFR Part 830) issued on April 5, 1994, restructured the DOE Quality Assurance Program and requires the development and implementation of a formalized Quality Assurance Program to address three areas: management, performance, and assessment. These three program areas incorporate the 10 program criteria included in both 10 CFR §830.120 and DOE O 414.1A. Title 10 applies only to nuclear facilities, which include radiological facilities. These requirements do not apply to nonnuclear facilities.

C.5.2 Protocols and Procedures Used to Ensure Quality in Environment, Safety, and Health

Quality Assurance Program

The Quality Assurance Plan, describing the Quality Assurance Program, was developed in response to DOE requirements. The Quality Assurance Program, as described in the Quality Assurance Plan, implements the rule (10 CFR §830.120) and DOE O 414.1A in accordance with the statutory and regulatory requirements identified in the LLNL Work Smart Standards. When conflicts occur between the Quality Assurance Plan and lower-tier documents, the requirements of the Quality Assurance Plan will govern (LLNL 2000i).

LLNL policy includes quality assurance in the ongoing efforts of the technical and administrative personnel at all levels and in all functions of LLNL to be effective. Quality assurance is a system of activities and processes put in place to ensure that monitoring and measurement data meet user requirements and needs. Quality control consists of procedures used to verify that prescribed standards of performance in the monitoring and measurement process are met. DOE orders and guidance mandate quality assurance requirements for environmental monitoring of DOE facilities. DOE O 5400.1 identifies quality assurance requirements for radiological effluent and surveillance monitoring and specifies that a quality assurance program consistent with the DOE order addressing quality assurance is established. This order sets forth policy, requirements, and responsibilities for the establishment and maintenance of plans and actions that ensure quality in DOE programs.

LLNL conducts quality assurance activities at the Livermore Site and Site 300 in accordance with the Environmental Protection Department Quality Assurance Management Plan, which is based on DOE O 414.1A and prescribes a risk-based, graded approach to quality assurance. This process promotes the selective application of quality assurance and management controls based on the risk associated with each activity in order to maximize effectiveness and efficiency in resource use (LLNL 2003l).

The DOE Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance requires that an environmental monitoring plan be prepared. LLNL environmental monitoring is conducted according to procedures published in Appendix A of the LLNL Environmental Monitoring Plan (LLNL 1995a).

Management dictates that all programs and line organizations use quality assurance to assist in ascertaining that LLNL's programmatic objectives are achieved with appropriate considerations for ES&H. All risks to people, property, and the environment must be reduced to levels as low as reasonably achievable. The LLNL Quality Assurance Program is intended to meet the goal of ensuring quality through existing line organizations.

The Quality Assurance Office is the LLNL primary interface to DOE on quality assurance matters and provides the point of contact for all external audits and appraisals of quality assurance activities. The associate director for plant operations appoints the manager of the Quality Assurance Office and provides the resources for staffing and operating it. This office reviews all new and revised quality assurance plans to ensure conformity with the LLNL Quality Assurance Program requirements, maintains a list of all quality assurance plans and audits, and coordinates independent appraisals of the LLNL Quality Assurance Program as directed by the associate director.

The manager of the Quality Assurance Office is responsible for preparing and revising the LLNL Quality Assurance Manual. The office also provides each directorate with the following:

- Professional guidance and advice in quality assurance methodologies, including the publication of quality assurance guides
- Assistance in developing quality assurance plans and implementing procedures
- A training and auditor-certification program for line-organization personnel in quality assurance and audit procedures
- Assistance in conducting internal audits and reviews and in coordinating external audits and reviews

Each quality assurance plan focuses on a specific activity (i.e., facilities, research activities, or development of prototype and test equipment). Activity leaders are accountable to the program leader or line manager funding the activity for the following:

- Preparing quality assurance plans and implementing procedures that ensure achievement of objectives and quality goals that are consistent with the cognizant associate director's policy

- Implementing and monitoring plans to ensure that required actions are carried out to achieve objectives and quality goals
- Promptly correcting deviations from plans and/or modifying the plans/procedures to improve effectiveness

ES&H Program Quality Assurance

Planning ES&H programs has been and remains an important aspect of LLNL operations. To plan ES&H programs, several documents have been prepared, including the ES&H Manual; the Environmental Protection Manual; facility safety plans; safety analysis reports; hazard analysis reports; safety analysis documents; integration work sheets; and hazards screening reports.

In the increased formalization being brought about by the incorporation of Integrated Safety Management, there is considerable value in collecting and organizing the ES&H documents into a formal structure and placing it under configuration control. This has been done by establishing an ES&H document structure called the ES&H Manual. Included in this new manual are the contents of the former principal ES&H document at LLNL, the Health and Safety Manual. This new ES&H Manual applies across LLNL to all operations and activities. It was structured to address all of the topics needed at LLNL and was attentive to Federal regulations, DOE orders, and the current technical capabilities. Also included are the contents of the former second principal ES&H document at LLNL, the Environmental Compliance Manual, which addressed Federal, state, and local governmental regulations. Accompanying these in the ES&H Manual are specialty manuals such as the Training Program Manual and the Quality Assurance Program. To accomplish the purpose of the ES&H Manual to have the necessary ES&H documents for LLNL activities in one structure, criteria for the specific inclusion or exclusion of candidate ES&H documents were included in the ES&H Manual (LLNL 2003k).

The requirements in the ES&H Manual are based on the Work Smart Standards identified for the specific work and associated hazards and LLNL best management practices that have been determined to be requirements. The ES&H Manual also describes the implementation of the ES&H management commitments.

Until recently, there were two types of safety documents used at LLNL, facility safety plans and operational safety plans. Both types of documents addressed ES&H concerns associated with a facility or operation. LLNL is replacing operational safety plans with Integrated Work Sheets in a phased approach as operational facility plans come due for renewal. Facility safety plans remain as key facility-specific documents and are required for hazard-ranked facilities above the classification of general industry.

Facility safety plans outline the methods for controlling and minimizing the ES&H hazards and risks identified in safety-basis reports (e.g., safety analysis reports, hazard analysis reports, or screening reports) and other ES&H evaluations for a facility. Facility safety plans should be updated whenever a change is required. At minimum, a review by the facility manager is required every 12 months to determine if changes are necessary. In addition, the facility manager will initiate a triennial full review process to renew the facility safety plan for an additional 3 years.

All work at LLNL beyond activities commonly performed by the public must be authorized with an Integrated Work Sheet. Depending on the level of hazards associated with the activity, a safety plan may be required. Integrated Work Sheets/Safety Plans are project-specific documents and are required for all Work Authorization Level C work. The requirement for a safety plan may be met by completing a safety plan form including the additional information, attaching a current operational safety plan covering the work described in the Integrated Work Sheet or attaching or referencing applicable sections of the facility safety plan covering the work described in the Integrated Work Sheet. The additional information typically addresses such issues as hazardous/radioactive material quantities, potential accidents/consequences, key ES&H limits, hazards and controls, maintenance, inspection and quality assurance, emergency response actions, and references. Every 12 months the responsible individual or his or her designee, in consultation with the ES&H Team leader or designee, reviews the Integrated Work Sheet/Safety Plan with authorized workers to determine if changes are needed. Additionally, Integrated Work Sheet/Safety Plans are renewed every 3 years and the information in the document is updated at that time as needed. The document is reviewed again and the facility point of contact, ES&H Team leader, and site managers (if applicable) re-concur on the document.

LLNL has been appraised and audited by internal and external groups to ensure that LLNL is in compliance with DOE directives and the regulations and standards of other agencies. However, a major component of the ISMS feedback and continuous improvement focus is a robust self-assessment program. Under the provisions of Contract 48, LLNL conducts an annual institutional-level self-assessment to evaluate its management performance in a number of administrative and operational areas, including ES&H. This self-assessment is made against a set of performance objectives, criteria, and measures. The self-assessment report is reviewed and verified and LLNL's performance is evaluated by NNSA and the University of California, Office of the President. LLNL also contracts with outside experts to conduct a triennial review of the ES&H Internal Review System. This review, the annual institutional-level self-assessment, Assurance Review Office evaluations, and other special reviews are accompanied by NNSA management throughout appraisals of LLNL, which include several ES&H areas (LLNL 1998d, LLNL 2003k).

In addition to the institutional assessments, LLNL has a well-developed annual self-assessment program that is specified in the ES&H Manual. These LLNL organization self-assessments evaluate the effectiveness of adherence to ES&H requirements and implemented controls at both the facility and activity levels.

C.5.3 Other Organizations Performing Environmental Inspections and Appraisals at Lawrence Livermore National Laboratory

LLNL had a total of 14 inspections in fiscal year 2002 by 7 regulatory agencies, resulting in 2 validated violations (See Table C.5.3–1). There were no additional violations from inspections in previous years. Inspections were conducted by the BAAQMD, the SJVUAPCD, the Alameda County Health Care Services Agency (Division of Environmental Protection), the Alameda County Department of Environmental Health, the Central Valley Regional Water Quality Control Board, the California Department of Toxic Substances Control, and the Livermore Water Reclamation Plant. LLNL continues to demonstrate a strong commitment to protecting the environment and meeting its regulatory commitments. The number of inspections by regulatory agencies continues to decline, indicating that regulators are becoming more comfortable with quality of the environmental program at LLNL (LLNL 2002bk).

TABLE C.5.3–1.—*Environmental Inspections and Violations in Fiscal Year 2002*

	Inspection Date	Report Date	Initial Violations	Number Contested	Validated Violations	Site
Air, 7 Inspections						
Bay Area Air Quality Management District	11/8/01	NRI	0	0	0	Livermore
	12/6/01	NRI	0	0	0	Livermore
	2/8/02	NRI	0	0	0	Livermore
	3/13/02	NRI	0	0	0	Livermore
	6/6/02	NRI	0	0	0	Livermore
	9/6/02	NRI	0	0	0	Livermore
San Joaquin Valley Unified Air Pollution Control District	6/4/02	NRI	0	0	0	300
Groundwater, 0 Inspections						
No inspections						
Natural Resources/Floodplains/Stormwater, 0 Inspections						
No inspections						
Tanks, 1 Inspection						
Alameda County Health Care Services Agency – Division of Environmental Protection	10/17/01	10/17/01	0	0	0	Livermore
Waste, 3 Inspections						
Central Valley Regional Water Quality Control Board	10/16/01	NRI	0	0	0	300
California Department of Toxic Substances Control	5/22 – 24/02 5/30/02 6/4/02	8/14/02 (final report)	4	2	2	Livermore
Alameda County Department of Environmental Health (medical waste)	9/25/02	9/25/02	0	0	0	Livermore
Wastewater, 3 Inspections						
City of Livermore Water Reclamation Plant	10/2/01, 10/8 – 9/01	12/4/01	0	0	0	Livermore
	10/15/01	11/1/01, 12/4/01	0	0	0	Livermore
	10/31/01	11/1/01, 12/4/01	0	0	0	Livermore
Hazardous Materials Transportation, 0 Inspections						
No inspections						
Total of 14 Inspections			**4**	**2**	**2**	

Source: LLNL 2002ab, LLNL 2003l.
NRI = No report issued by the agency.

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APPENDIX D: ACCIDENT ANALYSIS

This appendix of the *Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (LLNL SW/SPEIS) presents the estimated consequences of accidents that could occur at the Lawrence Livermore National Laboratory (LLNL). The scenarios described here define the bounding envelope of accidents—that is, any other reasonably foreseeable accident at LLNL would be expected to have smaller consequences. These accident analyses are conservative, with little or no credit taken for existing preventative and mitigating features in each building or operation analyzed or the safety procedures that are mandatory at LLNL. Onsite transportation accidents are included in this appendix. The discussion of offsite transportation accidents is included in Appendix J.

Four types of accidents are discussed: (1) accidents with a potential for releases of radioactive material, (2) accidents with a potential for release of toxic chemicals, (3) accidents involving high explosives, and (4) accidents involving biological hazards. For accidents involving radioactive materials and toxic chemicals, this appendix describes how locations or operations were selected for analysis, the computer codes used to estimate consequences, the development of the scenario and assumptions about source terms, the selection of computer modeling and a description of the results, and predicted health effects. For accidents involving high explosives, this appendix discusses the uses of high explosives at the sites, the potential accidents associated with these uses, and the effects of potential accidents. For accidents involving biological hazards, this appendix summarizes and incorporates analyses previously performed for activities conducted by the U.S. Army (Army 1989).

D.1 APPROACH TO THE ANALYSIS OF POTENTIAL ACCIDENTS

D.1.1 Overview

Accident scenarios have been developed to reflect the broad range of accidents that might occur at LLNL. The scenarios are specific to particular buildings and operations. The following terms are used to define the scenarios:

- A reasonably foreseeable accident could include an accident with "impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason" (40 *Code of Federal Regulations* [CFR] §1502.22). "Credible" means having reasonable grounds for believability, and the "rule of reason" means that the analysis is based on scientifically sound judgment.

- An accident is bounding if no reasonably foreseeable accident with greater consequences can be identified. A bounding envelope is a set of individual bounding accidents covering the range of probabilities and possible consequences. Presenting the impacts from bounding accidents provides a conservative representation of impacts from postulated accidents at LLNL.

A deterministic, nonprobabilistic approach was used to develop the accident scenarios, including those scenarios without a specific initiating cause. The wide range of postulated accidents characterizes the range of accident impacts associated with the operation of LLNL. Bounding scenarios were developed for specific hazards such as radioactive material, toxic chemicals, or high explosives for an operation in a building. The postulated accident scenario for radioactive material, toxic chemicals, or high explosives, can be reasonably evaluated in terms of the effective dose equivalent, specific toxic effects of individual chemicals, or the radius of impact; and from this, the bounding scenario can be determined. In all cases, bounding scenarios are based on the most limiting consideration: radiation exposure, chemical concentration, or peak overpressure.

The radiological exposures are discussed in the individual scenario descriptions reported in Section D.2.4. The health effects from these exposures are presented in Section D.2.5. The chemical exposures are discussed in the individual scenario descriptions reported in Section D.3.2. The health effects associated with chemical releases are analyzed separately and presented in Section D.3.3. The consequences of high explosive accidents are addressed in the individual scenario descriptions in Section D.4. The consequences of accidents involving biological hazards are described in Section D.5. Section D.6 presents the potential releases and consequences of a situation involving a multiple building event.

It is not possible to predict whether intentional attacks would occur at LLNL or at other critical facilities, or the nature of the types of attacks that might be made. Nevertheless, NNSA reevaluated scenarios involving malevolent, terrorist, or intentionally destructive acts at LLNL in an effort to assess potential vulnerabilities and identify improvements to security procedures and response measures in the aftermath of the attacks of September 11, 2001. Security at NNSA and DOE facilities is a critical priority for the Department, and it continues to identify and implement measures designed to defend against and deter attacks at its facilities. In March 2004, DOE's Office of Safeguards and Security Evaluations completed a special department-wide review at LLNL that included performance testing LLNL's Protective Force. LLNL was given a rating of "Effective Performance", which is the highest one possible.

Substantive details of terrorist attack scenarios and security countermeasures are not releasable to the public, since disclosure of this information may be exploited by terrorists to plan attacks.

D.1.2 Selection of Buildings and Operations for Accident Scenarios

Developing accident scenarios began with reviewing the initial database listing of all LLNL facilities, which comprised 738 individual facilities as of October 2002.

These facilities were reviewed with emphasis on building hazard classification and radionuclide and chemical inventories (including type, quantity, and physical form), high explosives usage, and storage and use conditions. Administrative buildings without hazardous materials were excluded. Buildings ranked as low hazard and those without radioactive materials were eliminated from consideration. The potential offsite consequences of facilities screened out would be well bounded by LLNL's bounding accident scenarios. The following 23 existing LLNL facilities and complexes remained after this initial screening process:

- Building 190, Multi-User Tandem Laboratory
- Building 191, High Explosives Application Facility (HEAF)
- Building 194, 100-MeV Electron-Positron Linear Accelerator (LINAC) Facility
- Building 233, Container Storage Unit (CSU)
- Building 235, 4-MeV Ion Accelerator
- Building 239, Radiography Facility
- Building 251, Heavy Element Facility
- Building 280, Dome
- Building 322, Plating Shop
- Building 331, Tritium Facility
- Building 332, Plutonium Facility
- Building 334, Hardened Engineering Test Building
- Building 368, BioSafety Level-3 Facility
- Buildings 514/612/625/693, Radioactive and Hazardous Waste Management Complex*
- Building 581, National Ignition Facility (NIF)
- Building 695, Decontamination and Waste Treatment Facility (DWTF)
- Building 696R, Radioactive Waste Storage Area
- Site 300 Materials Management Facilities*
- Site 300 Weaponization Program*
- Site 300 Process Area*
- Site 300 Chemistry Area*
- Site 300 Explosive Waste Treatment Facility (EWTF)*
- Site 300 B-Division Firing Areas*

*Includes several individual buildings.

In addition, the following proposed LLNL facilities or projects under the Proposed Action were analyzed:

- Building 581, NIF use of special nuclear material (SNM)
- Building 331, Tritium Facility material-at-risk (MAR) increase (30 grams)
- Building 332, Plutonium Facility MAR Increase (40 kilograms plutonium)
- Energetic Material Processing Center (EMPC)
- Building 239, Radiography Facility MAR Increase (50 kilograms highly enriched uranium)

The next step in the selection process was to identify the most current documentation describing/quantifying the hazards associated with each facility's operation. Current safety documentation was obtained for all of these facilities. Section D.2.4 uses data from these safety documents to describe accident scenarios for each facility. The potential offsite consequences associated with Building 695, Decontamination and Waste Treatment Facility, the Site 300 Process Area, and the Site 300 Chemistry Area were bounded by other similar facilities; thus, these facilities did not warrant further consideration in this analysis. The Building 233 Container Storage Unit no longer contains transuranic waste (LLNL 2001ax), therefore the Building 233 Container Storage Unit was removed from further consideration. Similarly, Building 280 Dome was removed from further consideration because using this facility for radioactive waste storage (LLNL 1999e) is no longer being contemplated. This left 18 existing and 5 proposed LLNL facilities/projects for detailed analysis.

D.2 ACCIDENTS WITH POTENTIAL RELEASE OF RADIOACTIVE MATERIAL

LLNL uses radioactive materials in a wide variety of operations including scientific and weapons research and development, diagnostic research, research on the properties of materials, isotope separation, surveillance and aging studies, machining and inspection, chemical processing, analytical chemistry, metallurgy, weapon component processing, and as calibration and irradiation sources. Radioactive materials are collected as waste products in forms varying from contaminated laboratory equipment and metal filings to contaminated trash and liquids. Radioactive materials are transported onsite. Therefore, there is a potential for releases of radioactive materials due to human error, failure or malfunctioning of equipment, accidents during the treatment, handling, or transportation of radioactive wastes, and severe natural events like earthquakes.

This section analyzes postulated accidents that could result in radioactive material releases. This section also describes how bounding scenarios were selected for analysis. Additionally, this section discusses the computer code that was used in the analysis as well as assumptions about weather conditions and atmospheric dispersion, presents the bounding scenarios, and estimates the potential health effects.

D.2.1 Scenarios, Consequence Analysis, and Risk

An accident is a sequence of one or more unplanned events with potential outcomes that endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictate the accident's progression and the extent of materials released. Initiating events fall into three categories:

- *Internal initiators* normally originate in and around the facility, but are always a result of facility operations. Examples include equipment or structural failures and human errors.

- *External initiators* are independent of facility operations and normally originate from outside the facility. Some external initiators affect the ability of the facility to maintain its confinement of hazardous materials because of potential structural damage. Examples include aircraft crashes, vehicle crashes, nearby explosions, and toxic chemical releases at nearby facilities that affect worker performance.

- *Natural phenomena initiators* are natural occurrences that are independent of facility operations and occurrences at nearby facilities or operations. Examples include earthquakes, high winds, floods, lightning, and snow. Although natural phenomena initiators are independent of external facilities, their occurrence can involve those facilities and compound the progression of the accident.

If an accident were to occur involving the release of radioactive or chemical materials, workers, members of the public, and the environment would be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location. The offsite public would also be at risk of exposure to the extent that meteorological conditions exist for the atmospheric dispersion of released hazardous materials.

Consequences of accidental radiological releases were determined using the MELCOR Accident Consequence Code System, Version 2 (MACCS2) computer code (Chanin and Young 1997). MACCS2 is a U.S. Department of Energy/Nuclear Regulatory Commission (DOE/NRC) sponsored computer code that has been widely used in support of probabilistic risk assessments for the nuclear power industry and in support of safety and NEPA documentation for facilities throughout the DOE complex.

The MACCS2 code uses three distinct modules for consequence calculations: ATMOS, EARLY, and CHRONC. The ATMOS module performs atmospheric transport calculations, including dispersion, deposition, and decay. The EARLY module performs exposure calculations corresponding to the period immediately following the release. This module also includes the capability to simulate evacuation from areas surrounding the release. The EARLY module exposure pathways include inhalation, cloudshine, and groundshine. The CHRONC module considers the time period following the early phase; i.e., after the plume has passed. The CHRONC module exposure pathways include groundshine, resuspension inhalation, and ingestion of contaminated food and water. Land use interdiction (e.g., decontamination) can be simulated in this module. Other supporting input files include a meteorological data file and a site data file containing distributions of the population and agriculture surrounding the release site.

Because of assumptions used in this document analysis, not all of the code's capabilities were used. It was conservatively assumed that there would be no evacuation or protection of the surrounding population following an accidental release of radionuclides.

The source term for each scenario was derived by multiplying the MAR times various release factors (damage ratio, airborne release fraction, respirable fraction, and leak path factor) that describe the material available to potentially impact a receptor. Facility inventory is the amount of a hazardous material present in a building or facility. MAR is a portion of the inventory and is defined as the maximum amount of the referenced material that is involved in the process and thus at risk in the event of a postulated accident.

The meteorological data consisted of sequential hourly wind speed, wind direction, stability class and precipitation measured for 1 year. Five years of data (1997 through 2001) were considered. The maximum impacts occurred in 1999, which was used in the analyses, although the impacts from all of the years are roughly equivalent (within 15 percent).

Ten radial rings and 16 uniform direction sectors were used to calculate the collective dose to the offsite population. The radial rings were every 1 mile to 5 miles, a ring at 10 miles, and every 10 miles, from 10 to 50 miles starting at the distribution center. Three centers of distribution were used to represent the Livermore Site: one in the south (Building 331), the center of the site, and the north (Building 381). The location of the offsite maximally exposed individual (MEI) was assumed to be along the site boundary or, for elevated or buoyant releases, at the highest point of offsite consequence. The shortest distance to the boundary from each release location, in all 16 directions sectors, was identified for the MEI analysis. Similarly, the noninvolved onsite worker location was taken as 100 meters from the release in any direction. The spatial distribution of onsite workers, on a quadrant-by-quadrant basis, was conservatively estimated and used in the calculation of noninvolved worker population dose.

Population doses were statistically sampled by assuming an equally likely accident start time during any 4-hour period of the year. All 4-hour periods were sampled. The results from each of these samples were then sorted to obtain a distribution of results (radiation dose), from which the median (50^{th} percentile) and unfavorable (95^{th} percentile) results were extracted and presented in this LLNL SW/SPEIS. Median results are presented in this LLNL SW/SPEIS to give an indication of the most likely consequences, while unfavorable results are presented to give an indication of what the consequences would be under unfavorable conditions. The unfavorable meteorological results can also be used for comparison with LLNL Documented Safety Analysis.

Similarly, two sets of MEI and noninvolved worker doses were calculated. Both sets included conservative assumptions, such as the wind blowing toward the site boundary location closest to the release and locating the receptor along the plume centerline. The first set assumed 95^{th} percentile meteorology (stability class F and a 0.5-meter-per-second wind speed for most Livermore cases and 1.3 meters per second for Site 300). The second set assumed median meteorology based on site measurements for 1999 (stability class D and 2.80 meters per second for Livermore Site or 5.80 meters per second for Site 300).

The doses (70-year committed effective dose equivalent for members of the public and 50-year committed effective dose equivalent for workers) were converted into latent cancer fatalities (LCFs) using the factor of 6×10^{-4} LCFs per person-rem for both members of the public and workers (Lawrence 2002). Seventy-year doses were used because they represent the expected average lifetime of a resident. Fifty-year doses represent the average lifespan of a worker after receiving a dose, assuming the worker was at least 20 years old when the dose was received.

To characterize the accident risk, this analysis chooses a range of types of accidents and consequences. This analysis does not attempt to identify every possible accident scenario, but instead selects accidents that characterize or dominate the risk to the public and workers from site operations. Such accidents do not imply a threshold or particular magnitude of risk. If the risk posed by a facility is small, then such an accident has a correspondingly small risk.

By grouping accidents according to their likelihood or frequency and the magnitude of their consequences, it is possible to select accidents for further characterization and qualitatively portray their relative risk. The accidents selected for this detailed analysis are those with bounding consequences and those that characterize the risk of operating LLNL.

Such grouping or “binning” of accidents is illustrated in Figure D.2.1–1. Accidents assigned to bins within a column vary in terms of their frequency but not their consequences. Accidents have an increasing level of risk going from left to right within a row or from bottom to top within a column. By selecting the accidents with the highest consequences for a particular frequency row, the accidents that contribute the most to overall risk from site operations can be considered.

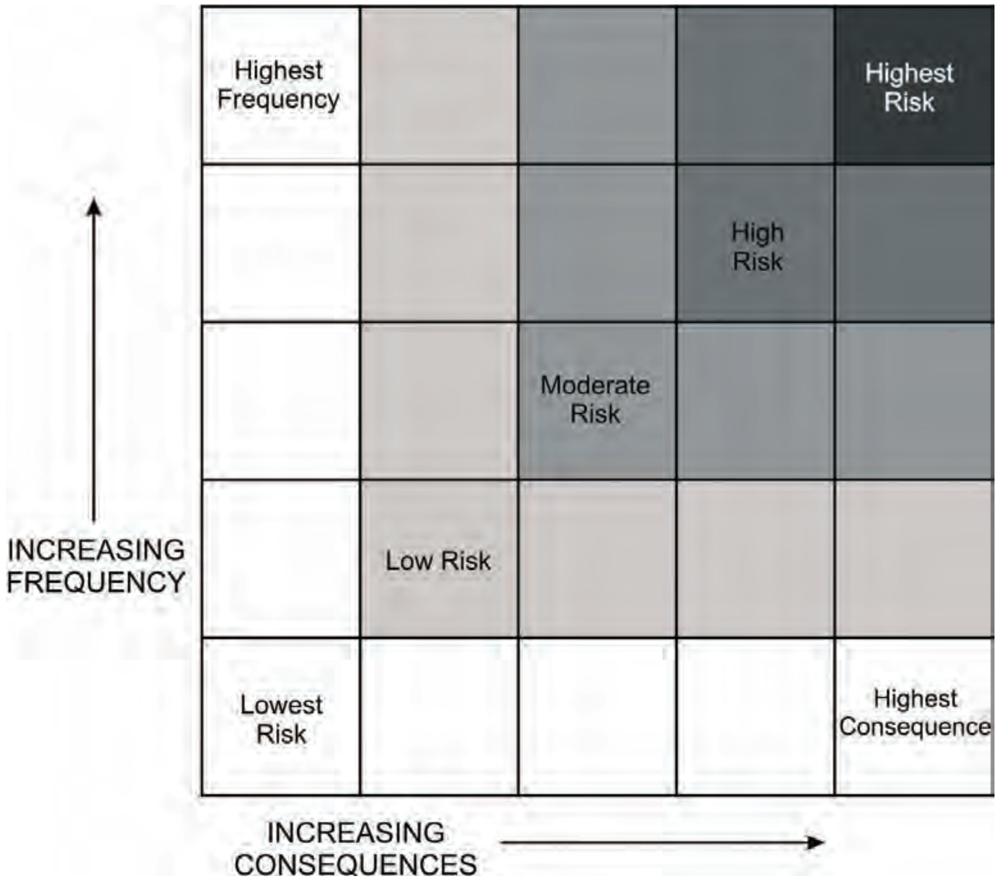
Any particular facility can be affected by a wide variety of accidents that may have about the same consequences. Such accidents might have similar frequencies and consequences, and so can be represented by a “representative accident.” In the analysis, the frequency of that representative accident might be increased to account for other initiators that lead to the same release. Conversely, there may be an accident whose probability of release is low but that would have larger consequences than other releases. This postulated accident would be a “bounding accident” with consequences that not be exceeded with any reasonable probability.

D.2.2 Mitigation Measures

Mitigations to exposure and dose that would affect the postulated results of the accident scenarios are discussed below. In general, no mitigation was assumed for emergency response in the consequence analysis.

D.2.2.1 *Emergency Response and Protective Actions*

LLNL has detailed plans for responding to accidents of the type described here, and the response activities would be closely coordinated with those of local communities such as Alameda County. LLNL personnel are trained and drilled in the protective actions to be taken if a release of radioactive or otherwise toxic material occurs. Refer to Appendix I for further details on LLNL emergency planning and response information.



Source: Original.

FIGURE D.2.1–1.—*Facility Accident Risk Matrix*

The underlying principle for the protective action guides is that under emergency conditions all reasonable measures should be taken to minimize the radiation exposure of the general public and emergency workers. In the absence of significant constraints, protective actions could be implemented when projected doses are lower than the ranges given in the protective action guides. No credit was taken for emergency response and protective actions in the consequence analysis.

D.2.2.2 *High-Efficiency Particulate Air Filtration*

In all areas where unconfined plutonium or other radioactive materials can be handled and can exist in a dispersible form, high-efficiency particulate air (HEPA) filters provide a final barrier against the inadvertent release of radioactive aerosols into the outside environment. However, these filters would not trap volatile fission products such as the noble gases and iodine; such gases would be released into the outside environment.

HEPA filter efficiencies are 99.99 percent or greater with the minimum efficiency of 99.97 percent for 0.3-micron particles, the size least efficiently captured by the filter. To maximize containment of particles and provide redundancy, two HEPA filters in a series are used. Actual data from HEPA filter replacement records in Building 332 show that none of the filters used to prevent a potential for release of plutonium to the atmosphere have degraded to the overall efficiencies assumed for the accident scenarios (LLNL 2003f). These HEPA filters are protected by design features against the consequences of an earthquake or fire. Credit was taken for filtration in the consequence analysis when ventilation and building containment were shown by analysis to survive during the accident.

D.2.3 Derivation of Aircraft Crash Frequencies

In this appendix, the National Nuclear Security Administration (NNSA) considers the impacts of a postulated aircraft crash on Buildings 331, 332, 625, and 696R. A postulated aircraft crash into Buildings 239, 334, and 693 was also initially considered. However, NNSA determined that buckling failure or perforation of the concrete structures in Buildings 239 and 334 was not predicted to occur. Building 693 has a lower radionuclide inventory and is physically smaller than Building 696R, and would be bounded by the analysis for Building 696R. Therefore, these three facilities were not evaluated further. The purpose of this section is to describe the process and data that NNSA used to derive the estimated frequencies for the aircraft crash for each of these four facilities.

The frequency evaluation for an aircraft crash uses a "four-factor formula" which considers the following factors:

1. The number of operations (N)
2. The probability that the plane will crash (P)
3. Given a crash, the probability that it will occur in a 1-square-mile area where the facility is located (f)
4. The effective area of the facility (A)

The annual aircraft crash frequency is calculated as follows:

$$F=\sum N_{i,j,k}\times P_{i,j,k}\times f_{i,j,k}(x,y)\times A_{i,j}$$

Where:

F = Estimated annual aircraft crash impact frequency for the facility (crashes per year)

N = Number of operations (operations per year)

P = Probability of a place crashing (crashes per operation)

f(x,y) = Aircraft crash location probability ($1/\text{mile}^2$)

A = Effective area of the facility (mile^2)

i = Phase of flight operation, i = 1, 2, 3 (takeoff, inflight, landing)

j = Aircraft type (commercial, military, general aviation, etc.)

k = Aircraft source (airports, inflight, etc.)

The values for each of these parameters are described in the following subsections.

D.2.3.1 *Number of Operations (N)*

In accordance with DOE standard "Accident Analysis for Aircraft Crash into Hazardous Facilities" (DOE-STD-3014-96), any airport further than 22 miles from LLNL would not increase the probability of an aircraft crash into the facility due to airport operations (takeoffs and landings). The airports in the vicinity of LLNL are Oakland International (28 miles), Hayward Municipal (23 miles), Livermore Municipal (6.5 miles), Moffett Field (26.5 miles), Tracy Municipal (14.5 miles), Meadowlark Field (1.5 miles), Byron (11.25 miles), and San Jose International (25.5 miles). The only airports within 22 miles are the Livermore Municipal, Tracy Municipal, Meadowlark Field, and Byron. These airports operate principally for general aviation.

Livermore Municipal Airport reported 252,470 operations during fiscal year (FY) 1999 (LLNL 2002bl). Of these, 158,592 were local, which only go as far as Livermore Avenue, and are not considered a direct threat to LLNL facilities. Of the remaining 93,878 operations, 1,711 were air taxi operations, 189 were military, and 91,978 operations were general aviation. The airport control tower is open from 7:00 a.m. to 9:00 p.m., but planes can land outside these hours. Therefore, an additional 10 percent of operations was assumed for general aviation. This results in 101,176 general aviation operations. Half of these operations were assumed to be takeoffs and half were assumed to be landings. At the Livermore Municipal Airport, 82 percent of takeoffs and landings are from the east to west; the remaining 18 percent are from the west to east.

Tracy Municipal Airport reported an average rate of 164 operations per day, which equals 59,860 operations per year (LLNL 2003bg). Approximately 1 percent of these operations (599 operations) are air taxi, and the remaining 59,261 operations are general aviation. Half of these operations were assumed to be takeoffs and half were assumed to be landings.

The Meadowlark Field Airport is a privately owned airfield, which reported about 3 flights per week, or 156 flights per year (LLNL 2002bl). The field is gravel and can only take general aviation planes. Half of these operations were assumed to be takeoffs and half were assumed to be landings.

The Byron Airport reported an average rate of 71 general aviation operations per day, or 25,915 per year (LLNL 2002bl). Half of these operations were assumed to be takeoffs and half were assumed to be landings.

D.2.3.2 *Crash Probability (P)*

Aircraft crash frequencies can be divided into two categories: accidents in the vicinity of an airport, and accidents while a plane is in flight. Aircraft crash frequencies are also a function of the type of aircraft. Generally, commercial air carriers have the lowest accident frequency for both takeoff and landing operations and per mile in flight. Military aviation and general aviation have higher accident frequencies. Analysis of aircraft frequencies have shown increased accident rates within 22 miles of an airport. Increased accident frequencies near airports are attributed to aircraft takeoff and landing traffic. DOE standard "Accident Analysis for Aircraft Crash into Hazardous Facilities" (DOE-STD-3014-96) contains crash rates and location probabilities for aircraft near airports associated with takeoffs and landings.

Aircraft crash probabilities while a plane is in flight are independent of the vicinity of airports. DOE standard gives this information as a combination of NPf(x,y).

D.2.3.3 *Aircraft Crash Location Probability (f)*

The f(x,y) values for the aircraft crash frequency equation are based on the location of the facility with respect to the airport (x and y). The x value is measured in the direction of aircraft travel and y value is measured perpendicular to aircraft travel. The values of f(x,y) were obtained from DOE standard for both takeoffs and landings. Values for air taxis were assumed to be the same as for commercial carriers.

Table D.2.3–1 presents that calculation of the aircraft crash probability at the Livermore Site using the values for N, P, and f discussed above.

D.2.3.4 *Effective Area of the Facility (A)*

The effective area of the facility needs to be determined to complete the frequency calculations. DOE standard defines the effective area as "… the ground surface area surrounding a facility such that if an unobstructed aircraft were to crash within the area, it would impact the facility, either by direct fly-in or skid into the facility. The effective area depends on the length, width, and height of the facility, as well as on the aircraft's wingspan, flight path angle, heading angle relative to the heading of the facility, and the length of its skid." The equation for effective area is as follows:

$$A = A_{sk}+A_{fp}+A_{sh}$$

$$A_{sk} = (WS+R) \times S$$

$$A_{fp} = L \times W+\frac{(2 \times L \times W \times WS)}{R}$$

$$A_{sh} = (WS + R) \times H \times \cot(\Phi)$$

Where:

A = total effective area

A_{sk} = effective area associated with the skid

A_{fp} = effective area associated with the footprint

A_{sh} = effective area associated with the shadow

WS = aircraft wingspan

S = aircraft skid distance

L = length of facility

W = width of facility

H = height of facility

cot(Φ) = mean of the cotangent of the building shadow angle

R = length of the diagonal of the facility = $(L^2 + W^2)^{0.5}$

Table D.2.3–2 presents the values for each of these parameters, as well as the calculated total area for each of the five LLNL facilities for each aircraft type. The total area is the sum of the A_{sk}, A_{fp} and A_{sh} values.

Table D.2.3–3 presents the product of the crash probabilities from Table D.2.3–1 and the total effective areas from Table D.2.3–2. As a result of the probabilities reflected in Table D.2.3–3, aircraft accidents involving the categories of general aviation and air taxi were considered.

The aircraft crash probability is dominated by general aviation, which represents approximately 99 percent of the total probability reflected in Table D.2.3–1. Operations at the Livermore Municipal Airport dominate the data for air taxi operations, which represent less than 1 percent of the probability reflected in Table D.2.3–1. The 1999 Livermore Municipal Airport data used for analysis had the highest number of total annual flight operations for 1993 through 2003. The annual number of air taxi operations has varied widely and were as low as 324 in the year 2000 versus the 1,711 analyzed in the data for the year 1999. Therefore, an aircraft accident at LLNL involving an air taxi was not considered reasonably foreseeable.

General aviation operations at the Livermore Municipal Airport represent approximately 93 percent of the total probability reflected in Table D.2.3–1. Over 95 percent of the Livermore Municipal Airport operations are represented by the general aviation subcategories of single-engine piston, multiengine aircraft, and helicopter aircraft. A similar distribution of airframes was assumed for the general aviation data for Tracy Municipal, Byron, and in-flight operations. Helicopter velocities are generally lower than that of fixed-wing aircraft and single-engine aircraft engines are generally heavier than multiengine aircraft for equivalent performance. Therefore, the consequences of a large single-engine piston aircraft impacting facilities at the Livermore Site bound the reasonably foreseeable accidents into LLNL facilities.

The conditional probability of occurrence of a fire from a general aviation aircraft crash is approximately 0.3 (LLNL 2003bg). This value is applied to those facilities where the MAR includes drums of transuranic waste (i.e., Buildings 625, 695, and 696R) and to Building 331. Also, approximately 20 percent of the total area of Building 696R is shielded by nearby facilities (LLNL 2003y). Thus, the frequencies must be multiplied by the fire factor and the unshielded fraction to give the values for “adjusted annual crash probability leading to an uncontrolled release,” which are listed in the final column of Table D.2.3–4 and presented in the rest of the appendix.

TABLE D.2.3–1.—*Calculation of Aircraft Crash Probability*

Airport	Aircraft Type	Flight Phase	Number of Operations (N)	Aircraft Crash Rate (P)	X Distance (mi)	Y Distance (mi)	Crash Location Probability f(x,y) (1/mi²)	Crash Probability (crashes/mi²)
Livermore	Single-Engine Piston	Takeoff (E-W)	28,291	1.10×10^{-5}	-6.5	0	0	0.00
Livermore	Single-Engine Piston	Takeoff (W-E)	6,210	1.10×10^{-5}	6.5	0	1.50×10^{-3}	1.02×10^{-4}
Livermore	Single-Engine Piston	Landing (E-W)	28,291	2.00×10^{-5}	-6.5	0	2.90×10^{-3}	1.64×10^{-3}
Livermore	Single-Engine Piston	Landing (W-E)	6,210	2.00×10^{-5}	6.5	0	6.50×10^{-4}	8.07×10^{-5}
		Sub-Total	69,002					1.82×10^{-3}
Livermore	Multi-Engine Piston	Takeoff (E-W)	2,821	9.30×10^{-6}	-6.5	0	0	0.00
Livermore	Multi-Engine Piston	Takeoff (W-E)	619	9.30×10^{-6}	6.5	0	1.50×10^{-3}	8.64×10^{-6}
Livermore	Multi-Engine Piston	Landing (E-W)	2,821	2.30×10^{-5}	-6.5	0	2.90×10^{-3}	1.88×10^{-4}
Livermore	Multi-Engine Piston	Landing (W-E)	619	2.30×10^{-5}	6.5	0	6.50×10^{-4}	9.26×10^{-6}
		Sub-Total	6,880					2.06×10^{-4}
Livermore	Turboprop	Takeoff (E-W)	996	3.50×10^{-6}	-6.5	0	0	0.00
Livermore	Turboprop	Takeoff (W-E)	219	3.50×10^{-6}	6.5	0	1.50×10^{-3}	1.15×10^{-6}
Livermore	Turboprop	Landing (E-W)	996	8.30×10^{-6}	-6.5	0	2.90×10^{-3}	2.40×10^{-5}
Livermore	Turboprop	Landing (W-E)	219	8.30×10^{-6}	6.5	0	6.50×10^{-4}	1.18×10^{-6}
		Sub-Total	2,428					2.63×10^{-5}
Livermore	Turbojet	Takeoff (E-W)	581	1.40×10^{-6}	-6.5	0	0	0.00
Livermore	Turbojet	Takeoff (W-E)	127	1.40×10^{-6}	6.5	0	1.50×10^{-3}	2.68×10^{-7}
Livermore	Turbojet	Landing (E-W)	581	4.70×10^{-6}	-6.5	0	2.90×10^{-3}	7.92×10^{-6}
Livermore	Turbojet	Landing (W-E)	127	4.70×10^{-6}	6.5	0	6.50×10^{-4}	3.89×10^{-7}
		Sub-Total	1,416					8.57×10^{-6}
Livermore	Helicopter	Takeoff (E-W)	8,794	1.25×10^{-5}	-6.5	0	0	0.00
Livermore	Helicopter	Takeoff (W-E)	1,930	1.25×10^{-5}	6.5	0	1.50×10^{-3}	3.62×10^{-5}
Livermore	Helicopter	Landing (E-W)	8,794	1.25×10^{-5}	-6.5	0	2.90×10^{-3}	3.19×10^{-4}
Livermore	Helicopter	Landing (W-E)	1,930	1.25×10^{-5}	6.5	0	6.50×10^{-4}	1.57×10^{-5}
		Sub-Total	21,449					3.71×10^{-4}
		Livermore Total	**101,176**					**2.44×10^{-3}**

TABLE D.2.3–1.—*Calculation of Aircraft Crash Probability (continued)*

Airport	Aircraft Type	Flight Phase	Number of Operations (N)	Aircraft Crash Rate (P)	X Distance (mi)	Y Distance (mi)	Crash Location Probability f(x,y) (1/mi^2)	Crash Probability (crashes/mi^2)
Tracy	Single-Engine Piston	Takeoff	15,564	1.10×10^{-5}	14.5	0.5	0	0.00
Tracy	Single-Engine Piston	Landing	15,564	2.00×10^{-5}	-14.5	0.5	1.00×10^{-4}	3.11×10^{-5}
		Sub-Total	31,128					3.11×10^{-5}
Tracy	Multi-Engine Piston	Takeoff	3,891	9.30×10^{-6}	14.5	0.5	0	0.00
Tracy	Multi-Engine Piston	Landing	3,891	2.30×10^{-5}	-14.5	0.5	1.00×10^{-4}	8.95×10^{-6}
		Sub-Total	7,782					8.95×10^{-6}
		Tracy Total	**38,910**					**4.01×10^{-5}**
Byron	General Aviation	Takeoff	12,958	1.10×10^{-5}	9.62	5.83	0	0.00
Byron	General Aviation	Landing	12,958	2.00×10^{-5}	-9.62	5.83	0	0.00
Meadowlark	Single-Engine Piston	Takeoff	78	1.10×10^{-5}	0	1.5	1.50×10^{-2}	1.29×10^{-5}
Meadowlark	Single-Engine Piston	Landing	78	2.00×10^{-5}	0	1.5	1.20×10^{-2}	1.87×10^{-5}
In Flight	General Aviation	In Flight						1.00×10^{-4}
	General Aviation	**Total**						**2.61×10^{-3}**
In Flight	Air Carrier	In Flight						5.00×10^{-7}
	Air Carrier	**Total**						**5.00×10^{-7}**
Livermore	Air Taxi	Takeoff (E-W)	702	1.00×10^{-6}	-6.5	0	0	0.00
Livermore	Air Taxi	Takeoff (W-E)	154	1.00×10^{-6}	6.5	0	1.50×10^{-3}	2.31×10^{-7}
Livermore	Air Taxi	Landing (E-W)	702	2.30×10^{-6}	-6.5	0	8.60×10^{-3}	1.39×10^{-5}
Livermore	Air Taxi	Landing (W-E)	154	2.30×10^{-6}	6.5	0	0	0.00
Tracy	Air Taxi	Takeoff	300	1.00×10^{-6}	14.5	0.5	0	0.00
Tracy	Air Taxi	Landing	300	2.30×10^{-6}	-14.5	0.5	2.90×10^{-5}	2.00×10^{-8}
In Flight	Air Taxi	In Flight						2.00×10^{-6}
	Air Taxi	**Total**						**1.61×10^{-5}**
In Flight	Large Military	In Flight						2.00×10^{-7}
Livermore	Small Military	Takeoff (E-W)	78	1.80×10^{-6}	-6.5	0	0	0.00

TABLE D.2.3–1.—*Calculation of Aircraft Crash Probability (continued)*

Airport	Aircraft Type	Flight Phase	Number of Operations (N)	Aircraft Crash Rate (P)	X Distance (mi)	Y Distance (mi)	Crash Location Probability f(x,y) ($1/mi^2$)	Crash Probability ($crashes/mi^2$)
Livermore	Small Military	Takeoff (W-E)	17	1.80×10^{-6}	6.5	0	1.20×10^{-2}	3.67×10^{-7}
Livermore	Small Military	Landing (E-W)	78	3.30×10^{-6}	-6.5	0	1.40×10^{-2}	3.60×10^{-6}
Livermore	Small Military	Landing (W-E)	17	3.30×10^{-6}	6.5	0	1.10×10^{-4}	6.17×10^{-9}
In Flight	Small Military	In Flight						3.00×10^{-6}
	Military	**Total**						$\mathbf{7.18 \times 10^{-6}}$
		Grand Total						$\mathbf{2.63 \times 10^{-3}}$

Source: Original.
E = east; W = west.

TABLE D.2.3–2.—*Calculation of Effective Area by Aircraft Type*

Facility	Aircraft Type	Length of facility, L (ft)	Width of facility, W (ft)	Height of facility, H (ft)	Aircraft wingspan, WS (ft)	Cotangent of aircraft impact angle cot(Φ)	Aircraft skid distance, S (ft)	Length of Diagonal, R (ft)	Skid Area, A_{sk}, (mi^2)	Footprint Area, A_{fp} (mi^2)	Shadow Area, A_{sh} (mi^2)	Total Effective Area, A (mi^2)
B331	General Aviation (fixed wing)	240	68.5	14	50	8.2	60	249.6	6.45×10^{-4}	8.26×10^{-4}	1.23×10^{-3}	2.70×10^{-3}
B331	General Aviation (helicopter)	240	68.5	14	50	0.58	0	249.6	0.00	8.26×10^{-4}	8.73×10^{-5}	9.13×10^{-4}
B331	Air Carrier	240	68.5	14	98	10.2	1,440	249.6	1.80×10^{-2}	1.05×10^{-3}	1.78×10^{-3}	2.08×10^{-2}
B331	Air Taxi	240	68.5	14	59	10.2	1,440	249.6	1.59×10^{-2}	8.68×10^{-4}	1.58×10^{-3}	1.84×10^{-2}
B331	Large Military											
B331	Takeoff	240	68.5	14	223	7.4	780	249.6	1.32×10^{-2}	1.64×10^{-3}	1.76×10^{-3}	1.66×10^{-2}
B331	Landing	240	68.5	14	223	9.7	368	249.6	6.24×10^{-3}	1.64×10^{-3}	2.30×10^{-3}	1.02×10^{-2}
B331	In-Flight	240	68.5	14	223	7.4	780	249.6	1.32×10^{-2}	1.64×10^{-3}	1.76×10^{-3}	1.66×10^{-2}
B331	Small Military											
B331	Takeoff	240	68.5	14	94	8.4	246	249.6	3.03×10^{-3}	1.03×10^{-3}	1.45×10^{-3}	5.52×10^{-3}
B331	Landing	240	68.5	14	94	10.4	447	249.6	5.51×10^{-3}	1.03×10^{-3}	1.79×10^{-3}	8.34×10^{-3}
B331	In-Flight	240	68.5	14	94	8.4	246	249.6	3.03×10^{-3}	1.03×10^{-3}	1.45×10^{-3}	5.52×10^{-3}
B332	General Aviation (fixed wing)	240	87	16	6	8.2	60	255.3	5.62×10^{-4}	7.84×10^{-4}	1.23×10^{-3}	2.58×10^{-3}
B332	General Aviation (helicopter)	240	87	16	6	0.58	0	255.3	0.00	7.84×10^{-4}	8.70×10^{-5}	8.71×10^{-4}
B332	Air Carrier	240	87	16	98	10.2	1,440	255.3	1.82×10^{-2}	1.32×10^{-3}	2.07×10^{-3}	2.16×10^{-2}
B332	Air Taxi	240	87	16	59	10.2	1,440	255.3	1.62×10^{-2}	1.10×10^{-3}	1.84×10^{-3}	1.92×10^{-2}
B332	Large Military											
B332	Takeoff	240	87	16	223	7.4	780	255.3	1.34×10^{-2}	2.06×10^{-3}	2.03×10^{-3}	1.75×10^{-2}
B332	Landing	240	87	16	223	9.7	368	255.3	6.31×10^{-3}	2.06×10^{-3}	2.66×10^{-3}	1.10×10^{-2}
B332	In-Flight	240	87	16	223	7.4	780	255.3	1.34×10^{-2}	2.06×10^{-3}	2.03×10^{-3}	1.75×10^{-2}
B332	Small Military											
B332	Takeoff	240	87	16	94	8.4	246	255.3	3.08×10^{-3}	1.30×10^{-3}	1.68×10^{-3}	6.07×10^{-3}
B332	Landing	240	87	16	94	10.4	447	255.3	5.60×10^{-3}	1.30×10^{-3}	2.08×10^{-3}	8.99×10^{-3}
B332	In-Flight	240	87	16	94	8.4	246	255.3	3.08×10^{-3}	1.30×10^{-3}	1.68×10^{-3}	6.07×10^{-3}

TABLE D.2.3–2.—*Calculation of Effective Area by Aircraft Type (continued)*

Facility	Aircraft Type	Length of facility, L (ft)	Width of facility, W (ft)	Height of facility, H (ft)	Aircraft wingspan, WS (ft)	Cotangent of aircraft impact angle cot(Φ)	Aircraft skid distance, S (ft)	Length of Diagonal, R (ft)	Skid Area, A_{sk}, (mi^2)	Footprint Area, A_{fp} (mi^2)	Shadow Area, A_{sh} (mi^2)	Total Effective Area, A (mi^2)
B625	General Aviation (fixed wing)	120	37	8	50	8.2	60	125.6	3.78×10^{-4}	2.86×10^{-4}	4.13×10^{-4}	1.08×10^{-3}
B625	General Aviation (helicopter)	120	37	8	50	0.58	0	125.6	0.00	2.86×10^{-4}	2.92×10^{-5}	3.15×10^{-4}
B625	Air Carrier	120	37	8	98	10.2	1,440	125.6	1.15×10^{-2}	4.08×10^{-4}	6.54×10^{-4}	1.26×10^{-2}
B625	Air Taxi	120	37	8	59	10.2	1,440	125.6	9.54×10^{-3}	3.09×10^{-4}	5.40×10^{-4}	1.04×10^{-2}
B625	Large Military											
B625	Takeoff	120	37	8	223	7.4	780	125.6	9.75×10^{-3}	7.25×10^{-4}	7.40×10^{-4}	1.12×10^{-2}
B625	Landing	120	37	8	223	9.7	368	125.6	4.60×10^{-3}	7.25×10^{-4}	9.70×10^{-4}	6.30×10^{-3}
B625	In-Flight	120	37	8	223	7.4	780	125.6	9.75×10^{-3}	7.25×10^{-4}	7.40×10^{-4}	1.12×10^{-2}
B625	Small Military											
B625	Takeoff	120	37	8	94	8.4	246	125.6	1.94×10^{-3}	3.98×10^{-4}	5.29×10^{-4}	2.86×10^{-3}
B625	Landing	120	37	8	94	10.4	447	125.6	3.52×10^{-3}	3.98×10^{-4}	6.55×10^{-4}	4.57×10^{-3}
B625	In-Flight	120	37	8	94	8.4	246	125.6	1.94×10^{-3}	3.98×10^{-4}	5.29×10^{-4}	2.86×10^{-3}
B696R	General Aviation (fixed wing)	114	77	8	50	8.2	60	137.6	4.04×10^{-4}	5.44×10^{-4}	4.41×10^{-4}	1.39×10^{-3}
B696R	General Aviation (helicopter)	114	77	8	50	0.58	0	137.6	0.00	5.44×10^{-4}	3.12×10^{-5}	5.75×10^{-4}
B696R	Air Carrier	114	77	8	98	10.2	1,440	137.6	1.22×10^{-2}	7.63×10^{-4}	6.90×10^{-4}	1.36×10^{-2}
B696R	Air Taxi	114	77	8	59	10.2	1,440	137.6	1.02×10^{-2}	5.85×10^{-4}	5.75×10^{-4}	1.13×10^{-2}
B696R	Large Military											
B696R	Takeoff	114	77	8	223	7.4	780	137.6	1.01×10^{-2}	1.34×10^{-3}	7.66×10^{-4}	1.22×10^{-2}
B696R	Landing	114	77	8	223	9.7	368	137.6	4.76×10^{-3}	1.34×10^{-3}	1.00×10^{-3}	7.10×10^{-3}
B696R	In-Flight	114	77	8	223	7.4	780	137.6	1.01×10^{-2}	1.34×10^{-3}	7.66×10^{-4}	1.22×10^{-2}
B696R	Small Military											
B696R	Takeoff	114	77	8	94	8.4	246	137.6	2.04×10^{-3}	7.45×10^{-4}	5.58×10^{-4}	3.35×10^{-3}
B696R	Landing	114	77	8	94	10.4	447	137.6	3.71×10^{-3}	7.45×10^{-4}	6.91×10^{-4}	5.15×10^{-3}
B696R	In-Flight	114	77	8	94	8.4	246	137.6	2.04×10^{-3}	7.45×10^{-4}	5.58×10^{-4}	3.35×10^{-3}

Source: Original.
ft = feet; mi^2 = square mile.

TABLE D.2.3–3.—*Detailed Evaluation of Impact Frequency without Building Shielding*

Facility	Aircraft Subtype	Crash Probability (crashes/mi^2)	Total Effective Area, A (mi^2)	Impact Frequency, F, (crashes/yr)
B331	General Aviation			
B331	Single-Engine Piston	1.89×10^{-3}	2.70×10^{-3}	5.10×10^{-6}
B331	Multi-Engine Piston	2.15×10^{-4}	2.70×10^{-3}	5.81×10^{-7}
B331	Turboprop	2.63×10^{-5}	2.70×10^{-3}	7.11×10^{-8}
B331	Turbojet	8.57×10^{-6}	2.70×10^{-3}	2.32×10^{-8}
B331	Helicopter	3.71×10^{-4}	9.13×10^{-4}	3.39×10^{-7}
B331	In-Flight	1.00×10^{-4}	2.70×10^{-3}	2.70×10^{-7}
B331	Total General Aviation			6.39×10^{-6}
B331	Air Carrier	5.00×10^{-7}	2.08×10^{-2}	1.04×10^{-8}
B331	Air Taxi	1.61×10^{-5}	1.84×10^{-2}	2.97×10^{-7}
B331	Large Military (In-flight)	2.00×10^{-7}	1.66×10^{-2}	3.32×10^{-9}
B331	Small Military			
B331	Takeoff	3.67×10^{-7}	5.52×10^{-3}	2.03×10^{-9}
B331	Landing	3.61×10^{-6}	8.34×10^{-3}	3.01×10^{-8}
B331	In-Flight	3.00×10^{-6}	5.52×10^{-3}	1.65×10^{-8}
B331	Total Small Military			4.87×10^{-8}
B331	**Grand Total**	**2.63×10^{-3}**		**6.75×10^{-6}**
B332	General Aviation			
B332	Single-Engine Piston	1.89×10^{-3}	2.58×10^{-3}	4.86×10^{-6}
B332	Multi-Engine Piston	2.15×10^{-4}	2.58×10^{-3}	5.54×10^{-7}
B332	Turboprop	2.63×10^{-5}	2.58×10^{-3}	6.77×10^{-8}
B332	Turbojet	8.57×10^{-6}	2.58×10^{-3}	2.21×10^{-8}
B332	Helicopter	3.71×10^{-4}	8.71×10^{-4}	3.23×10^{-7}
B332	In-Flight	1.00×10^{-4}	2.58×10^{-3}	2.58×10^{-7}
B332	Total General Aviation			6.08×10^{-6}
B332	Air Carrier	5.00×10^{-7}	2.16×10^{-2}	1.08×10^{-8}
B332	Air Taxi	1.61×10^{-5}	1.92×10^{-2}	3.09×10^{-7}
B332	Large Military (In-flight)	2.00×10^{-7}	1.75×10^{-2}	3.49×10^{-9}
B332	Small Military			
B332	Takeoff	3.67×10^{-7}	6.07×10^{-3}	2.23×10^{-9}
B332	Landing	3.61×10^{-6}	8.99×10^{-3}	3.24×10^{-8}
B332	In-Flight	3.00×10^{-6}	6.07×10^{-3}	1.82×10^{-8}
B332	Total Small Military			5.29×10^{-8}
B332	**Grand Total**	**2.63×10^{-3}**		**6.46×10^{-6}**

TABLE D.2.3–3.—*Detailed Evaluation of Impact Frequency without Building Shielding (continued)*

Facility	Aircraft Subtype	Crash Probability (crashes/mi²)	Total Effective Area, A (mi²)	Impact Frequency, F, (crashes/yr)
B625	General Aviation			
B625	Single-Engine Piston	1.89×10^{-3}	1.08×10^{-3}	2.03×10^{-6}
B625	Multi-Engine Piston	2.15×10^{-4}	1.08×10^{-3}	2.32×10^{-7}
B625	Turboprop	2.63×10^{-5}	1.08×10^{-3}	2.83×10^{-8}
B625	Turbojet	8.57×10^{-6}	1.08×10^{-3}	9.23×10^{-9}
B625	Helicopter	3.71×10^{-4}	3.15×10^{-4}	1.17×10^{-7}
B625	In-Flight	1.00×10^{-4}	1.08×10^{-3}	1.08×10^{-7}
B625	Total General Aviation			2.53×10^{-6}
B625	Air Carrier	5.00×10^{-7}	1.26×10^{-2}	6.31×10^{-9}
B625	Air Taxi	1.61×10^{-5}	1.04×10^{-2}	1.68×10^{-7}
B625	Large Military (In-flight)	2.00×10^{-7}	1.12×10^{-2}	2.24×10^{-9}
B625	Small Military			
B625	Takeoff	3.67×10^{-7}	2.86×10^{-3}	1.05×10^{-9}
B625	Landing	3.61×10^{-6}	4.57×10^{-3}	1.65×10^{-8}
B625	In-Flight	3.00×10^{-6}	2.86×10^{-3}	8.59×10^{-9}
B625	Total Small Military			2.62×10^{-8}
B625	**Grand Total**	$\mathbf{2.63 \times 10^{-3}}$		$\mathbf{2.73 \times 10^{-6}}$
B696R	General Aviation			
B696R	Single-Engine Piston	1.89×10^{-3}	1.39×10^{-3}	2.62×10^{-6}
B696R	Multi-Engine Piston	2.15×10^{-4}	1.39×10^{-3}	2.99×10^{-7}
B696R	Turboprop	2.63×10^{-5}	1.39×10^{-3}	3.65×10^{-8}
B696R	Turbojet	8.57×10^{-6}	1.39×10^{-3}	1.19×10^{-8}
B696R	Helicopter	3.71×10^{-4}	5.75×10^{-4}	2.13×10^{-7}
B696R	In-Flight	1.00×10^{-4}	1.39×10^{-3}	1.39×10^{-7}
B696R	Total General Aviation			3.32×10^{-6}
B696R	Air Carrier	5.00×10^{-7}	1.36×10^{-2}	6.81×10^{-9}
B696R	Air Taxi	1.61×10^{-5}	1.13×10^{-2}	1.83×10^{-7}
B696R	Large Military (In-flight)	2.00×10^{-7}	1.22×10^{-2}	2.44×10^{-9}
B696R	Small Military			
B696R	Takeoff	3.67×10^{-7}	3.67×10^{-7}	1.35×10^{-13}
B696R	Landing	3.61×10^{-6}	3.61×10^{-6}	1.30×10^{-11}
B696R	In-Flight	3.00×10^{-6}	3.00×10^{-6}	9.00×10^{-12}
B696R	Total Small Military			2.22×10^{-11}
B696R	**Grand Total**	$\mathbf{2.63 \times 10^{-3}}$		$\mathbf{3.51 \times 10^{-6}}$

Source: Original.
mi^2 = square mile.

TABLE D.2.3–4.—*Calculation of Overall Aircraft Crash Frequency for a Single-Engine Piston General Aviation Aircraft*

Facility	Crash Probability (crashes/mi^2)	Total Effective Area, A (mi^2)	Product	Post-crash Fire Probability	Shielding	Adjusted Annual Crash Probability Leading to an Uncontrolled Release
B331	1.89×10^{-3}	2.70×10^{-3}	5.10×10^{-6}	0.3	0	1.53×10^{-6}
B332	1.89×10^{-3}	2.58×10^{-3}	4.86×10^{-6}	1	0	4.86×10^{-6}
B625	1.89×10^{-3}	1.08×10^{-3}	2.03×10^{-6}	0.3	0	6.10×10^{-7}
B696R	1.89×10^{-3}	1.39×10^{-3}	2.62×10^{-6}	0.3	0.2	6.29×10^{-7}

Source: Original.

D.2.4 Description of Accident Scenarios

From the safety documents obtained through the process described in Section D.1.2, the next step was to identify potential accident scenarios and source terms (release rates and frequencies) associated with those facilities. Some safety documents present accident frequencies as a range reflecting uncertainties in the analysis. Table D.2.4–1 lists the results of this process, and contains the accident name, its frequency, and its source term, for both the No Action Alternative and Proposed Action. Potential radiological accident scenarios for the Reduced Operation Alternative would be the same as for the No Action Alternative. The values shown are those contained in existing safety documents as noted in the references cited in Table D.2.4–1. In Table D.2.4–1, the bounding accident scenario for each facility is highlighted. These bounding scenarios are described in Sections D.2.4.1 through D.2.4.16.

Facilities that manage transuranic waste at LLNL employ the concept of plutonium-equivalent curies to normalize the quantity of transuranic radioactivity within waste containers to plutonium-239. Normalizing all radionuclides to a common radiotoxic hazard index allows for facility accident consequence analysis to be performed without the requirement to characterize the radionuclide composition of each waste stream or package. Plutonium-239, as a common component of most transuranic wastes generated by LLNL, was selected as the radionuclide to which the radiotoxic hazard of other transuranic radionuclides could be indexed.

From the listing of accidents in Table D.2.4–1, the next step was to perform MACCS2 calculations (as described in Section D.2.1) to identify the accidents that present the highest public or worker consequences for each facility (i.e., the "bounding" accidents). These accident scenarios were highlighted in Table D.2.4–1 and are discussed further below.

TABLE D.2.4–1.—*Potential Radiological Accident Scenarios*

Accident	Frequency (per year)	Source Term or Hazard (No Action Alternative)	Source Term or Hazard (Proposed Action)
190, Multi-User Tandem Laboratory[a]			
Exposure to incidental x-ray radiation	10^{-4} to 10^{-2}	Minimal radiation exposure to workers. No impacts to other onsite personnel or the offsite population.	Same
Exposure to prompt radiation	10^{-4} to 10^{-2}	Exposure to worker of "several rem." No impacts to other onsite personnel or the offsite population.	Same
Exposure to residual radiation	10^{-4} to 10^{-2}	Minor radiation exposure to workers. No impacts to other onsite personnel or the offsite population.	Same
191, High Explosives Application Facility[b]			
Personnel exposure to x-ray radiation	10^{-6} to 10^{-4}	Inadvertent exposure inside a firing tank or workroom area could possibly exceed exposure limits but acute effects probably would not occur.	Same
Radioactive material dispersion from a spill and fire	$<10^{-6}$	5.0×10^{-5} g Pu	Same
194, 100-MeV Electron-Positron LINAC Facility[c]			
Exposure to primary LINAC beam	$<10^{-6}$	Death to a person who might be present (e.g., in the 0° Cave or high-energy end of the Accelerator Cave) during beam operation. There would be no consequences to facility personnel, onsite personnel, the public, or the environment, other than Emergency Rescue workers who could receive moderate exposure from the high levels of residual radioactivity present immediately after beaming.	Same

TABLE D.2.4–1.—*Potential Radiological Accident Scenarios (continued)*

Accident	Frequency (per year)	Source Term or Hazard (No Action Alternative)	Source Term or Hazard (Proposed Action)
194, 100-MeV Electron-Positron LINAC Facility[c]			
Exposure to high levels of ionizing radiation	10^{-2} to 10^{-1}	Doses of up to a few rem to personnel who might be exposed to high levels of induced radioactivity present in the target areas after beam operation. Significant exposure could also occur from improper handling of calibration sources or other radioactive materials used in a particular experimental process. The activity induced in shielding materials, targets, or beam transport components, however, is nondispersible. Therefore, there is no risk to personnel outside of the facility, to the public, or to the environment.	Same
Exposure to airborne radionuclides	10^{-2} to 10^{-1}	Facility personnel could be accidentally exposed to airborne radioactivity because of a ventilation system failure for a target cave or from a major leak of a closed loop cooling water system. Exposed personnel could receive integrated radiation doses of up to 1 mrem (ventilation failure) or 4 mrem (cooling water leak). None of these events would result in an increased risk to the public or the environment.	Same
Design basis earthquake and fire	10^{-6} to 10^{-4}	0.0012 Ci C-11 0.047 Ci N-13 0.903 Ci O-15 3.4×10^{-4} Ci weapons grade Pu	Same
235, 4-MeV Ion Accelerator[d]			
Exposure to ionizing radiation	10^{-4} to 10^{-2}	Small radiation doses to facility personnel, within all regulatory standards. No risk to the public or the environment.	Same

TABLE D.2.4–1.—*Potential Radiological Accident Scenarios (continued)*

Accident	Frequency (per year)	Source Term or Hazard (No Action Alternative)	Source Term or Hazard (Proposed Action)
239, Radiography Facility[e]			
Personnel exposure to x-ray radiation	10^{-4} to 10^{-2}	Minimal radiation exposure to workers. No impacts to other site personnel or the offsite population.	Same
Waste drum fire	$<10^{-7}$	8.0×10^{-3} g Pu-239 equivalent	Same
Fire involving SNM	$<\sim10^{-5}$	25 g HEU	50 g HEU
Uncontrolled oxidation of plutonium (fuel-grade plutonium)	$<\sim10^{-4}$	8.7×10^{-4} g fuel-grade Pu	Same
Uncontrolled oxidation of plutonium at elevated temperatures (weapons grade plutonium)	$<4.5 \times 10^{-7}$	4.5×10^{-2} g weapons grade Pu	Same
Release of tritium	$\sim7 \times 10^{-5}$	0.2 g tritium as HTO	Same
251, Heavy Element Facility[f]			
Spill release accident	10^{-4} to 10^{-2}	Unmitigated spill = 0.12 Ci (Am-241 equivalent) Mitigated spill = 1.2×10^{-3} Ci (Am-241 equivalent)	Same
Seismic (evaluation basis earthquake)	10^{-6} to 10^{-4}	0.051 Ci (Am-241 equivalent)	Same
Evaluation Basis Fire	10^{-6} to 10^{-4}	0.081 Ci (Am-241 equivalent)	Same
331, Tritium Facility[g]			
Tritium release during earthquake	10^{-6} to 10^{-4}	3.5 g tritium (0.035 g as HTO)	30 g tritium (0.3 g as HTO)
Aircraft crash with subsequent fire	1.53×10^{-6}	3.5 g tritium (as HTO)	30 g tritium (as HTO)

TABLE D.2.4–1.—*Potential Radiological Accident Scenarios (continued)*

Accident	Frequency (per year)	Source Term or Hazard (No Action Alternative)	Source Term or Hazard (Proposed Action)
Plutonium metal fire	10^{-4} to 10^{-2}	0.065 g fuel-grade Pu	Same
Waste drum event, fire	10^{-4} to 10^{-2}	0.0065 g fuel-grade Pu	Same
Waste drum event	10^{-4} to 10^{-6}	0.026 g fuel-grade Pu	Same
332, Plutonium Facility[h, i]			
Evaluation-basis room fire			
Room fire filtered	3×10^{-3}	1.0×10^{-5} g fuel-grade Pu	2.0×10^{-5} g fuel-grade Pu
Room fire unfiltered	3.9×10^{-7}	0.25 g fuel-grade Pu	0.50 g fuel-grade Pu
Fire in loft	3×10^{-2}	6.2×10^{-3} g fuel-grade Pu	Same
Radioactive Material Spill			
Spill filtered	4.8×10^{-3}	5.4×10^{-6} g fuel-grade Pu	Same
Spill unfiltered	$<10^{-6}$	0.11 g fuel-grade Pu	Same
Pyrophoric material event			
Filtered	9.8×10^{-2}	9.0×10^{-6} g fuel-grade Pu	Same
Unfiltered	2.3×10^{-6}	2.3×10^{-1} g fuel-grade Pu	Same
Aircraft crash			
Aircraft crash	4.86×10^{-6}	0.25 g fuel-grade Pu	Same
Materials Management Transport and Waste Drum Events			
Materials management transportation spill	4.5×10^{-4}	7.5×10^{-3} g fuel-grade Pu	Same
Waste drum puncture/rupture with fire	2.7×10^{-4}	0.19 g fuel-grade Pu	Same
Inadvertent Criticality			
Uranium criticality in a powder, slurry, or solution system in a workstation	3.2×10^{-5}	1×10^{18} fissions (see below for inventories released criticality events)	Same
Plutonium criticality for a powder, slurry, or solution system in a workstation	3.2×10^{-5}	1×10^{18} fissions (see below for inventories released criticality events)	Same
Evaluation-basis earthquake			
Evaluation-basis earthquake (filtered)	1.0×10^{-3}	1.4×10^{-5} g fuel-grade Pu	Same

TABLE D.2.4–1.—*Potential Radiological Accident Scenarios (continued)*

Accident	Frequency (per year)	Source Term or Hazard (No Action Alternative)	Source Term or Hazard (Proposed Action)
Hydrogen deflagration			
Hydrogen event filtered	8.1×10^{-5}	9.0×10^{-3} g fuel-grade Pu	0.018 g fuel-grade Pu
Hydrogen event unfiltered	$<1 \times 10^{-6}$	1.21 g fuel-grade Pu	2.42 g fuel-grade Pu
334, Hardened Engineering Test Building[j]			
Personnel exposure to x-ray radiation	10^{-4} to 10^{-2}	Minimal radiation exposure to workers. No impacts to other site personnel or the offsite population.	Same
Fire involving HEU (unmitigated)	$<\sim10^{-5}$	100 g HEU	Same
Fire involving HEU (mitigated)	$<\sim10^{-5}$	0.1 g HEU	Same
Uncontrolled oxidation of plutonium (unmitigated)	$<\sim10^{-4}$	9.4×10^{-4} g fuel-grade Pu	Same
Uncontrolled oxidation of plutonium (mitigated)	$<\sim10^{-4}$	9.4×10^{-7} g fuel-grade Pu	Same
Uncontrolled oxidation of plutonium at elevated temperatures	$<1 \times 10^{-6}$	0.185 g fuel-grade Pu	Same
514/612/625/693, Radioactive and Hazardous Waste Management Complex[k]			
Earthquake	10^{-4} to 10^{-2}	1.6×10^{-4} Ci Transuranic Waste (use Am-241 as a surrogate), 5,000 Ci tritium, 6.0×10^{-4} Ci Aqueous low-level waste (Pu-equivalent Ci)	Same

TABLE D.2.4–1.—*Potential Radiological Accident Scenarios (continued)*

Accident	Frequency (per year)	Source Term or Hazard (No Action Alternative)	Source Term or Hazard (Proposed Action)
Fire	10^{-4} to 10^{-2}	3.18×10^{-3} Ci Transuranic Waste (use Am-241 as a surrogate), 5,000 Ci tritium, 3.48×10^{-4} Ci DU	Same
Leaks and Spills	10^{-4} to 10^{-2}	1.9×10^{-4} Ci Transuranic Waste (use Am-241 as a surrogate), 5,000 Ci tritium, 6.0×10^{-4} Ci Aqueous low-level waste (Pu-equivalent Ci) 3.48×10^{-8} Ci DU	Same
Pressurized Releases	10^{-4} to 10^{-2}	1.0×10^{-4} Ci Aqueous low-level waste (Pu-equivalent Ci)	Same
Crane fall in Building 625 during severe earthquake	NA	0.0072 Pu-equivalent Ci	0.022 Pu-equivalent Ci
Aircraft Crash into Building 625	6.1×10^{-7}	0.46 Pu-equivalent Ci	1.40 Pu-equivalent Ci
581, National Ignition Facility[1]			
Earthquake during experiment using tritium	2.0×10^{-8}	500 Ci tritium plus activated gases and particulates	Same
Earthquake during depleted uranium experiment	2.0×10^{-8}	0.005 g depleted uranium plus 500 Ci tritium plus activated gases and particulates	0.1 g depleted uranium plus 500 Ci tritium plus fission products plus activated gases and particulates
Earthquake during HEU experiment	2.0×10^{-9}	NA	0.1 g HEU plus 500 Ci tritium plus fission products plus activated gases and particulates

TABLE D.2.4–1.—*Potential Radiological Accident Scenarios (continued)*

Accident	Frequency (per year)	Source Term or Hazard (No Action Alternative)	Source Term or Hazard (Proposed Action)
Earthquake during thorium experiment	2.0×10^{-9}	NA	0.45 g Th-232 plus 500 Ci tritium plus fission products plus activated gases and particulates
Earthquake during tracer experiment	2.0×10^{-9}	NA	0.031 Ci I-124 0.032 Ci I-125 0.075 Ci I-126 Plus 500 Ci tritium plus fission products plus activated gases and particulates
Earthquake during plutonium without yield experiment	2.0×10^{-9}	NA	0.003 g weapons grade Pu plus 500 Ci tritium plus fission products plus activated gases and particulates
Earthquake during plutonium experiment in the in the presence of yield	2.0×10^{-9}	NA	0.001 g weapons grade Pu plus 500 Ci tritium plus gaseous and particulate fission and activation products plus activated gases and particulates
696R, Radioactive Waste Storage Area[m]			
Large fire involving staged transuranic waste containers	$<\sim10^{-6}$	0.092 Pu-equivalent Ci	Same
Deflagration in transuranic waste drum	10^{-4} to 10^{-2}	0.0016 Pu-equivalent Ci	Same
Spill of transuranic waste container in yard	10^{-4} to 10^{-2}	0.0013 Pu-equivalent Ci	Same

TABLE D.2.4–1.—*Potential Radiological Accident Scenarios (continued)*

Accident	Frequency (per year)	Source Term or Hazard (No Action Alternative)	Source Term or Hazard (Proposed Action)
Aircraft Crash	6.29×10^{-7}	0.925 Pu-equivalent Ci	Same
Site 300 Materials Management Facilities[n]			
Inadvertent exposure to hazardous materials	10^{-4} to 10^{-2}	Exposure to tritium gas (inside a room) at concentrations of up to 0.74 Ci/m^3, which would lead to 5-minute dose of 4.7 rem, and a 1-hour dose of 35 rem.	Same
Depleted uranium release by fire	10^{-4} to 10^{-2}	0.95 g/sec DU for two hours for a total of 6,840 g DU	Same
Onsite Transportation[o]			
Radioactive and Hazardous Waste Management package explosion	$<10^{-6}$	0.0099 Pu-equivalent Ci	0.0132 Pu-equivalent Ci
Radioactive and Hazardous Waste Management Truck Fire	$<10^{-6}$	0.070 Pu-equivalent Ci	Same
Materials Management Section package explosion	$<10^{-6}$	0.104 g fuel-grade Pu	Same

Source: [a] LLNL 2000ad.
[b] LLNL 2002cp.
[c] LLNL 2002cq.
[d] LLNL 2000d.
[e] LLNL 2002ac.
[f] LLNL 2001aj.
[g] LLNL 2002ad.
[h] LLNL 2002r, LLNL 2002af.
[i] LLNL 2002r.
[j] LLNL 2002s.
[k] LLNL 2000t.
[l] LLNL 2003d.
[m] LLNL 2002da.
[n] LLNL 2002l.
[p] LLNL 2003e.
[o] LLNL 2003e is the basis for the RHWM truck fire and MMS package explosion source terms. For the RHWM package explosion, the source term is estimated based on the inventories for waste management facilities.

Note: Am = Americium; Ci = curies; DU = depleted uranium; HEU = highly enriched uranium; HTO = tritiated water; Pu = plutonium; SNM = special nuclear material; NA = not available.

D.2.4.1 Building 332 Criticality Accident

Table D.2.4–2 lists the calculated source term that would be released to the environment following the postulated criticality event in Building 332. For criticality events that result in less than 10^{18} fissions, the source terms listed in Table D.2.4–2 were assumed to be linearly proportional to the number of fissions. The frequency of occurrence of this event is conservatively estimated to be 3.2×10^{-5} per year.

TABLE D.2.4–2.—*Inventories Released from 10^{18} Fission Criticality Events*

Nuclide	Uranium Criticality Released Inventories (Ci)	Plutonium Criticality Released Inventories (Ci)
^{83m}Kr	1.6×10^{1}	1.1×10^{1}
^{85m}Kr	1.5×10^{1}	7.1
^{85}Kr	1.6×10^{-4}	8.1×10^{-5}
^{87}Kr	9.9×10^{1}	4.3×10^{1}
^{88}Kr	6.5×10^{1}	2.3×10^{1}
^{89}Kr	4.2×10^{3}	1.3×10^{3}
^{131m}Xe	8.2×10^{-3}	1.0×10^{-2}
^{133m}Xe	0.18	0.22
^{133}Xe	2.7	2.7
^{135m}Xe	2.2×10^{2}	3.3×10^{2}
^{135}Xe	3.6×10^{1}	4.1×10^{1}
^{137}Xe	4.9×10^{3}	4.9×10^{3}
^{138}Xe	1.3×10^{3}	1.1×10^{3}
^{131}I	0.22	0.28
^{132}I	2.8×10^{1}	3.0×10^{1}
^{133}I	4.0	4.0
^{134}I	1.1×10^{2}	1.1×10^{2}
^{135}I	1.2×10^{1}	1.2×10^{1}

Source: LLNL 2002r.
Ci = curie; I = iodine; Kr = krypton; m = isotope; Xe = xenon.

For plutonium releases, the isotopic composition of the source term depends on the type of material used. For accidents involving a plutonium release, in most cases the isotopic mixture of 30-year-old fuel-grade plutonium was used as the source term. Table D.2.4–3 lists the isotopic mixtures for both fuel-grade and weapons grade plutonium.

Table D.2.4–3.—*Isotopic Mixtures of 30-Year-Old Fuel-Grade and Weapons Grade Plutonium*

Isotope	30-Year-Old Fuel-Grade Plutonium (Mass %)	30-Year-Old Weapons grade Plutonium (Mass %)
Plutonium-238	0.0789	0.03
Plutonium-239	77.9	93.26
Plutonium-240	17.9	5.98
Plutonium-241	0.376	0.14
Plutonium-242	0.490	0.04
Americium-241	3.00	0.45

Source: LLNL 2002r.
Am = americium; Pu = plutonium.

D.2.4.2 *Building 190, Multi-User Tandem Laboratory—Exposure to Prompt Radiation*

Prompt radiation can be produced by the interaction of accelerated ion beams and targets. The prompt radiation in Building 190 can take the form of x-rays, gamma rays, and neutrons. In general, the amount of radiation produced is greater for light ions (such as protons or deuterons) and increases with increasing beam energy. Prompt radiation levels can be several tens of millirem per hour, 1 meter from the production point. As the prompt radiation levels depend upon the beam being accelerated, the energy of acceleration, losses along specific beam transport paths, and target and shielding materials of each beam line, specific analyses and controls are required for each experimental configuration. Shielding and access controls are implemented to keep radiation levels as low as reasonably achievable (ALARA). Although not achieved in any allowed operation, worst-case prompt radiation fields of a few rem per hour to workers are theoretically possible while operating any of the Building 190 accelerators. The frequency of occurrence of this event is conservatively estimated to be 10^{-4} to 10^{-2} per year. This bounding accident scenario applies to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS.

D.2.4.3 *Building 191, High Explosives Application Facility—Radioactive Material Dispersion from a Spill and Fire*

Although plutonium is not normally used in Building 191, a release of 200 milligrams of plutonium-239 was used to bound the radionuclide release scenarios. This bounding accident scenario applies to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS. A fire involving ordinary combustibles in the HEAF was considered to postulate a bounding release. It was assumed that a small quantity of plutonium metal present in the room would be involved in the fire. The plutonium would be partially burned, and oxide particles would be released to the environment through unfiltered room ventilation system.

The source term is computed using the bounding airborne release fraction and respirable fraction involving self-sustained oxidation of plutonium metal. Particle deposition mechanisms such as thermophoresis, gravitational settling, and agglomeration, which would substantially reduce the amount released to the atmosphere, are ignored in this analysis. Hence, the resultant conservative source term for this scenario is 5×10^{-5} grams of weapons grade plutonium. The frequency of occurrence of this event is conservatively estimated to be less than 10^{-6} per year.

D.2.4.4 *Building 194, 100-MeV Electron-Positron LINAC Facility—Design Basis Earthquake and Fire*

This scenario assumes an earthquake with sufficiently violent ground motion as to cause structural damage to the facility. This bounding accident scenario applies to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS. Specifically, it assumes the collapse of the 30-meter exhaust stack, movement of the below ground cave doors (i.e., failure of the radiation confinement barriers), rupture of the sulfure hexafluoride and cryogenic liquid containment systems below ground, a belowground fire melting lead, uranium-235 foils, and sodium sources, and a complete rupture of the aboveground closed-loop cooling water system. Furthermore, this scenario assumes that this earthquake occurs during secondary beam generation, with saturation levels of radioactive and toxic gases in the 0° Cave, while experimenters are working belowground in the South Cave. The frequency of occurrence of this event is 10^{-6} to 10^{-4} per year.

An earthquake of sufficient magnitude to cause facility damage would certainly cause the failure of any of a number of key LINAC systems resulting in the immediate cessation of beam operation. The prompt radiation associated with beam operation would therefore cease, and there would be no risk of exposure of personnel inside or outside of the facility to lethal radiation levels.

The presence of SNM samples modestly increases the potential radiological impact of a design-basis earthquake and fire. The worst-case impact to the facility workers would involve a fire that released 3.4×10^{-4} curies of the sample (assumed to be weapons grade plutonium) with the simultaneous failure of the ventilation system. All intense, prompt, and residual radiation would be completely contained within the belowground facility and no pathway would exist for exposure of or dispersal to aboveground personnel or to the environment. Noninvolved workers, the public, and the environment could be impacted by the release of radioactive materials. The release rate would be greatest if the ventilation system continued to function normally under emergency power. With the collapse of the 30-meter exhaust stack, the release would occur from a release height of 3 meters. The released quantities are summarized below in Table D.2.4.4–1.

TABLE D.2.4.4–1.—*Summary of Released Radiation Quantities, Building 194*

Radionuclide	Released Activity (Ci)
^{11}C	0.0012
^{13}N	0.047
^{15}O	0.903
Weapons grade Pu	3.4×10^{-4}
Total	**0.952**

C = carbon; Ci = curies; O = oxygen; N = nitrogen; Pu = plutonium.

D.2.4.5 *Building 235, 4-MeV Ion Accelerator—Exposure to Ionizing Radiation*

X-ray radiation due to the deceleration of secondary electrons and neutrons and gamma-ray radiation from bombardment of some materials by certain ions could pose a hazard to the personnel in the accelerator laboratory. The radiation level on the outside of the wall would be below LLNL design criterion of 0.25 millirem per hour during operation of the accelerator. The entrances to the accelerator enclosure are interlocked to ensure that any breaching of the interlocks turns off the equipment that produces the high acceleration voltages. The frequency of occurrence of this event is 10^{-4} to 10^{-2} per year.

Because of the accelerator enclosure and the alarmed and interlocked x-ray/gamma-ray and neutron detectors, exposures to ionizing radiation would be limited. The health and safety consequences would be negligible. This bounding accident scenario applies to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS.

D.2.4.6 *Building 239, Radiography Facility—Uncontrolled Oxidation of Plutonium at Elevated Temperatures (Weapons Grade Plutonium)*

This bounding accident scenario applies to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS. In this scenario, the item is removed from its container and placed onto the table for radiography. While being removed, the item is rammed by a forklift, dropped while being carried by hand, or impacted by a failure of the overhead crane. The outer metal barrier becomes punctured, cracked, or fails completely. Air and moisture enter and react with the plutonium inside. At the same time, a fire is postulated to occur, elevating the temperature in the bay. Plutonium begins to oxidize at elevated temperatures and subsequently releases material into the room. The released material mixes with the room air and 0.045 gram of weapons grade plutonium is exhausted unfiltered from the ventilation system. The frequency of occurrence for this event is conservatively estimated to be less than 4.5×10^{-7} per year.

D.2.4.7 *Building 251, Heavy Element Facility—Evaluation Basis Fire*

In this scenario, falling debris in the aftermath of a major earthquake (> 0.57 *g* [where 1.0 *g* equals acceleration due to gravity]) is assumed to impact a rack that had previously fallen, crushing all underground storage vault containers and inner secondary containers, if any, to approximately half of their original volumes. A fire is assumed to be ignited in one of the waste drums that had been breached by the falling debris. The fire is assumed to spread to other drums and involve surface contaminated equipment. This bounding accident scenario applies to all the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS.

The MAR for this scenario is 510 curies (americium-241 equivalent), which is assumed to be a powder. The airborne release fraction is assumed to be 5.3×10^{-4}, and the respirable fraction is 0.3. Therefore, the amount of material released to the environment is 0.081 curies (americium-241 equivalent). The frequency of occurrence of this event is 10^{-6} to 10^{-4} per year.

Airborne Release Fraction—The coefficient used to estimate the amount of a radioactive material that can be suspended in air and made available for airborne transport under a specific set of induced physical stresses. Applicable to events and situations that are completed during the course of the event.

Damage Ratio—The fraction of the MAR impacted by the accident-generated conditions.

Leak Path Factor—The fraction of airborne materials transported from containment or confinement deposition or filtration mechanism (e.g., fraction of airborne material in a glovebox leaving the glovebox under static conditions, fraction of material passing through a HEPA filter.)

Respirable Fraction—The fraction of airborne radionuclides as particles that can be transported through air and inhaled into the human respiratory system. This term is commonly assumed to include particles 10-µm Aerodynamic Equivalent Diameter and less.

D.2.4.8 *Building 331, Tritium Facility*

D.2.4.8.1 *Plutonium Metal Fire*

Actinide chemistry activities, including surface characterization, glow discharge mass spectrometry (GDMS), and elemental and isotopic analyses would be performed in three rooms of Building 331. Building 331 would receive metal samples contained in a GDMS cell or powdered samples pressed into indium and contained in a GDMS cell.

The powdered samples are pressed into indium and metal samples are contained in GDMS cells. No radioactive material spill or drop of metal or powder is considered, as there is no mechanism to cause the material to form an aerosol for distribution through the room and then to be transported to the environment. It is unlikely that a fire would be initiated within the building because flammable materials are kept to a minimum and within flameproof storage cabinets. In this scenario, it is assumed that 260 grams of fuel-grade equivalent plutonium are in the room. Using an airborne release fraction of 5×10^{-4} and a respirable fraction of 0.5 results in a release to the environment of 0.065 gram of fuel-grade plutonium. The frequency of occurrence for this event is 10^{-6} to 10^{-4} per year. This scenario represents the bounding accident for Building 331 under the No Action Alternative and Reduced Operation Alternative.

D.2.4.8.2 *Aircraft Crash with Subsequent Fire*

The total proposed tritium MAR for Building 331 under the Proposed Action is 30 grams of elemental tritium. At any given time, a portion of this inventory would be stored in uranium hydride beds and traps, while the tritium gas would be stored in containers with strict limits on quantity. For this scenario, the release of the total MAR of 30 grams of tritium gas (0.3 grams as HTO, tritiated water) was assumed.

It was assumed that an aircraft crash (single-engine piston aircraft) and subsequent gasoline pool fire occurred while a laboratory technician was opening or transferring the contents of a primary container holding 30 grams of tritium gas. All electrical power including emergency power was lost, shutting down the ventilation system. The glovebox was breached, allowing all of the tritium gas to enter the room. Because the roof in the room was damaged by the crash, tritium was released into the environment. All of the tritium is oxidized by fire into tritiated water. The ventilation system became inoperable, causing the tritium to be released at ground level instead of through the stack. The major impact to involved workers would have been injury or death from the crash or subsequent fire. These workers could have also been briefly exposed to tritiated water. The frequency of occurrence of this event was conservatively estimated to be 1.53×10^{-6} per year. This scenario represents the bounding accident for Building 331 under the Proposed Action.

D.2.4.9 *Building 332, Plutonium Facility*

D.2.4.9.1 *Aircraft Crash*

The principal threat to the gloveboxes and equipment in the room is expected to be from high velocity impacts of concrete shrapnel from a 30-inch radius, 10-inch-thick wall section created by impact of an aircraft. The flying concrete pieces may cause major damage in the room. There would be a range of types of concrete shrapnel, from low-velocity chunks falling off the walls or ceiling to small pieces of higher velocity. Gloveboxes in the impact path may sustain damage and possibly lose their confinement capacity but would not likely overturn, as they are robust and seismically restrained.

Because the general aviation aircraft engine is not expected to enter the room, the impacts of the concrete shrapnel are not expected to be of sufficient magnitude to credibly threaten the interior walls of the room. Thus, the maximum credible extent of the damage for this scenario is limited to a single room. All materials in the room would be threatened by the shrapnel and are assumed at risk. MAR estimates and release fractions were calculated using the factors of damage ratio, airborne release fraction, respirable fraction, and leak path factor. This analysis concluded that the largest source term for the No Action Alternative would be 0.25 gram of 30-year-old fuel-grade plutonium. The frequency of occurrence for this event is conservatively estimated to be 4.86×10^{-6} per year. This scenario represents the bounding accident for Building 332 under the No Action Alternative and Reduced Operation Alternative.

D.2.4.9.2 *Evaluation-Basis Room Fire (Unfiltered)*

An evaluation-basis room fire is postulated to be of sufficient magnitude that the entire room is threatened, that all of the radioactive MAR within the room is engulfed in the fire, and the fire burns long enough to release the material from storage containers to the glovebox, room, and the environment.

A fire in a room would most likely be initiated by human error. Potential ignition sources such as oxygen and fuel in the form of plastics, paper products, and wood are presumed to be present in the room. Fires caused by human error are minimized by control of both ignition sources and combustibles. Nevertheless, fewer failures are needed for fires caused by human error than for any other postulated initiator. A room fire caused by human error can be the result of procedural violation, carelessness, or misuse of power tools, to name a few.

Mechanical failure as the cause of the evaluation-basis room fire is less likely than human error because installation and inherent construction requirements minimize the potential for fire initiation and propagation. Experience at LLNL and other facilities indicates that equipment fires initiated by electrical faults generate smoke from smoldering or burning cable insulation and other plastics. This type of fire is quickly detected by facility workers or smoke detectors, and is readily extinguished by facility workers or responding emergency personnel.

The building structure is capable of containing a room fire of at least 1-hour severity for the radioactive material area (RMA) walls. The combustible loading within the RMA is maintained at a low level. Because of the robust nature of the construction of the building structure and the typical fire loads characteristic of building operations, no credible mechanisms were identified that would lead to a fire spreading beyond the specific room where the fire started.

The MAR in any room, excluding the vaults, was assumed to be the entire MAR limit of 20 kilograms of 30-year-old fuel-grade plutonium for the No Action Alternative and 40 kilograms of 30-year-old fuel-grade plutonium for the Proposed Action. The material-at-risk limit for all other rooms would remain 20 kilograms fuel grade equivalent plutonium. This includes material in waste containers in RMA rooms and in the basement. Because most processes in any of the laboratories in Building 332 involve solid forms of plutonium, the airborne release fraction in a fire is assumed to be 5×10^{-4}. An appropriate respirable fraction is 0.5. A damage ratio of 1.0 is assumed.

If the room ventilation system exhaust and supply fans are inoperable, the air in the building will become stagnant with only very small pressure differences between the corridor and the environment, the rooms and the corridor, and the rooms and the gloveboxes. The primary unfiltered pathways for material to escape to the environment will be through the cracks around the RMA exit doors and possible by reverse flow through the room ventilation system supply ducting. The leak path factor for this case is bounded by a value of 0.05. Therefore the total release to the environment is 0.25 gram of 30-year-old fuel-grade plutonium for the No Action Alternative and 0.50 gram of 30-year-old fuel-grade plutonium for the Proposed Action. The frequency of this event is 3.9×10^{-7} per year. This scenario represents the bounding accident for Building 332 for the Proposed Action.

D.2.4.10 *Building 334, Hardened Engineering Test Building—Uncontrolled Oxidation of Plutonium at Elevated Temperatures*

Components containing SNM may be brought into the facility for nondestructive testing and measurements. SNM components are not stored in the facility, but are shipped back out of the facility once the testing and measurements are completed.

The potential exists for a fire to occur while a gasoline-powered vehicle is in the building. However, because test items are required to be in shipping containers when there is a fossil fuel-powered vehicle in the building and because the shipping containers are built to survive transport accidents including fire, the test items would be unaffected.

For items containing plutonium, there is no credible accident in which a fire could occur to engulf plutonium because the material is not packaged with any other significant amount of combustible material.

The concern with plutonium is an accident wherein the components' metal casing could be breached. If a component is dropped, rammed with a forklift, or crushed in an accident, the material inside could be exposed to the atmosphere. Subsequent room temperature oxidation would then release plutonium oxide into the area. In this uncontrolled oxidation scenario, the item is removed from its shipping container. While being removed, the item is rammed by a forklift, dropped while being hand-carried, or impacted by a failure of the overhead crane. The outer metal barrier is damaged. Air and moisture enter and react with the plutonium inside. Simultaneously a fire occurs, that elevates temperature in the bay above normal. Plutonium begins to oxidize and plutonium oxide is released into the room. The released material mixes with the room air and is exhausted by the ventilation system. The source term is calculated as 0.185 grams. The frequency of this event is conservatively estimated to be less than 1×10^{-6} per year. This bounding accident scenario applies to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS.

D.2.4.11 *Buildings 514/612/625/693, Radioactive and Hazardous Waste Management Complex—Aircraft Crash into Building 625*

The potential for a general aviation aircraft crash into Building 625 was considered. For an aircraft crash impacting Building 625, the most likely scenario would be an aircraft crashing into the building structure with subsequent gasoline pool fire. To determine the MAR for this scenario, the analysis considered the geometry of stored waste drums at Building 625 Radiological and Hazardous Waste Storage Facility, the effective area of an aircraft engine, and the potential size of the gasoline pool fire.

The calculated annual frequency of an aircraft crashing into the building structure with subsequent gasoline pool fire is 6.1×10^{-7}, which is less frequent than once in a million years. The aircraft accident scenario evaluated at Building 625 is very conservative in that it assumes the facility is loaded to its physical limit with containers of transuranic waste loaded to their maximum curie limit. The maximum curie limit under the Proposed Action is equivalent to an array of drums where one drum contains 60 plutonium-equivalent curies and the other surrounding drums contain 12 plutonium-equivalent curies. It is planned that by the end of 2005, all legacy transuranic waste drums in Building 625 would be shipped to the Waste Isolation Pilot Plant (WIPP). It is projected that waste shipments to WIPP would be completed before Building 625 and other LLNL transuranic waste storage facilities are fully loaded. Therefore, the consequences discussed above are associated with what would be considered a maximum peak inventory in Building 625 that would be allowed under the facilities operational procedures but may never occur.

It is anticipated that drums containing up to 60 plutonium-equivalent curies would be stored in Building 625. For the purpose of this analysis, the assumed inventory in the remaining involved drums is 12 plutonium-equivalent curies each. The number of failed drums from the aircraft crash and subsequent gasoline pool fire would correspond to the area of the gasoline pool. Drums are stored on pallets that measure 4 feet by 4 feet. Pallets, each with four drums, can be stacked two high. In addition, there is a 30-inch separation between rows of stacked drums. Dimensions of a general aviation aircraft engine are assumed to be approximately 36 inches by 20 inches.

For conservatism, it is assumed that the initial direct impact leads to penetration through the structure of Building 625 and catastrophic failure of a total of four drums on two stacked pallets (i.e., two drums per pallet) (LLNL 2003y). One of the four impacted drums is postulated to be a

60 plutonium-equivalent-curies drum. For those drums directly impacted by the engine, the product of the airborne release fraction and respirable fraction (ARF × RF) is assumed to be 1 percent (0.01). This value represents a standard value for drums subjected to impact followed by fire. The damage ratio (DR) and leak path factor (LPF) are both conservatively assumed to be 1. Therefore, for those drums directly impacted by the general aviation aircraft engine, the source term is as follows:

(1 drum)(60 plutonium-equivalent curies)(0.01)(1)(1) = 0.6 plutonium-equivalent curies

(3 drums)(12 plutonium-equivalent curies)(0.01)(1)(1) = 0.36 plutonium-equivalent curies

The equivalent diameter of the gasoline pool fire is 10 feet. Based on the pallet dimensions and the required 30-inch spacing between pallets, a total of 25 drums can be engulfed in the gasoline pool fire with an ARF × RF of 0.01. The catastrophic drum failure rate of 20 percent is assumed, from which 50 percent of the content is assumed to be expelled. Additionally, five other drums would fail from the engulfing fire with an ARF × RF of 5×10^{-4}. Of these five additional drums, 50 percent of the content is assumed to be expelled. A total of 36 additional drums within the dimensions of the gasoline pool fire are assumed to not have failed catastrophically, but to fail by lid seal failure leading to a release with an ARF × RF of 5×10^{-4}. The assumed DR for these 36 drums is 0.6 (LLNL 2003y). Therefore, the source term for the drums indirectly impacted is as follows:

(25 drum)(0.2)(12 plutonium-equivalent curies)(0.01)(0.5)(1) = 0.3 plutonium-equivalent curies

(5 drums)(12 plutonium-equivalent curies)(5×10^{-4})(0.5)(1) = 0.015 plutonium-equivalent curies

(36 drums)(12 plutonium-equivalent curies)(5×10^{-4})(0.6)(1) = 0.13 plutonium-equivalent curies

Thus, the total source term for the Proposed Action is:

0.6 curies + 0.36 curies + 0.3 curies + 0.015 curies + 0.13 curies = 1.40 plutonium-equivalent curies

The source term for the No Action Alternative and Reduced Operation Alternative is 0.46 plutonium-equivalent curies.

The peak heat release rate from a fire involving a full tank of gasoline (90 gallons) is 18.4 megawatts (LLNL 2003y). Because fire occurs inside the structure, the ambient heat loss to the surrounding walls must be accounted for in computing the plume sensible heat. For conservatism, the total heat loss to the environment, including the conduction loss to the structure is assumed to be 75 percent. Therefore, the plume sensible heat (a MACCS2 input) is 4.6 megawatts (18.4 megawatts × 0.25).

D.2.4.12 *Building 581, National Ignition Facility—Earthquake During Plutonium Experiment Without Yield*

The initiating event for this scenario is a severe earthquake. The event considers an earthquake of frequency 10^{-4} per year (~ 1 *g* horizontal ground acceleration) occurring at the time of a maximum credible yield experiment. Assuming 10 non-yield experiments per year, the estimated frequency of the accident is 2×10^{-8} per year, assuming a 1 minute window for the earthquake. Tritium sources located outside the target bay in the Laser and Target Area Building (LTAB) would also be vulnerable to release. These primarily include tritium in elemental form as stored targets or on the cryopumps, or tritium as oxide on the molecular sieve of the tritium processing system.

The target building has been shown by analysis to withstand a severe earthquake, but other areas and components have not been analyzed beyond their design basis. The beam tubes leading from the switchyard into the target chamber are assumed to fail in the proposed earthquake. The switchyards may sustain the earthquake, but are conservatively assumed to collapse. Components of the tritium processing system may be compromised and the area could be flooded by water released from failed water supply piping. Further, natural gas piping in areas of the LTAB outside the target bay could cause localized fires if damaged under these extreme conditions.

For inventories in the target bay, a pathway out to the environment is created through the beam tube penetrations in the target bay walls. Airborne activity in the target bay would be swept out to the environment by wind blowing through this volume. The wind is assumed to blow in through the penetrations on one side of the target bay, and out through the penetrations on the opposite side.

Radioactive inventories vulnerable to release under the Proposed Action include activated gases; activated particulate in the target chamber; tritium; and for fissile/fissionable materials, the source material (and for yield experiments, associated fission products). For the Proposed Action, there would be no change in the activated gas or tritium source terms. The activated particulate inventory in the target chamber would change based on the new materials proposed. In addition to the target chamber particulate, gaseous and semivolatile fission products would be present immediately after the experiments and would be vulnerable to release. Alternately, inventories from tracers that are part of the Proposed Action could also be present. Plutonium shots would add additional radioisotopes including weapons grade plutonium and, for experiments with yield, associated fission products and activated particulates. These source terms would not all be simultaneously present.

The type of experiment that produces the largest offsite consequences under the Proposed Action is the plutonium experiment without yield. In this experiment, the quantity of target material present in the container is 3 grams of weapons grade plutonium. It is assumed that this material would be subject to a release fraction of 1×10^{-3}, resulting in a release to the environment of 0.003 grams of weapons grade plutonium (LLNL 2003d).

D.2.4.13 *Building 696R, Radioactive Waste Storage Area—Aircraft Crash*

For an aircraft crash impacting Building 696R, the most likely scenario would result in an aircraft crashing into the building structure with a subsequent gasoline pool fire. To determine the MAR for this scenario, the analysis considered the geometry of stored waste drums at Building 696R, the effective area of an aircraft engine, and the potential size of the gasoline pool fire.

The aircraft accident scenario evaluated at Building 696R is conservative in that it assumes the facility is loaded to its physical limit with containers of transuranic waste and that each container is loaded to the maximum curie limit. Given the plans to ship current and newly generated transuranic waste to the WIPP for disposal, the consequences would be associated with what would be considered an interim peak inventory for Building 696R.

For the purpose of this analysis, the inventory in the Building 696R drums is conservatively assumed to be 12 plutonium-equivalent curies each and the drums are assumed to be stacked two high. The number of failed 55-gallon drums from the aircraft crash and subsequent gasoline pool fire would correspond to the area of the gasoline pool. Drums are stored on pallets that measure 4 feet by 4 feet. Pallets, each with four drums, can be stacked two high. In addition, there is a 30-inch separation between rows of stacked drums. Dimensions of a general aviation aircraft engine are approximately 36 inches by 20 inches.

For conservatism, it is assumed that the initial direct impact leads to penetration through the structure of Building 696R and catastrophic failure of a total of four drums on two stacked pallets (i.e., two drums per pallet) (LLNL 2003y). For those drums directly impacted by the engine, the product of the ARF × RF is assumed to be 1 percent (0.01). This value represents a standard value for drums subjected to impact followed by fire. The damage ration and leak path factor are both conservatively assumed to be 1. Therefore, for those drums directly impacted by the engine, the source term is as follows:

> (4 drums)(12 plutonium-equivalent curies)(0.01)(1)(1) = 0.48 plutonium-equivalent curies

The equivalent diameter of the gasoline pool is 10 feet. Based on the pallet dimensions and the required 30-inch spacing between pallets, a total of 25 drums can be engulfed in the gasoline pool fire (with an ARF × RF of 0.01). The catastrophic drum failure rate of 20 percent is assumed, from which 50 percent of the content is assumed to expelled. Additionally, five other drums would fail from the engulfing fire (with an ARF × RF of 5×10^{-4}). Of these five additional drums, 50 percent of the content is assumed to be expelled. A total of 36 additional drums within the dimensions of the pool fire are assumed to not have failed catastrophically, but to fail by lid seal failure leading to a release with an ARF × RF of 5×10^{-4}. The assumed damage ratio for these 36 drums is 0.6 (LLNL 2003y). Therefore, the source term for indirectly impacted drums is as follows:

> (25 drum)(0.2)(12 plutonium-equivalent curies Ci)(0.01)(0.5)(1) = 0.3 plutonium-equivalent curies

(5 drums)(12 plutonium-equivalent curies)(5×10^{-4})(0.5)(1) = 0.015 plutonium-equivalent curies

(36 drums)(12 plutonium-equivalent curies)(5×10^{-4})(0.6)(1) = 0.13 plutonium-equivalent curies

Thus, the total source term is:

0.48 curies + 0.3 curies + 0.015 curies + 0.13 curies = 0.925 plutonium-equivalent curies

The peak heat release rate from a fire involving a full tank of gasoline (90 gallons) is 18.4 megawatts (LLNL 2003y). Because fire occurs inside the structure, the ambient heat loss to the surrounding walls must be accounted for in computing the plume sensible heat. For conservatism, the total heat loss to the environment, including the conduction loss to the structure is assumed to be 75 percent. Therefore, the plume sensible heat (a MACCS2 input) is 4.6 megawatts (18.4 megawatts × 0.25). The frequency of occurrence of this event is 6.29×10^{-7} per year. This bounding accident scenario applies to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS.

D.2.4.14 *Site 300 Materials Management Facilities—Depleted Uranium Release by Fire*

Depleted uranium is stored in Site 300 Controlled Materials Group facilities. The causes of a fire that releases depleted uranium could include human error in using materials handling equipment, fire in the storage magazine, natural phenomenon such as a lightning strike, or accidental detonation of explosives in a neighboring magazine. The most probable initiating cause of a depleted uranium release is the penetration of a storage bay and a container by a fragment from an explosion at a remote high explosives machining operation.

A magazine fire involving test assemblies could result in the exposure of worksite and other Site 300 personnel to fumes from the smoke. However, because personnel are not allowed in the area during a remote operation and do not approach a structure that is in flames, the actual probability of onsite exposure is low. The frequency of this event is mitigated by the strict control of ignition sources and fuel loadings in the facilities. These controls are extremely effective because depleted uranium does not burn well when in solid form. In addition, this material is packaged in its shipping container, which protects the material from ignition from the outside and limits the access to oxygen if a fire is ignited, which tends to snuff out the fire or at least slow its rate of burn. Approximately 0.95 grams per second is released for 2 hours, for a total of 6,840 grams of depleted uranium assumed to be released in this scenario. The frequency of this event is 10^{-4} to 10^{-2} per year. This bounding accident scenario applies to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS.

D.2.4.15 *Onsite Transportation*

The risk from accidents during onsite transportation of radiological material was not considered in the previous Livermore Site-wide EIS (LLNL 1992) but is considered here. Onsite transportation can be thought of as a roving facility; accidents involve transport of radiological materials between facilities along various possible routes within the site. Accidents can occur at various locations with various consequences. This differs from the other (stationary) facilities, of which all accidents can occur essentially at a single location.

Each of the onsite transportation accidents listed in Table D.2.4–1 is described here. Each of the accidents is bounding for particular receptors. The Radioactive and Hazardous Waste Management (RHWM) package explosion scenario is characterized by a deflagration internal to an RHWM transuranic (TRU) waste container as a result of flammable gas buildup in the container. Two phenomena are postulated to result from this accident. Initially, part of the container inventory is released as a direct result of the deflagration. After the deflagration, aerodynamic entrainment occurs as the exposed waste material is drawn into the environment by the ambient airflow. For the No Action Alternative, the total source term is 0.0099 plutonium-equivalent curie based on currently allowed inventories in Building 625. For the Proposed Action, the total source term is 0.0132 plutonium-equivalent curie based on projected operations in Building 625. This release is assumed to occur 170 meters from the closest site boundary (LLNL 2003e). The dose from this accident bounds that which would be received by the MEI from an onsite transportation accident for each of the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS.

The RHWM truck fire scenario is characterized by a truck impact that damages the TRU waste containers being transported followed by a fire resulting from a breached fuel tank. Several phenomena are postulated to result from this accident. Initially, part of the truck inventory is spilled as a result of the truck impact. After the impact, a fire occurs that impacts the spilled inventory and also the inventory that remains in containers. Finally, aerodynamic entrainment occurs after the fire is extinguished. The dispersion of the initial spill and the aerodynamic entrainment source terms are assumed to not be affected by the fire and they are treated as non-buoyant plumes. The total non-buoyancy affected source term is 0.0027 plutonium- equivalent curie. The source term from the fire is 0.0675 plutonium-equivalent curie. The fire is postulated to result in a plume sensible heat of 5 megawatts. This release is assumed to occur 170 meters from the closest site boundary (LLNL 2003e). The dose from this accident bounds that which would be received by the offsite population from an onsite transportation accident and applies to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS.

The Materials Management Section (MMS) explosion scenario is characterized by an internal hydrogen deflagration occurring inside the MMS transfer package exposing the material inside the package to the blast effects of the deflagration. It is assumed that the explosion results in breach of the confining and containing barriers of the MMS package on the transfer vehicle. This allows the potential release of the radioactive materials in the package. The deflagration source term is 0.1 grams of fuel-grade equivalent plutonium. After the deflagration, aerodynamic entrainment results in an additional source term of 0.004 grams of fuel-grade plutonium. This release is assumed to occur 800 meters from the closest site boundary (LLNL 2003e). The dose from this accident bounds that which would be received by LLNL workers from an onsite transportation accident and applies to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS.

D.2.5 Estimated Health Effects

Tables D.2.5–1 and D.2.5–2 show the frequencies and consequences of the postulated set of accidents for the Proposed Action and the No Action Alternative for a noninvolved worker, the population of noninvolved workers, and the public (offsite maximally exposed individual [MEI] and the general population living within 50 miles of LLNL) for both median and unfavorable meteorological conditions. These tables show both the radiation dose (collective dose) and the number of LCFs for the offsite population and the population of noninvolved workers. For the MEI and the individual noninvolved worker, these tables show radiation dose and the probability of an LCF, which is calculated using the same dose-to-risk conversion factor of 6×10^{-4} per person-rem as for the population doses. The results for the Reduced Operation Alternative are the same as for the No Action Alternative. The median meteorological conditions are presented to provide an indication of the average consequences, while the unfavorable are presented to give an indication of the unfavorable consequences. The results for the unfavorable meteorological conditions can also be used for comparison with LLNL safety documents.

For median meteorological conditions, the accident with the highest consequence to the offsite population (see Table D.2.5–1) is an aircraft crash into Building 625. The collective radiation dose to the approximately 6,900,000 people living within 50 miles of LLNL under median meteorological conditions was calculated to be approximately 2,020 person-rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the collective population dose is estimated to result in an additional 1.2 LCFs to this population.

For the noninvolved worker, the accident with the largest dose is an evaluation-basis fire in Building 251. The radiation dose under median meteorological conditions would be 5.7 rem at a distance of 100 meters. Using the dose-to-risk conversion factor of 6×10^{-4} LCFs per person-rem, the 100-meter dose has a probability of 3.42×10^{-3} (or one chance in 292) of the development of a fatal cancer.

For the population of noninvolved workers, the bounding accident for the Proposed Action and the No Action Alternative is an evaluation basis fire in Building 251, which is estimated to result in 826 person-rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the collective noninvolved worker dose is estimated to result in an additional 0.50 LCFs in this population.

For the MEI, the accident with the highest dose is an aircraft crash into the Building 696R. The radiation dose at the site boundary nearest to the release (140 meters from the release point) under median meteorological conditions is 0.86 rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the MEI dose has a probability of 5.17×10^{-4} (or one chance in 1,934) of the development of a fatal cancer.

For the unfavorable meteorological conditions, the accident with the highest consequences to all receptors other than the noninvolved worker population is the aircraft crash into Building 625. The offsite collective dose to the approximately 6,900,000 people within 50 miles of LLNL for this accident was calculated to be 17,640 person-rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the collective population dose is estimated to result in an additional 10.6 LCFs to this population.

For the noninvolved worker, the radiation dose for the aircraft into Building 625 under unfavorable meteorological conditions would be 82.3 rem at a distance of 100 meters. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the 100-meter dose has a probability of 0.049 (or one chance in 20) of the development of a fatal cancer.

The radiation dose at the site boundary nearest to the release (250 meters east of the release point) for the aircraft into Building 625 under unfavorable meteorological conditions is 23.1 rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the MEI dose has a probability of 0.014 (or one chance in 72) of the development of a fatal cancer.

For the population of noninvolved workers, the accident with the highest collective dose is a room fire (unfiltered) in Building 332. The collective radiation dose to this noninvolved worker population under unfavorable meteorological conditions is 5,200 person-rem. Using the dose-to-risk conversion factors of 6×10^{-4} per person-rem, the collective noninvolved worker dose is estimated to result in an additional 3.1 LCFs in this population.

TABLE D.2.5–1.—*Potential Accident Frequency and Consequences (Median Meteorology)*[a]

			MEI		Offsite Population[b]		Individual Noninvolved Worker		Noninvolved Worker Population	
Building	**Accident**	**Frequency (per year)**	**Dose (rem)**	**LCFs[c]**	**Dose (person-rem)**	**LCFs[d]**	**Dose (rem)**	**LCFs[c]**	**Dose (person-rem)**	**LCFs[d]**
Building 191	Radioactive material dispersion from a spill and fire - No Action	$<10^{-6}$	3.32×10^{-5}	1.99×10^{-8}	4.70×10^{-3}	2.82×10^{-6}	7.23×10^{-5}	4.34×10^{-8}	9.72×10^{-3}	5.83×10^{-6}
	Radioactive material dispersion from a spill and fire - Proposed Action	$<10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same
Building 194	Design-basis earthquake and fire - No Action	10^{-6} to 10^{-4}	8.66×10^{-4}	5.20×10^{-7}	2.23×10^{-1}	1.34×10^{-4}	3.43×10^{-3}	2.06×10^{-6}	5.83×10^{-1}	3.50×10^{-4}
	Design-basis earthquake and fire-Proposed Action	10^{-6} to 10^{-4}	Same	Same	Same	Same	Same	Same	Same	Same
Building 239	Uncontrolled oxidation of plutonium at elevated temperature - No Action	$<4.5 \times 10^{-7}$	1.73×10^{-2}	1.04×10^{-5}	6.49	3.89×10^{-3}	2.47×10^{-1}	1.48×10^{-4}	2.59×10^{1}	1.55×10^{-2}
	Uncontrolled oxidation of plutonium at elevated temperature - Proposed Action	$<4.5 \times 10^{-7}$	Same	Same	Same	Same	Same	Same	Same	Same
Building 251	Evaluation basis fire - No Action	10^{-6} to 10^{-4}	6.01×10^{-1}	3.61×10^{-4}	1.88×10^{2}	1.13×10^{-1}	5.70	3.42×10^{-3}	8.26×10^{2}	4.96×10^{-1}
	Evaluation basis fire - Proposed Action	10^{-6} to 10^{-4}	Same	Same	Same	Same	Same	Same	Same	Same
Building 331	Plutonium Metal Fire - No Action	10^{-6} to 10^{-4}	5.02×10^{-2}	3.01×10^{-5}	2.39×10^{1}	1.43×10^{-2}	6.40×10^{-1}	3.84×10^{-4}	8.95×10^{1}	5.37×10^{-2}
	Aircraft crash with subsequent fire - Proposed Action	1.53×10^{-6}	1.63×10^{-1}	9.78×10^{-5}	1.13×10^{2}	6.78×10^{-2}	2.11	1.27×10^{-3}	2.73×10^{2}	1.64×10^{-1}
Building 332	Aircraft Crash - No Action	4.86×10^{-6}	1.48×10^{-1}	8.85×10^{-5}	9.70×10^{1}	5.82×10^{-2}	1.84	1.10×10^{-3}	3.18×10^{2}	1.91×10^{-1}
	Room Fire Unfiltered - Proposed Action	3.90×10^{-7}	2.94×10^{-1}	1.76×10^{-4}	1.87×10^{2}	1.12×10^{-1}	3.29	1.97×10^{-3}	6.20×10^{2}	3.72×10^{-1}

TABLE D.2.5–1.—*Potential Accident Frequency and Consequences (Median Meteorology) (continued)*[a]

			MEI		Offsite Population[b]		Individual Noninvolved Worker		Noninvolved Worker Population	
Building	**Accident**	**Frequency (per year)**	**Dose (rem)**	**LCFs**[c]	**Dose (person-rem)**	**LCFs**[d]	**Dose (rem)**	**LCFs**[c]	**Dose (person-rem)**	**LCFs**[d]
Building 334	Uncontrolled oxidation of plutonium at elevated temperatures - No Action	$< 1.00 \times 10^{-6}$	1.64×10^{-1}	9.84×10^{-5}	6.80×10^{1}	4.08×10^{-2}	3.25	1.95×10^{-3}	2.31×10^{2}	1.39×10^{-1}
	Uncontrolled oxidation of plutonium at elevated temperatures - Proposed Action	$< 1.00 \times 10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same
Building 581	Earthquake - No Action	2.00×10^{-8}	4.78×10^{-4}	2.87×10^{-7}	1.96×10^{-1}	1.18×10^{-4}	1.43×10^{-3}	8.60×10^{-7}	2.08×10^{-1}	1.25×10^{-4}
	Earthquake during plutonium experiment without yield - Proposed Action	2.00×10^{-9}	1.65×10^{-3}	9.89×10^{-7}	5.46×10^{-1}	3.28×10^{-4}	4.99×10^{-3}	3.00×10^{-6}	7.41×10^{-1}	4.45×10^{-4}
Building 625	Aircraft Crash - No Action	6.10×10^{-7}	2.39×10^{-1}	1.43×10^{-4}	6.62×10^{2}	3.97×10^{-1}	6.49×10^{-1}	3.89×10^{-4}	3.04×10^{1}	1.82×10^{-2}
	Aircraft Crash - Proposed Action	6.10×10^{-7}	7.27×10^{-1}	4.36×10^{-4}	2.02×10^{3}	1.21	1.97	1.18×10^{-3}	9.24×10^{1}	5.54×10^{-2}
Building 696R	Aircraft Crash - No Action	6.29×10^{-7}	8.61×10^{-1}	5.17×10^{-4}	1.29×10^{3}	7.71×10^{-1}	1.39	8.33×10^{-4}	8.33×10^{1}	5.00×10^{-2}
	Aircraft Crash - Proposed Action	6.29×10^{-7}	Same	Same	Same	Same	Same	Same	Same	Same
Site 300 Materials Management Facilities	Depleted uranium release by fire - No Action	10^{-4} to 10^{-2}	3.93×10^{-4}	2.36×10^{-7}	3.81×10^{-1}	2.29×10^{-4}	3.94×10^{-2}	2.36×10^{-5}	9.42×10^{-2}	5.65×10^{-5}
	Depleted uranium release by fire - Proposed Action	10^{-4} to 10^{-2}	Same	Same	Same	Same	Same	Same	Same	Same

TABLE D.2.5–1.—*Potential Accident Frequency and Consequences (Median Meteorology) (continued)*[a]

			MEI		Offsite Population[b]		Individual Noninvolved Worker		Noninvolved Worker Population	
Building	**Accident**	**Frequency (per year)**	**Dose (rem)**	**LCFs[c]**	**Dose (person-rem)**	**LCFs[d]**	**Dose (rem)**	**LCFs[c]**	**Dose (person-rem)**	**LCFs[d]**
Onsite Transportation	Radioactive and Hazardous Waste Management package explosion - No Action	$< 1.00 \times 10^{-6}$	4.13×10^{-1}	2.48×10^{-4}	1.46×10^{1}	8.76×10^{-3}	8.63×10^{-1}	5.18×10^{-4}	6.88×10^{1}	4.13×10^{-2}
	Radioactive and Hazardous Waste Management package explosion-Proposed Action	$< 1.00 \times 10^{-6}$	5.50×10^{-1}	3.30×10^{-4}	1.95×10^{1}	1.17×10^{-2}	1.15	6.90×10^{-4}	9.17×10^{1}	5.50×10^{-2}
	Radioactive and Hazardous Waste Management Truck Fire - No Action	$< 1.00 \times 10^{-6}$	1.09×10^{-1}	6.54×10^{-5}	1.01×10^{2}	6.06×10^{-2}	3.5×10^{-1}	2.10×10^{-4}	7.36×10^{1}	4.42×10^{-2}
	Radioactive and Hazardous Waste Management Truck Fire - Proposed Action	$< 1.00 \times 10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same
	Materials Management Section package explosion-No Action	$< 1.00 \times 10^{-6}$	1.16×10^{-1}	6.96×10^{-5}	4.01×10^{1}	2.41×10^{-2}	2.79	1.67×10^{-3}	1.71×10^{2}	1.03×10^{-1}
	Materials Management Section package explosion-Proposed Action	$< 1.00 \times 10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same

Source: Original.
[a] The consequences for the Reduced Operation Alternative would be the same as for the No Action Alternative.
[b] Based on the population of approximately 6,900,000 persons residing within 50 miles of LLNL.
[c] Increased likelihood of a LCF .
[d] Increased number of LCFs.
LCF = latent cancer fatalities.

TABLE D.2.5–2.—*Potential Accident Frequency and Consequences (Unfavorable Meteorology)*[a]

			MEI		Offsite Population[b]		Individual Noninvolved Worker		Noninvolved Worker Population	
Building	**Accident**	**Frequency (per year)**	**Dose (rem)**	**LCFs[c]**	**Dose (person-rem)**	**LCFs[d]**	**Dose (rem)**	**LCFs[c]**	**Dose (person-rem)**	**LCFs[d]**
Building 191	Radioactive material dispersion from a spill and fire - No Action	$<10^{-6}$	4.25×10^{-4}	2.55×10^{-7}	4.20×10^{-2}	2.52×10^{-5}	7.14×10^{-4}	4.28×10^{-7}	6.96×10^{-2}	4.18×10^{-5}
	Radioactive material dispersion from a spill and fire - Proposed Action	$<10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same
Building 194	Design-basis earthquake and fire - No Action	10^{-6} to 10^{-4}	1.30×10^{-2}	7.80×10^{-6}	1.81	1.09×10^{-3}	3.30×10^{-2}	1.98×10^{-5}	3.47	2.08×10^{-3}
	Design-basis earthquake and fire-Proposed Action	10^{-6} to 10^{-4}	Same	Same	Same	Same	Same	Same	Same	Same
Building 239	Uncontrolled oxidation of plutonium at elevated temperature - No Action	$<4.5 \times 10^{-7}$	3.68×10^{-1}	2.21×10^{-4}	1.02×10^{2}	6.12×10^{-2}	2.97	1.78×10^{-3}	2.02×10^{2}	1.21×10^{-1}
	Uncontrolled oxidation of plutonium at elevated temperature - Proposed Action	$<4.5 \times 10^{-7}$	Same	Same	Same	Same	Same	Same	Same	Same
Building 251	Evaluation basis fire - No Action	10^{-6} to 10^{-4}	1.18×10^{1}	7.10×10^{-3}	1.22×10^{3}	7.34×10^{-1}	6.46×10^{1}	3.88×10^{-2}	4.52×10^{3}	2.71
	Evaluation basis fire - Proposed Action	10^{-6} to 10^{-4}	Same	Same	Same	Same	Same	Same	Same	Same
Building 331	Plutonium Metal Fire - No Action	10^{-6} to 10^{-4}	9.98×10^{-1}	5.99×10^{-4}	3.85×10^{2}	2.31×10^{-1}	7.52	4.51×10^{-3}	6.70×10^{2}	4.02×10^{-1}
	Aircraft crash with subsequent fire - Proposed Action	1.53×10^{-6}	3.26	2.28×10^{-4}	1.56×10^{3}	1.10×10^{-1}	2.55×10^{1}	1.79×10^{-3}	2.05×10^{3}	1.44×10^{-1}
Building 332	Aircraft Crash - No Action	4.86×10^{-6}	2.89	1.73×10^{-3}	1.19×10^{3}	7.14×10^{-1}	2.36×10^{1}	1.42×10^{-2}	2.53×10^{3}	1.52
	Room Fire Unfiltered - Proposed Action	3.90×10^{-7}	5.60	3.36×10^{-3}	2.17×10^{3}	1.30	2.98×10^{1}	1.79×10^{-2}	5.20×10^{3}	3.12

TABLE D.2.5–2.—*Potential Accident Frequency and Consequences (Unfavorable Meteorology) (continued)*[a]

			MEI		Offsite Population[b]		Individual Noninvolved Worker		Noninvolved Worker Population	
Building	**Accident**	**Frequency (per year)**	**Dose (rem)**	**LCFs[c]**	**Dose (person-rem)**	**LCFs[d]**	**Dose (rem)**	**LCFs[c]**	**Dose (person-rem)**	**LCFs[d]**
Building 334	Uncontrolled oxidation of plutonium at elevated temperatures - No Action	$<1.00 \times 10^{-6}$	3.68	2.21×10^{-3}	1.03×10^{3}	6.18×10^{-1}	4.39×10^{1}	2.63×10^{-2}	2.08×10^{3}	1.25
	Uncontrolled oxidation of plutonium at elevated temperatures - Proposed Action	$<1.00 \times 10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same
Building 581	Earthquake - No Action	2.00×10^{-8}	6.15×10^{-3}	3.69×10^{-6}	3.05	1.83×10^{-3}	1.33×10^{-2}	8.01×10^{-6}	2.22	1.33×10^{-3}
	Earthquake during plutonium experiment without yield - Proposed Action	2.00×10^{-9}	2.16×10^{-2}	1.30×10^{-5}	8.33	5.00×10^{-3}	4.69×10^{-2}	2.82×10^{-5}	8.23	4.94×10^{-3}
Building 625	Aircraft Crash - No Action	6.10×10^{-7}	7.59	4.55×10^{-3}	5.80×10^{3}	3.48	2.70×10^{1}	1.62×10^{-2}	6.44×10^{2}	3.86×10^{-1}
	Aircraft Crash - Proposed Action	6.10×10^{-7}	2.31×10^{1}	1.39×10^{-2}	1.76×10^{4}	1.06×10^{1}	8.23×10^{1}	4.94×10^{-2}	1.96×10^{3}	1.18
Building 696R	Aircraft Crash - No Action	6.29×10^{-7}	1.66×10^{1}	9.93×10^{-3}	1.06×10^{4}	6.38	2.16×10^{1}	1.30×10^{-2}	1.73×10^{3}	1.04
	Aircraft Crash - Proposed Action	6.29×10^{-7}	Same	Same	Same	Same	Same	Same	Same	Same
Site 300 Materials Management Facilities	Depleted uranium release by fire - No Action	10^{-4} to 10^{-2}	7.89×10^{-3}	4.73×10^{-6}	2.60	1.56×10^{-3}	6.27×10^{-1}	3.76×10^{-4}	5.50×10^{-1}	3.30×10^{-4}
	Depleted uranium release by fire - Proposed Action	10^{-4} to 10^{-2}	Same	Same	Same	Same	Same	Same	Same	Same

TABLE D.2.5–2.—*Potential Accident Frequency and Consequences (Unfavorable Meteorology) (continued)*[a]

			MEI		Offsite Population[b]		Individual Noninvolved Worker		Noninvolved Worker Population	
Building	**Accident**	**Frequency (per year)**	**Dose (rem)**	**LCFs[c]**	**Dose (person-rem)**	**LCFs[d]**	**Dose (rem)**	**LCFs[c]**	**Dose (person-rem)**	**LCFs[d]**
Onsite Transportation	Radioactive and Hazardous Waste Management package explosion - No Action	$< 1.00 \times 10^{-6}$	7.73	4.64×10^{-3}	2.26×10^{2}	1.36×10^{-1}	1.43×10^{1}	8.58×10^{-3}	2.96×10^{2}	1.78×10^{-1}
	Radioactive and Hazardous Waste Management package explosion - Proposed Action	$< 1.00 \times 10^{-6}$	1.03×10^{1}	6.18×10^{-3}	3.01×10^{2}	1.81×10^{-1}	1.91×10^{1}	1.15×10^{-2}	3.94×10^{2}	2.36×10^{-1}
	Radioactive and Hazardous Waste Management Truck Fire - No Action	$<1.00 \times 10^{-6}$	3.13	1.88×10^{-3}	8.10×10^{2}	4.86×10^{-1}	6.00	3.60×10^{-3}	5.53×10^{2}	3.32×10^{-1}
	Radioactive and Hazardous Waste Management Truck Fire - Proposed Action	$<1.00 \times 10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same
	Materials Management Section package explosion - No Action	$< 1.00 \times 10^{-6}$	2.76	1.66×10^{-3}	6.50×10^{2}	3.90×10^{-1}	5.32×10^{1}	3.19×10^{-2}	1.02×10^{3}	6.12×10^{-1}
	Materials Management Section package explosion - Proposed Action	$< 1.00 \times 10^{-6}$	Same	Same	Same	Same	Same	Same	Same	Same

Source: Original.
[a] The consequences for the Reduced Operation Alternative would be the same as for the No Action Alternative.
[b] Based on the population of approximately 6,900,000 persons residing within 50 miles of LLNL.
[c] Increased likelihood of a LCF .
[d] Increased number of LCFs.
LCF = latent cancer fatality.

Involved Worker Impacts

Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location. For all of the accidents, there is a potential for injury or death to involved workers in the vicinity of the accident. However, prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident location and the worker decreases. This is because the individual worker exposure cannot be precisely defined with respect to the presence of shielding and other protective features. The worker also may be injured or killed by physical effects of the accident itself.

The facility ventilation system would control dispersal of the airborne radiological debris from the accident. Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional radiological injury.

The bounding case radiological accident for involved workers is a plutonium criticality for a powder, slurry, or solution system in a workstation in Building 332. Severe worker exposures could occur inside the facility as a result of a criticality, due primarily to the effects of prompt neutrons and gammas. A criticality would be detected by the criticality alarm system, and an evacuation alarm would sound. All personnel would immediately evacuate the building.

Personnel close to the criticality event within the building may incur prompt external exposures. Depending on distance and the amount of intervening shielding material, lethal doses composed of neutron and gamma radiation could be delivered. The dose due to prompt gamma and neutron radiation at a distance can be evaluated by the following formulas:

Prompt gamma dose: $D_g = 2.1 \times 10^{-20}\ N\ d^{-2}\ \exp^{-3.4d}$

Prompt neutron dose: $D_n = 7.0 \times 10^{-20}\ N\ d^{-2}\ \exp^{-5.2d}$

Where:

D_g = gamma dose (rem)

D_n = neutron dose (rem) (neutron quality factor = 20)

N = number of fissions

d = distance from source (km)

At a distance of 10 meters, the combined prompt gamma and neutron radiation dose to personnel from a criticality in a powder, solution, or slurry of uranium or plutonium (1×10^{18} fissions) would be 867 rem (D_g = 203 rem plus D_n = 664 rem), which is greater than the average lethal radiation dose to humans of approximately 450 rem. Thus, the potential for lethal exposure exists. On average, there could be two workers in a room who could be exposed to this radiation.

In Building 332, the laboratory interior walls are a minimum of 8 inches of concrete. These walls provide substantial shielding, except through the doors. In the event of a criticality, this shielding and rapid evacuation from the laboratories would reduce doses to personnel not in the immediate vicinity of the criticality excursion.

Direct exposure to airborne fission products produced during the criticality event would contribute only a small fraction to the total worker dose to a worker. Because of ventilation system operation, other personnel inside the building would not likely incur radiation dose resulting from the inhalation of airborne radioactive materials or immersion in the plume. If the ventilation system were unavailable, this dose would be small in comparison to the direct dose received at the time of the burst. The worker immediately involved would act appropriately according to training and emergency procedures.

D.2.6 Assessment of Accident Risks for Lawrence Livermore National Laboratory Facilities

In this section, NNSA considers the consequence of an event with the probability that it will occur. This combination is referred to as the "risk." The risk is expressed mathematically as the product of the consequence and its probability. In illustration, if the expected public consequence of an accident at a particular facility is one LCF per accident, and if the accident has a probability of occurring once during a period of 1,000 years, then the continuing risk presented by that accident is (1 × 1/1,000) or 0.001 excess LCFs per year.

Tables D.2.6–1 and D.2.6–2 show the frequency and risk of the postulated set of LLNL facility accidents (shown in Tables D.2.5–1 and D.2.5–2) for a noninvolved worker (assumed to be a worker located 100 meters from the release point), the population of noninvolved workers, and the public (offsite MEI and the general population living within 50 miles of LLNL) for both median and unfavorable meteorological conditions.

TABLE D.2.6–1.—*Annual Cancer Risks from Accidents (Median Meteorology)*[a]

		MEI	Offsite Population[b]	Individual Noninvolved Worker	Noninvolved Worker Population
Building	**Accident**	**LCFs (per year)[c]**	**LCFs (per year)[d]**	**LCFs (per year)[c]**	**LCFs (per year)[d]**
Building 191	Radioactive material dispersion from a spill and fire - No Action	1.99×10^{-14}	2.82×10^{-12}	4.34×10^{-14}	5.83×10^{-12}
	Radioactive material dispersion from a spill and fire - Proposed Action	Same	Same	Same	Same
Building 194	Design-basis earthquake and fire - No Action	5.20×10^{-12}	1.34×10^{-9}	2.06×10^{-11}	3.50×10^{-9}
	Design-basis earthquake and fire- Proposed Action	Same	Same	Same	Same
Building 239	Uncontrolled oxidation of plutonium at elevated temperature - No Action	4.67×10^{-12}	1.75×10^{-9}	6.67×10^{-11}	6.99×10^{-9}
	Uncontrolled oxidation of plutonium at elevated temperature - Proposed Action	Same	Same	Same	Same
Building 251	Evaluation basis fire - No Action	3.61×10^{-9}	1.13×10^{-6}	3.42×10^{-8}	4.96×10^{-6}
	Evaluation basis fire - Proposed Action	Same	Same	Same	Same
Building 331	Plutonium Metal Fire - No Action	3.01×10^{-10}	1.43×10^{-7}	3.84×10^{-9}	5.37×10^{-7}
	Aircraft crash with subsequent fire - Proposed Action	1.50×10^{-10}	1.04×10^{-7}	1.94×10^{-9}	2.51×10^{-7}
Building 332	Aircraft Crash - No Action	4.30×10^{-10}	2.83×10^{-7}	5.37×10^{-9}	9.27×10^{-7}
	Room Fire Unfiltered - Proposed Action	6.87×10^{-11}	4.36×10^{-8}	7.70×10^{-8}	1.45×10^{-7}

TABLE D.2.6–1.—*Annual Cancer Risks from Accidents (Median Meteorology)*[a] *(continued)*

Building	Accident	MEI LCFs (per year) [c]	Offsite Population[b] LCFs (per year) [d]	Individual Noninvolved Worker LCFs (per year) [c]	Noninvolved Worker Population LCFs (per year) [d]
Building 334	Uncontrolled oxidation of plutonium at elevated temperatures - No Action	9.84×10^{-11}	4.08×10^{-8}	1.95×10^{-9}	1.39×10^{-7}
	Uncontrolled oxidation of plutonium at elevated temperatures - Proposed Action	Same	Same	Same	Same
Building 625	Aircraft Crash - No Action	8.74×10^{-11}	2.42×10^{-7}	2.37×10^{-10}	1.11×10^{-8}
	Aircraft Crash - Proposed Action	2.66×10^{-10}	7.38×10^{-7}	7.22×10^{-10}	3.38×10^{-8}
Building 581	Earthquake - No Action	5.74×10^{-15}	2.35×10^{-12}	1.72×10^{-14}	2.50×10^{-12}
	Earthquake during plutonium experiment without yield - Proposed Action	1.98×10^{-15}	6.55×10^{-13}	5.99×10^{-15}	8.90×10^{-13}
Building 696R	Aircraft Crash - No Action	3.25×10^{-10}	4.85×10^{-7}	5.24×10^{-10}	3.15×10^{-8}
	Aircraft Crash - Proposed Action	Same	Same	Same	Same
Site 300 Materials Management Facilities	Depleted uranium release by fire - No Action	2.36×10^{-10}	2.29×10^{-7}	2.36×10^{-8}	5.65×10^{-8}
	Depleted uranium release by fire - Proposed Action	Same	Same	Same	Same

TABLE D.2.6–1.—*Annual Cancer Risks from Accidents (Median Meteorology)[a] (continued)*

Building	Accident	MEI LCFs (per year) [c]	Offsite Population[b] LCFs (per year) [d]	Individual Noninvolved Worker LCFs (per year) [c]	Noninvolved Worker Population LCFs (per year) [d]
Onsite Transportation	Radioactive and Hazardous Waste Management package explosion - No Action	2.48×10^{-10}	8.76×10^{-9}	5.18×10^{-10}	4.13×10^{-8}
	Radioactive and Hazardous Waste Management package explosion - Proposed Action	3.30×10^{-10}	1.17×10^{-8}	6.90×10^{-10}	5.50×10^{-8}
	Radioactive and Hazardous Waste Management Truck Fire - No Action	6.54×10^{-11}	6.06×10^{-8}	2.10×10^{-10}	4.42×10^{-8}
	Radioactive and Hazardous Waste Management Truck Fire - Proposed Action	Same	Same	Same	Same
	Materials Management Section package explosion - No Action	6.96×10^{-11}	2.41×10^{-8}	1.67×10^{-9}	1.03×10^{-7}
	Materials Management Section package explosion - Proposed Action	Same	Same	Same	Same

Source: Original.
[a] The risk for the Reduced Operation Alternative would be the same as for the No Action Alternative.
[b] Based on the population of approximately 6,900,000 persons residing within 50 miles of LLNL.
[c] Increased likelihood of a LCF .
[d] Increased number of LCFs.
MEI = maximally exposed individual.
LCF = latent cancer fatality.

TABLE D.2.6–2.—*Annual Cancer Risks from Accidents (Unfavorable Meteorology)*[a]

		MEI	Offsite Population[b]	Individual Noninvolved Worker	Noninvolved Worker Population
Building	**Accident**	**LCFs (per year)** [c]	**LCFs (per year)** [d]	**LCFs (per year)** [c]	**LCFs (per year)** [d]
Building 191	Radioactive material dispersion from a spill and fire - No Action	2.55×10^{-13}	2.52×10^{-11}	4.28×10^{-13}	4.18×10^{-11}
	Radioactive material dispersion from a spill and fire - Proposed Action	Same	Same	Same	Same
Building 194	Design-basis earthquake and fire - No Action	7.80×10^{-11}	1.09×10^{-8}	1.98×10^{-10}	2.08×10^{-8}
	Design-basis earthquake and fire- Proposed Action	Same	Same	Same	Same
Building 239	Uncontrolled oxidation of plutonium at elevated temperature - No Action	9.94×10^{-11}	2.75×10^{-8}	8.02×10^{-10}	5.45×10^{-8}
	Uncontrolled oxidation of plutonium at elevated temperature - Proposed Action	Same	Same	Same	Same
Building 251	Evaluation basis fire - No Action	7.10×10^{-8}	7.34×10^{-6}	3.88×10^{-7}	2.71×10^{-5}
	Evaluation basis fire - Proposed Action	Same	Same	Same	Same
Building 331	Plutonium Metal Fire - No Action	5.99×10^{-9}	2.31×10^{-6}	4.51×10^{-8}	4.02×10^{-6}
	Aircraft crash with subsequent fire - Proposed Action	3.49×10^{-10}	1.68×10^{-7}	2.73×10^{-9}	2.20×10^{-7}
Building 332	Aircraft Crash - No Action	8.43×10^{-9}	3.47×10^{-6}	6.88×10^{-8}	7.38×10^{-6}
	Room Fire Unfiltered - Proposed Action	1.31×10^{-9}	5.08×10^{-7}	6.96×10^{-9}	1.22×10^{-6}

TABLE D.2.6–2.—*Annual Cancer Risks from Accidents (Unfavorable Meteorology)*[a] *(continued)*

Building	Accident	MEI LCFs (per year) [c]	Offsite Population[b] LCFs (per year) [d]	Individual Noninvolved Worker LCFs (per year) [c]	Noninvolved Worker Population LCFs (per year) [d]
Building 334	Uncontrolled oxidation of plutonium at elevated temperatures - No Action	2.21×10^{-9}	6.18×10^{-7}	2.63×10^{-8}	1.25×10^{-6}
	Uncontrolled oxidation of plutonium at elevated temperatures - Proposed Action	Same	Same	Same	Same
Building 581	Earthquake - No Action	7.38×10^{-14}	3.66×10^{-11}	1.60×10^{-13}	2.66×10^{-11}
	Earthquake during plutonium experiment without yield - Proposed Action	2.60×10^{-14}	1.00×10^{-11}	5.63×10^{-14}	9.88×10^{-12}
Building 625	Aircraft Crash - No Action	2.78×10^{-9}	2.12×10^{-6}	9.90×10^{-9}	2.36×10^{-7}
	Aircraft Crash - Proposed Action	8.45×10^{-9}	6.46×10^{-6}	3.01×10^{-8}	7.17×10^{-7}
Building 696R	Aircraft Crash - No Action	6.25×10^{-9}	4.01×10^{-6}	8.17×10^{-9}	6.53×10^{-7}
	Aircraft Crash - Proposed Action	Same	Same	Same	Same
Site 300 Materials Management Facilities	Depleted uranium release by fire - No Action	4.73×10^{-9}	1.56×10^{-6}	3.76×10^{-7}	3.30×10^{-7}
	Depleted uranium release by fire - Proposed Action	Same	Same	Same	Same

TABLE D.2.6–2.—*Annual Cancer Risks from Accidents (Unfavorable Meteorology)[a] (continued)*

Building	Accident	MEI LCFs (per year) [c]	Offsite Population[b] LCFs (per year) [d]	Individual Noninvolved Worker LCFs (per year) [c]	Noninvolved Worker Population LCFs (per year) [d]
Onsite Transportation	Radioactive and Hazardous Waste Management package explosion - No Action	4.64×10^{-9}	1.36×10^{-7}	8.58×10^{-9}	1.78×10^{-7}
	Radioactive and Hazardous Waste Management package explosion - Proposed Action	6.18×10^{-9}	1.81×10^{-7}	1.15×10^{-8}	2.36×10^{-7}
	Radioactive and Hazardous Waste Management Truck Fire - No Action	1.88×10^{-9}	4.86×10^{-7}	3.60×10^{-9}	3.32×10^{-7}
	Radioactive and Hazardous Waste Management Truck Fire - Proposed Action	Same	Same	Same	Same
	Materials Management Section package explosion - No Action	1.66×10^{-9}	3.90×10^{-7}	3.19×10^{-8}	6.12×10^{-7}
	Materials Management Section package explosion - Proposed Action	Same	Same	Same	Same

Source: Original.
[a] The risk for the Reduced Operation Alternative would be the same as for the No Action Alternative.
[b] Based on the population of approximately 6,900,000 persons residing within 50 miles of LLNL.
[c] Increased likelihood of a LCF .
[d] Increased number of LCFs.
MEI = maximally exposed individual.
LCF = latent cancer fatality.

D.3 ACCIDENT SCENARIOS INVOLVING TOXIC CHEMICALS

This section analyzes postulated accidents that could result in chemical releases. This section presents accident scenarios and source terms, selects bounding scenarios for each facility, and presents consequences.

D.3.1 Consequence Analysis

Consequences of accidental chemical releases were determined using the ALOHA computer code (EPA 1999). ALOHA is a U.S. Environmental Protection Agency (EPA)/National Oceanic and Atmospheric Administration (NOAA)-sponsored computer code that has been widely used in support of chemical accident responses and also in support of safety and NEPA documentation for DOE facilities.

The ALOHA code is a deterministic representation of atmospheric releases of toxic and hazardous chemicals. The code can predict the rate at which chemical vapors escape (e.g., from puddles or leaking tanks) into the atmosphere; a specified release rate is also an option. In the case of this LLNL SW/SPEIS, the chemical release rates were determined as part of the scenario development.

Either of two dispersion algorithms are applied by the code, depending on whether the release is neutrally buoyant or heavier than air. The former is modeled similarly to radioactive releases in that the plume is assumed to move with the wind velocity. The latter considers the initial slumping and spreading of the release because of its density. As a heavier than air release becomes more dilute, its behavior tends towards that of a neutrally buoyant release.

The ALOHA code uses a constant set of meteorological conditions (e.g., wind speed, stability class) to determine the downwind atmospheric concentrations. The same meteorological conditions used for the MACCS2 modeling of radiological releases were also used for the ALOHA modeling.

ALOHA contains physical and toxicological properties for approximately 1,000 chemicals. The physical properties were used to determine which of the dispersion models and accompanying parameters were applied. The toxicological properties were used to determine the levels of concern. Atmospheric concentrations at which health effects are of concern were used to define the footprint of concern. Because the meteorological conditions specified do not account for wind direction (i.e., it is not known *a priori* in which direction the wind would be blowing in the event of an accident), the areas of concern are defined by a circle of radius equivalent to the downwind distance at which the concentration decreases to levels less than the level of concern. The fraction of the area of concern actually exposed to the concentration of concern (footprint area/circle area) was noted.

The calculated concentrations were then compared to emergency response planning guidelines (ERPGs). These ERPGs are intended to provide estimates of concentration ranges at which adverse effects can be expected if exposure to a specified chemical lasts more than 1 hour. The ERPG levels are defined as follows:

- ERPG-1—The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor.

- ERPG-2—The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

- ERPG-3—The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

If a chemical did not have published ERPG values, the Temporary Emergency Exposure Limits (TEELs) were used. The TEELs were developed by the DOE Subcommittee on Consequences Assessment and Protective Actions for chemicals where ERPG values are not available and serve as temporary guidance until ERPGs can be developed.

D.3.2 Description of Accident Scenarios

The next step was to identify potential accident scenarios and source terms (release rates and frequencies) associated with the facilities identified in Section D.2.1. Table D.3.2–1 lists the results of this process and contains the accident name, its frequency, the source term, the source document from which this information was obtained, and any other notes or assumptions related to the accident scenario. The source terms presented in Table D.3.2–1 apply to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS.

From the listing of accidents in Table D.3.2–1, the next step was to perform ALOHA calculations (as described in Section D.3.1) to identify the accidents that present the highest public or worker consequence for each facility (i.e., the "bounding" accidents). These accident scenarios are discussed further following Table D.3.2–1.

TABLE D.3.2–1.—*Potential Chemical Accidents*

Accident	Frequency (per year)	Source Term or Hazard
190, Multi-User Tandem Laboratory [a]		
Oxygen deficiency and exposure to SF_6	10^{-6} to 10^{-4}	Severe injury or death to worker or workers who enter into oxygen-deficient environment (pressure vessel or trench) caused by SF_6 release. No impacts on other site personnel or the offsite population.
191, High Explosives Application Facility [b]		
Chemical dispersion	10^{-4} to 10^{-2}	0.002 lb 1,2-dibromoethane 0.1 lb 1,2-dichloroethane 0.015 lb captan 0.125 lb xylene 0.065 lb carbon tetrachloride 0.075 lb chloroform 0.025 lb benzene

TABLE D.3.2–1.—*Potential Chemical Accidents (continued)*

Accident	Frequency (per year)	Source Term or Hazard
194, 100-MeV Electron-Positron LINAC Facility[c]		
Exposure to toxic gases	10^{-2} to 10^{-1}	Accidental exposure of facility workers to high concentrations of ozone or NO_x. Concentrations could cause respiratory damage or other injury. There would be no risk to the public or the environment.
Dispersal of toxic materials by fire	10^{-4} to 10^{-2}	0.1 g of lead is oxidized and dispersed
235, 4-MeV Ion Accelerator[d]		
Slow release of SF_6 gas	10^{-6} to 10^{-4}	Severe injury or death to facility workers who may be exposed to SF_6 gas. Minor risk to the public or the environment.
Sudden release of SF_6 gas	10^{-6} to 10^{-4}	Severe injury or death to facility workers who may be exposed to SF_6 gas. Peak SF_6 concentrations outside the facility of less than 1,000 ppm approximately 15 minutes after release; mean exposure level for 10 minutes is about 500 ppm.
SF_6 leak into acceleration tube	10^{-6} to 10^{-4}	Severe injury or death to facility workers who may be exposed to SF_6 gas. Minor risk to the public or the environment.
239, Radiography Facility[e]		
Fire involving lithium hydride	$<\sim10^{-5}$	48 g LiOH
Fire involving beryllium component	$<\sim10^{-5}$	5 g Be
Impact involving BeO component	$<\sim10^{-5}$	2.5 g BeO
Toxic gas release (NO_2)	$<\sim10^{-5}$	10,000 g NO_2
322, Plating Shop		
Single-container powder free-fall spill	NR	6.12×10^{-2} lb chromic trioxide
Single-container liquid spill	NR	100 lb nitric acid
Multiple-container liquid spill	NR	100 lb hydrofluoric acid
Mixing of incompatible liquids	NR	675 g hydrogen cyanide gas
Earthquake	NR	5,800 g hydrogen cyanide gas
331, Tritium Facility Actinide Activities		
Nitric acid spill	NR	38 L nitric acid solution
332, Plutonium Facility[f]		
Unmitigated chlorine rupture	5.7×10^{-7}	100 lb chlorine gas
Unmitigated chlorine rupture	5.7×10^{-7}	40 lb chlorine gas
Unmitigated hydrogen chlorine rupture	5.7×10^{-7}	55 lb hydrogen chloride gas
334, Hardened Engineering Test Building[g]		
Fire involving LiH component (unmitigated)	$<\sim10^{-5}$	192 g LiOH
Fire involving LiH component (mitigated)	$<\sim10^{-5}$	0.192 g LiOH
Fire involving Be component (unmitigated)	$<\sim10^{-5}$	40 g BeO
Fire involving Be component (mitigated)	$<\sim10^{-5}$	0.04 g BeO
Impact involving BeO component (unmitigated)	$<\sim10^{-5}$	20 g BeO
Impact involving BeO component (mitigated)	$<\sim10^{-5}$	0.20 g BeO

TABLE D.3.2–1.—*Potential Chemical Accidents (continued)*

Accident	Frequency (per year)	Source Term or Hazard
Impact involving BeO component (mitigated)	$<\sim 10^{-5}$	0.20 g BeO
Toxic gas release	$<\sim 10^{-5}$	40,000 g NO_2
514/612/625/693, Radioactive and Hazardous Waste Management Complex[h]		
Earthquake	10^{-4} to 10^{-2}	422 lb Freon-22 (chlorodifluoromethane)
Leaks and spills	10^{-4} to 10^{-2}	550.8 lb hydrogen peroxide (at 0.28 g/sec) 826.2 lb sulfuric acid (at 0.01 g/sec) 688.5 lb sodium hydroxide (at 0.0087 g/sec) 741 lb ferric sulfate (at 0.0093 g/sec) 422 lb Freon-22 (chlorodifluoromethane)
Pressurized releases	10^{-4} to 10^{-2}	550.8 lb hydrogen peroxide (at 0.0069 g/sec) 826.2 lb sulfuric acid (at 0.01 g/sec) 688.5 lb sodium hydroxide (at 0.0087 g/sec) 741 lb ferric sulfate (at 0.0093 g/sec) 422 lb Freon-22 (chlorodifluoromethane)
581, National Ignition Facility		
Materials spill	NA	210 L acetone 400 L nitric acid solution (70%)
Mercury release from ignitrons	NA	9.8 g mercury
Earthquake	2×10^{-8}	0.13 g LiH 0.2 g beryllium 0.45 g thorium 0.1 g uranium
Site 300 Materials Management Facilities[i]		
Inadvertent exposure to hazardous materials	10^{-4} to 10^{-2}	Exposure to isopropanol (inside a room) at concentrations of up to 860 ppm
Hazardous materials release by fire	10^{-4} to 10^{-2}	1,100 g LiOH
Site 300 Explosive Waste Treatment Facility[j]		
Fire	$<10^{-1}$	16.5 kg hydrogen fluoride
Explosion	$<10^{-1}$	0.66 kg hydrogen fluoride (released at ground level) 2.64 kg hydrogen fluoride (released at 69 meters)
Site 300 B-Division Firing Areas[i]		
Toxic gas/hazardous material exposure outside firing chamber in contained firing facility	10^{-6} to 10^{-4}	Serious injury or death to personnel who might be sufficiently exposed to these hazardous gases or materials.
Exposure of personnel upon re-entry into firing chamber to oxygen deficient and toxic atmospheres (contained firing facility only)	10^{-6} to 10^{-4}	Personnel might be exposed to hydrogen fluoride and hydrochloric acid levels that are high enough to create irreversible health effects and possibly death.

Source:
[a] LLNL 2000ad.
[b] LLNL n.d.
[c] LLNL 2002cq.
[d] LLNL 2000d.
[e] LLNL 2002ac.
[f] LLNL 2002r, LLNL 2002af.
[g] LLNL 2002s.
[h] LLNL 2000t.
[i] LLNL 2002l.
[j] LLNL 2001ax.
Be = Beryllium; BeO = Beryllum oxide; LiH = Lithium hydride; LiOH = Lithium hydroxide; LINAC = Linear accelerator; NA = Not available; NO_2 = Nitrogen dioxide; NR = Not reported; ppm = parts per million; SF_6 = sulfur hexafluoride; NO_x = oxides of nitrogen.

D.3.2.1 *Building 190, Multi-User Tandem Laboratory—Oxygen Deficiency and Exposure to Sulfur Hexafluoride*

Approximately 30,000 cubic feet of sulfur hexafluoride gas is used in the operation of the various accelerators in Building 190. The accelerator pressure vessels and their associated gas handling systems are essentially leak-tight. However, there is the potential, under extreme fire scenarios or seismic conditions, for the pressure vessels to rupture or leak.

Although sulfur hexafluoride gas is considered to be nontoxic, it is an odorless, colorless asphyxiant, which is heavier than air and will completely exclude oxygen from whatever volume it occupies. In the event of a catastrophic breach of the accelerator vessels, there is sufficient gas to fill the Building 190 trench (16,000 cubic feet) and floor of the facility to a depth of 14 inches and create a potential asphyxiation hazard. Besides displacing oxygen and creating an oxygen deficient space, several decomposition products can be formed if arcing of corona discharge occurs in sulfur hexafluoride in the presence of air and water vapor. Decomposition products may include SOF_2, SO_2, F_2, SOF_4, HF, SO_2F_2, SF_4, and S_2F_{10}. The latter in particular is highly toxic. Many of the decomposition products are highly reactive and react with metal parts to form metal fluorides that are irritating to both the respiratory system and exposed skin.

The consequence to workers of an accident resulting from entering an oxygen deficient space is high (may cause death); however, through extensive administrative controls and the installed gas monitoring system, the probability of this accident occurring is extremely low (10^{-6} to 10^{-4} per year).

D.3.2.2 *Building 191, High Explosives Application Facility—Chemical Dispersion (1,2-Dichloroethane)*

The HEAF, Building 191, uses numerous chemicals in energetic materials research and development work. For a chemical dispersion outside the facility to occur, certain toxic gases, such as dichloroethane or chloroform, would have to be used in conjunction with energetic materials near a ventilation system that exhausts to the outside. The worst-case scenario is using a chemical in a fume hood and having an energetic reaction occur in the hood, which then drives the material out of the ventilation system. The selection of an energetic reaction rather than specifying a detonation is deliberate, as a detonation is likely to result in greater dispersion, thermal flux, and buoyancy, and thus lesser consequences.

Chemistry operations that may result in an undesired or unexpected energetic reaction are peer-reviewed to ensure that the desired results will be obtained. At least three people are involved in these reviews. The use of materials that could cause an exposure hazard outside the facility in proximity to one of these experiments would involve some type of human error. Therefore, this scenario is considered unlikely. This bounding scenario involves an inventory of 1,2-dichloroethane in Building 191, which is 100 pounds. The airborne release fraction for this material is 0.001. Therefore, there would be a total of 0.1 pound of this material released to the environment in this event. The frequency of this event is 10^{-4} to 10^{-2} per year.

D.3.2.3 *Building 194, 100-MeV Electron-Positron LINAC Facility—Exposure to Toxic Gases*

A ventilation failure could result in accidental exposure to high concentrations of ozone and oxides of nitrogen. The worst-case situation would involve either a failure of the 0° Cave exhaust fan, or an improperly closed damper to restrict the ventilation rate. Ozone and oxides of nitrogen could build up to approximately 18 parts per million ozone and 80 parts per million oxides of nitrogen. These levels significantly exceed the National Institute of Occupational Safety and Health-recommended immediately dangerous to life or health values of 10 parts per million ozone and 20 parts per million nitrogen dioxide, though not the immediately dangerous to life or health of 100 parts per million for nitrous oxide. No significant decrease in the concentrations would occur during the 10 minutes vent time allowed for exhausting the gases after the assumed continuous ventilation mode operation. If a worker entered the 0° Cave, the worker could potentially be overcome by the fumes. The air concentrations of ozone and oxides of nitrogen would decrease over several minutes to below immediately dangerous to life or health levels by diffusion into the rest of the belowground complex. Exposure to high levels of ozone could cause respiratory damage or other injury if the worker fails to retreat when the ozone odor is detected.

If the 0° Cave exhaust failed, but the supply fan continued to operate, the 0° Cave would have positive pressure with respect to the surrounding caves. In that situation, the ozone concentration in the 0° Cave was estimated to be approximately 60 parts per million. This could result in an increase in the ozone level in the corridor up to approximately 0.06 parts per million. Under nominal target configurations, a somewhat smaller rise in the corridor ozone concentration would be expected; however, the concentration in normally occupied areas could readily exceed the recommended 8-hour threshold limit values (TLV®) time-weighted average of 0.05 parts per million. Although the resulting odor should be detectable by most people, it is plausible that workers that remain underground could be exposed to levels between 0.05 and 0.1 parts per million for long periods. The potential for respiratory irritation exists, but it would not cause irreversible damage.

Ventilation failures leading to toxic gas exposure can affect facility workers only. The release rate of ozone and oxides of nitrogen is not increased, and the concentrations aboveground remain 10 to 100 times below ambient levels. There is no impact on receptors outside the facility or on the environment. The frequency of this event is 10^{-2} to 10^{-1} per year.

D.3.2.4 *Building 235, 4-MeV Ion Accelerator—Sudden Release of Sulfur Hexafluoride Gas*

About 2,500 pounds of sulfur hexafluoride gas is put into the accelerator tank to pressurize it to about 85 pounds per square inch gauge. Sulfur hexafluoride itself is an inert, nontoxic gas that, in large quantities, can displace oxygen and create an asphyxiation hazard. A sudden release of sulfur hexafluoride gas could occur as a result of rupture of one of the two tanks or the gas-handling system or associated piping. This release would allow the entire mass of heavy gas to flow along the ground with little mixing into the air. The release of the total amount of sulfur hexafluoride gas from the accelerator tank or other parts of the gas-handling system inside the enclosure could fill the entire enclosure (up to near the top of the 9-foot-high wall) with pure sulfur hexafluoride gas at atmospheric pressure, assuming all doors to the enclosure are closed and neglecting losses. The frequency of this event is 10^{-6} to 10^{-4} per year.

An alarmed oxygen sensor is installed about 1 foot above the floor to continuously monitor the oxygen level near the floor of the enclosure. There are two levels of alarm: "Caution" at a reading of 19.5 percent O_2 and "Danger" at 18 percent O_2. If the alarm ever indicates to either level, all personnel would immediately leave the enclosure (closing the east door on their way out) and the main laboratory part of the room. The tripping of the alarm at the danger level would automatically summon help from the LLNL Fire Department.

D.3.2.5 *Building 239, Radiography Facility––Toxic Gas Release, Nitrogen Dioxide*

Containers or items containing other hazardous material may be brought into this facility about twice a month for radiography or computed tomography and may be an integral part of an assembly. Hazardous components brought into the facility for radiography or computed tomography are shipped out upon completion of the work. This accident scenario would result in a release of toxic gas. The item is removed from the shipping container and placed on a table for radiography. While being removed, the item is rammed with a forklift, dropped while being carried by hand or overhead crane, or crushed due to failure of the overhead crane. The protective barrier is damaged. A fire could be initiated as a result of combustion of other materials (or of the material itself), burning the entire contents, or the impact could cause a release of the material into the air. The released material mixes with building air and is exhausted unfiltered from the ventilation system.

The bounding scenario involves the maximum amount of hazardous material that may be brought into the building for radiography, which is limited to no more than what could otherwise result in a release of 10 kilograms of airborne material. Therefore, this scenario conservatively assumes the release of the maximum allowable amount of 10,000 grams of nitrogen dioxide. The frequency of this event is less than 10^{-5} per year.

D.3.2.6 *Building 322, Metal Finishing Facility – Multiple Container Liquid Spill*

Multiple containers of liquid chemical material being delivered by forklift or by hand are postulated to be spilled during handling. It is assumed that the entire contents of the containers would spill instantaneously and spread to a depth of 1 millimeter on smooth surfaces. No credit was taken for building holdup or plateout. The respirable fraction, damage ratio, and leak path factor were all conservatively assumed to be unity.

The bounding scenario for aqueous liquids was determined to be hydrofluoric acid. The facility inventory of hydrofluoric acid is 100 pounds. It was assumed that two containers, each containing 50 gallons of hydrofluoric acid, are involved in this scenario.

Transfers within the facility, from a storage container to a process tank, involve lesser amounts. In addition, spills within the facility would have a small leak path factor, increasing the conservatism. The primary consequences of a smaller liquid spill in the facility would be an increase in exposure of facility workers.

This chemical release scenario also bounds potential accidents from Chemistry and Materials Science Facilities.

D.3.2.7 *Building 331, Tritium Facility Actinide Activities—Nitric Acid Spill*

Chemicals would be used for miscellaneous cleaning and decontamination activities throughout Building 331. An anticipated scenario that might occur is a spill of decontamination solution onto the ground outside the facility, possibly caused by a forklift during handling or movement.

Projected inventories of chemicals at Building 331 were evaluated on the basis of the amount of MAR, exposure criteria, and volatility. Nitric acid was selected as the bounding scenario for consequence analysis. A maximum quantity of 10 gallons (38 liters) of nitric acid would be used in the facility at any one time. This maximum quantity was used as the source term for this event.

D.3.2.8 *Building 332, Plutonium Facility—Chlorine Release*

A chlorination operation is performed in furnaces housed in a glovebox. This operation uses either a 100-pound or 40-pound chlorine gas cylinder or a 55-pound hydrogen chloride cylinder. During the operation, a chlorine gas cylinder or a hydrogen chloride cylinder is installed in a ventilated toxic-gas cabinet located outside the building. The gas cabinet is monitored for both chlorine and hydrogen chloride. The delivery line inside the gas cabinet has an excess flow shutoff valve and an emergency shutoff valve located near the cylinder head.

A release of chlorine or hydrogen chloride has been evaluated. A potential cause of such an event could be the failure of various system components. The potential release paths include pipe ruptures in four different piping sections or leaks from the chlorine cylinder and the two valves in the system. These contributors to the release potential were considered. It was assumed that any leak inside the gas cabinet would be detected and mitigated in time. Unless the gas cylinder valve fails catastrophically, the safety features associated with the toxic-gas installation would allow only a very small release of toxic gas under any abnormal conditions. A more severe release could result if these features, or combinations of these features, failed to function.

A source term was developed for the unmitigated release from the apparatus. An unmitigated release of chlorine or hydrogen chloride through a small orifice, 0.18 inch in diameter (corresponding to the internal diameter of the piping used [0.25-inch outer-diameter]) or a small hole in the cylinder, was examined. The source terms for the bounding scenario were developed by assuming that the chlorine gas was released through 0.25-inch outer-diameter tubing directly into the atmosphere. No credit was taken for the flow-restricting device, whose size is much smaller than 0.25 inch. The frequency of this event is 5.7×10^{-7} per year.

D.3.2.9 *Building 334, Hardened Engineering Test Building—Toxic Gas Release, Nitrogen Dioxide*

Containers or items containing other hazardous material may be brought into the facility about twice a month for testing or measurement. These components are shipped out of the facility upon completion of the work. This accident scenario would result in a release of toxic gas. The item is removed from the shipping container and placed on a table for test or measurement. While being removed, the item is rammed with a forklift, dropped while being carried by hand or overhead crane, or crushed due to failure of the overhead crane. The protective barrier is damaged. A fire could be initiated as a result of combustion of other materials (or of the material itself), burning the entire contents, or the impact could cause a release of the material into the air. The released material mixes with building air and is exhausted from the ventilation system.

The bounding scenario involves the maximum amount of hazardous material that may be brought into the building for test or measurement and is limited to no more than what could otherwise result in a release of 40 kilograms of airborne material. Therefore, this scenario conservatively assumes the release of the maximum allowable amount of 40,000 grams of nitrogen dioxide. The frequency of this event is less than 10^{-5} per year.

D.3.2.10 *Buildings 514/612/625/693, Radioactive and Hazardous Waste Management Complex—Earthquake Release of Freon-22*

Process reagents in this facility include sulfuric acid, hydrogen peroxide, ferric sulfate, and sodium hydroxide. These chemicals are presently stored in 55-gallon drums. It is assumed that these drums are stored in buildings that can withstand the design-basis earthquake. Therefore, no releases of reagents are assumed for this scenario.

The cold vapor evaporator contains 900 pounds of chlorodifluoromethane (Freon-22) as the refrigerant. It is assumed that during a design-basis earthquake, the pipes would break resulting in a release of approximately 422 pounds of Freon-22. This value was calculated assuming that one of the 2-inch copper pipes leading to the external condenser would be completely severed. Under this circumstance, the cold vapor evaporation unit would immediately lose vacuum and the compressor would automatically enter failure mode and cease functions due to the sudden loss of oil pressure resulting form the rapid release of Freon-22. This bounding scenario assumes that all of the Freon-22 in the system from the discharge side of the compressor up to and including any Freon-22 collected in the external condenser would be discharged to the atmosphere as an instantaneous release. No further Freon-22 releases would occur once the compressor stops since the compressor is a sealed unit that will not allow the passage or release of any additional Freon-22 once it has stopped.

D.3.2.11 *Building 581, National Ignition Facility—Materials Spill, Nitric Acid Solution*

Solvents would be used for cleaning activities throughout the NIF. Acidic and caustic solutions would also be used for various decontamination operations in the decontamination area of the Diagnostics Building. An anticipated scenario that might occur would be a spill of solvent or decontamination solution onto the ground outside the facility, possibly caused by a forklift during handling or movement.

Projected inventories of solvents at the NIF were evaluated on the basis of amount of MAR, exposure criteria, and volatility. That is, chemicals without inventory thresholds that are expected to be present in relatively small quantities, with low volatility, and those with relatively high exposure criteria were not considered further. A solvent (acetone) and a decontamination material (nitric acid) were selected for consequence analysis. The bounding scenario involves the chemical that presented the highest potential consequence, which was nitric acid.

D.3.2.12 *Site 300 Materials Management Facilities—Hazardous Materials Release by Fire (LiOH)*

The bounding scenario involves a fire involving lithium hydride (LiH), which is stored in Site 300 facilities. Lithium hydride burns and releases lithium oxide and lithium hydroxide (LiOH), with LiOH being the primary end product. The causes of a fire that releases LiOH could include human error in using materials handling equipment, fire in the storage magazine, natural phenomenon such as a lightning strike, or accidental detonation of explosives in a neighboring magazine. The most probable initiating cause of a LiOH release is the penetration of a storage bay and a container by a fragment from an explosion at a remote high explosives machining operation. The frequency of this event is 10^{-4} to 10^{-2} per year.

A magazine fire involving test assemblies could result in the exposure of worksite and other Site 300 personnel to fumes from the smoke. However, because personnel are not allowed in the area during a remote operation and do not approach a structure that is in flames, the actual probability of onsite exposure is low. The frequency of this event is mitigated by the strict control of ignition sources and fuel loadings in the facilities. These controls are extremely effective because LiH does not burn well when in solid form. In addition, this material is packaged in its shipping container, which protects the material from ignition from the outside and limits the access to oxygen if a fire is ignited, which tends to snuff out the fire or at least slow its rate of burn.

D.3.2.13 *Site 300 Explosive Waste Treatment Facility—Fire Release of Hydrogen Fluoride*

During an accidental explosives fire, toxic byproducts of combustion are given off and dispersed. In this analysis, several worst-case assumptions have been made, including:

- The fire's smallest radius is 1 meter.
- The thermal plume rise is taken to be 11 meters.
- The largest possible burnable explosive inventory of 350 pounds was used.

The bounding scenario source term is derived from the quantity of explosive involved (159 kilograms [350 pounds]) multiplied by the maximum value for hydrogen fluoride. This results in a total release of 16.5 kilograms of hydrogen fluoride. The frequency of this event is less than 10^{-1} per year.

D.3.2.14 *Site 300 B-Division Firing Areas—Toxic Gas/Hazardous Material Exposure Outside Contained Firing Facility Firing Chamber*

Explosive detonations within the Contained Firing Facility (CFF) can produce hazardous gases such as NH_3, HCN, carbon monoxide, oxides of nitrogen, hydrochloric acid, and hydrogen fluoride, and hazardous materials such as vaporized or particulate solids, including those from depleted uranium or beryllium. After a shot in the firing chamber, the CFF ventilation system removes particulates and soluble gases. Gases and particulates are further removed before the exhaust is discharged to the atmosphere by routing the ventilation exhaust through HEPA filters and an efficient gas absorption wet scrubber located in the ventilation exhaust piping. The CFF water washdown system can remove beryllium, uranium alloys, and miscellaneous metal particles resulting from the detonation. If personnel were sufficiently exposed to these hazardous gases or materials, serious injury or death could occur.

Isolation valves in the ventilation system might not be closed during a shot because of valve failure, human error, or control system error. As a result, gases would exhaust into the ventilation ducting system. The ducting in the supply side of the ventilation system cannot withstand shot pressure. As a result, it would fail, releasing toxic gases either to the outside or into the service area of the CFF. The same failure and toxic release would occur if the isolation valves were opened too soon after the shot. Although the areas where the releases would occur are outside of the approved shelter areas, personnel could be exposed to toxic gases if the affected areas were entered after the shot.

Personnel could also be exposed to hazardous gases or materials outside the CFF firing chamber if there was leakage through the firing door seals into the support area or leakage past camera or cable penetrations. The frequency of this event is 10^{-6} to 10^{-4} per year.

D.3.3 Estimated Health Effects

Table D.3.3–1 shows the consequences of the postulated set of accidents for a noninvolved worker and the public under median meteorological conditions. These consequences apply to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS. The accident with the highest consequence to the offsite population is the chlorine release from Building 332. For this accident, concentrations above the ERPG-2 level would exist as far out at 1.7 kilometers from Building 332, which would extend about 750 meters beyond the site boundary. At the site boundary, the concentration would be below ERPG-3 values, but above ERPG-2 values, indicating that persons exposed to this concentration could experience irreversible or other serious health effects or symptoms that could impair their ability to take protective action. At the noninvolved worker location, the concentration would be above ERPG-3 values, indicating that individuals exposed to this concentration could experience or develop life-threatening health effects.

Table D.3.3–2 shows the consequences of these accidents under unfavorable meteorological conditions. These consequences apply to the No Action Alternative, the Proposed Action, and the Reduced Operation Alternative of this LLNL SW/SPEIS. The accident with the highest consequence to the offsite population is, again, the chlorine release from Building 332. Concentrations above the ERPG-2 level would exist as far out as 1.9 kilometers from Building 332, which would extend about 950 meters beyond the site boundary. At the site boundary the concentration would be below ERPG-3 values, but above ERPG-2 values, indicating that persons exposed to this concentration could experience irreversible or other serious health effects or symptoms that could impair their ability to take protection action. At the noninvolved worker location, the concentration would be above ERPG-3 values, indicating that individuals exposed to this concentration could experience or develop life-threatening health effects.

TABLE D.3.3–1.—*Lawrence Livermore National Laboratory Chemical Accident Consequences (Median Meteorology)*[a]

ERPG-2 Concentration (ppm)	ERPG-3 Concentration (ppm)	Noninvolved Worker: Average Predicted Concentration (ppm)	Noninvolved Worker: Fraction of ERPG-2	MEI: Average Predicted Concentration (ppm)	MEI: Fraction of ERPG-2	ERPG-2 Distance (meters)
Building 191, High Explosives Application Facility – Chemical Dispersion (1,2-Dichloroethane)						
200	300	0.108	5.4×10^{-4}	0.0175	8.8×10^{-5}	11
Building 239, Radiography Facility – Toxic gas release (NO_2)						
5	20	18.3	3.7	0.40	0.08	198
Building 322, Plating Shop – Multiple Container Liquid Spill (Hydrofluoric Acid)						
20	50	371	18.6	4.86	0.24	475
Building 331, Tritium Facility actinide activities – Nitric acid spill						
6	78	24	4	0.24	0.04	205
Building 332, Plutonium Facility – Chlorine release						
3	20	593	198	11.6	3.9	1,700
Building 334, Hardened Engineering Test Building – Toxic gas release (NO_2)						
5	20	18.3	3.7	0.34	0.07	198
Building 514/612/625/693, Radioactive and Hazardous Waste Management Complex – Earthquake release of Freon-22						
7,500	7,500	415	0.06	169	0.023	19
Building 581, National Ignition Facility – Material Spill, Release of Nitric acid solution						
6	78	130	21.7	12.3	2.1	536
Site 300 Materials Management Facility – Hazardous materials release by fire (LiOH)						
1	102	1.42	1.42	0	0	119
Site 300 Explosive Waste Treatment Facility – Fire release of hydrogen fluoride						
20	50	28.1	1.41	0.097	0.049	119

Source: Original.
[a] These consequences apply to all alternatives.
ERPG = Emergency Response Planning Guideline; MEI = Maximally Exposed Individual; ppm = parts per million.

TABLE D.3.3–2.—*Potential Chemical Accident Consequences (Unfavorable Meteorology)* [a]

ERPG-2 Concentration (ppm)	ERPG-3 Concentration (ppm)	Noninvolved Worker: Average Predicted Concentration (ppm)	Noninvolved Worker: Fraction of ERPG-2	MEI: Average Predicted Concentration (ppm)	MEI: Fraction of ERPG-2	ERPG-2 Distance (meters)
Building 191, High Explosives Application Facility – Chemical Dispersion (1,2-Dichloroethane)						
200	300	1.41	7.1×10^{-3}	0.272	1.4×10^{-3}	11
Building 239, Radiography Facility – Toxic gas release (NO_2)						
5	20	954	191	17.6	3.52	1,500
Building 322, Plating Shop – Multiple Container Liquid Spill (Hydrofluoric Acid)						
20	50	4,680	234	46.4	2.32	1,400
Building 331, Tritium Facility actinide activities – Nitric acid spill						
6	78	68	11.3	1.1	0.18	358
Building 332, Plutonium Facility – Chlorine release						
3	20	5,220	1,740	16.9	5.64	1,900
Building 334, Hardened Engineering Test Building – Toxic gas release (NO_2)						
5	20	954	191	15.1	3.02	1,700
Building 514/612/625/693, Radioactive and Hazardous Waste Management Complex – Earthquake release of Freon-22						
7,500	7,500	4,080	0.54	1,312	0.17	75
Building 581, National Ignition Facility – Material Spill, Release of Nitric Acid Solution						
6	78	438	73	51.4	8.57	1,400
Site 300 Materials Management Facility – Hazardous materials release by fire (LiOH)						
1	102	59	59	0.151	0.15	865
Site 300 Explosive Waste Treatment Facility – Fire release of hydrogen fluoride						
20	50	1,168	58.4	2.98	0.15	860

Source: Original.
[a] These consequences apply to all alternatives.
ERPG = Emergency Response Planning Guideline; MEI = Maximally Exposed Individual; ppm = parts per million.

D.4 ACCIDENT SCENARIOS INVOLVING HIGH EXPLOSIVES

D.4.1 Site 300 Materials Management Facilities

D.4.1.1 *Accidental Detonation in an Explosives Assembly Storage Magazine*

The consequences of this accident would include severe injury or death to the facility workers (normally two) and the destruction of the magazine, with possible injuries to nearby personnel within intraline and fragment distance, and damage to nearby facilities. Additionally, low-level environmental releases and low-level exposures of personnel to airborne hazardous materials would be of lesser consequence. Onsite exposure to the resulting plumes would be below ERPG-3 levels. Offsite consequences would be limited to overpressures and the potential for hazardous material exposures below ERPG-2 levels. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.4.2 Site 300 Weaponization Program

D.4.2.1 *Accidental Bare Explosives Detonation in a Test Building with Personnel Present*

Severe or fatal injuries to the immediate workers (normally two to five) and damage to the test equipment and building would occur. Injuries to nearby personnel subjected to blast effects also would be possible. Offsite consequences would be limited to overpressures in populated areas. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.4.2.2 *Accidental Detonation in a Test Building During a Test with No Personnel Present*

The consequences of this accident would include damage to the test equipment and building, with possible injuries to nearby personnel. Offsite consequences would be limited to overpressures in populated areas. The frequency of this accident is estimated to be 10^{-4} to 10^{-2} per year.

D.4.2.3 *Accidental Detonation in a Storage Magazine*

The consequences of this accident would include severe or fatal injury to the immediate workers (normally two to three) and the destruction of the magazine, with possible injuries to nearby personnel subjected to blast effects. Offsite consequences would be limited to overpressures in populated areas. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.4.3 Site 300 B-Division Firing Areas

D.4.3.1 *Accidental Detonation at a Bunker Firing Table*

The consequences of this accident would include severe or fatal injury to the personnel present. Blast pressures and fragments could also cause injury to other personnel in the open area outside the controlled access-firing table. Activities other than handling or work on the explosives also could lead to accidental detonations resulting in severe or fatal injury of many personnel (normally 2 to 10, with a maximum of 20). Offsite consequences would be limited to overpressures in populated areas. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.4.3.2 *Accidental Detonation at the Contained Firing Facility Firing Chamber*

The consequences of this accident would include severe or fatal injury to personnel. The blast and the fragments might also injure personnel in the open area outside the facility. If an activity of higher level than the handling or work on the explosives led to an accidental detonation, the result could be severe or fatal injury to more personnel (normally 2 to 20). The exposure to blast and fragments from the detonation would be more severe than any exposure to airborne hazardous material, because the explosion would be more immediate and severe. An accidental detonation could result in significant damage to the service building and equipment. Offsite consequences would be limited to overpressures in populated areas. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.4.3.3 *Accidental Detonation During Transport Through the Contained Firing Facility Service Building*

The consequences of this accident would include localized severe or fatal injury to the immediate workers (normally two or fewer) and the destruction of the building, with possible injuries to nearby personnel subject to the blast effects. Additionally, low-level environmental releases and low-level exposures of personnel to airborne hazardous materials would result in lesser consequences. Offsite consequences would be limited to overpressures in populated areas. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.4.3.4 *Accidental Detonation in a Storage Magazine*

The consequences of this accident would include localized severe or fatal injury to the immediate workers (normally two or fewer) and the destruction of the magazine, with possible injuries to nearby personnel subject to the blast effects. Additionally, low-level environmental releases and low-level exposures of personnel to airborne hazardous materials would result in lesser consequences. Offsite consequences would be limited to overpressures in populated areas. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.4.3.5 *Accidental Firing/Improper Trajectory from Propellant-Driven Gun*

The consequences of this accident would include property damage and severe or fatal injury to personnel on the bunker-firing table. Offsite consequences would be limited to overpressures in populated areas. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.4.4 Energetic Materials Processing Center

Accidental Detonation

The consequences of this accident would include severe or fatal injury to personnel (normally two to six) involved in assembling high explosives and other components. An accidental detonation in an assembly bay would be the most severe, because the amount of explosives authorized in an assembly bay (100 kilograms) is more than for any other operation in EMPC. Other personnel within the EMPC would not be injured. The exposure to blast and fragments from the detonation would be more severe than any exposure to airborne hazardous material, because the explosion would be more immediate and severe. Offsite consequences would be limited to overpressures in populated areas. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.4.5 Building 191, High Explosives Application Facility

D.4.5.1 *Accidental Detonation or Deflagration of Explosives in Storage*

Personnel who are present in a magazine room or workroom where an accidental detonation occurs could be fatally injured, depending on the amount of explosives in the room. Others in proximity to the room of occurrence could suffer severe or fatal injuries, depending on their location. Personnel outside the room of occurrence could experience eardrum rupture, but they should not suffer any major lung damage. Offsite consequences would be limited to overpressures in populated areas. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.4.5.2 *Personnel Injury Due to Failure of Controls for Remote Explosives Operations*

The consequences of this accident would include property damage and severe or fatal injury to the worker. Offsite consequences would be limited to overpressures in populated areas. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.4.5.3 *Accidental Detonation of Explosives During Contact Operations*

All personnel inside the room of occurrence (up to six people) could receive fatal injuries. Although the consequences in a workroom with a 10-kilogram limit would likely be more severe than those in workrooms with lower explosives limits, it still would be possible that the consequences in these rooms could equal the consequences in a workroom with a 10 kilogram limit. Personnel outside the room of occurrence could also receive injury from overpressure effects (walls, mazes, and doors would preclude fragment hazards). Overpressure predictions outside the room of occurrence (but inside the facility) would be expected to result in some eardrum rupture. Lung damage would also be possible. There would be no blast effects (overpressure or fragments) outside the facility. The frequency of this accident is estimated to be 10^{-6} to 10^{-4} per year.

D.5 SCENARIOS INVOLVING BIOLOGICAL HAZARDS

Microbiology laboratories are unique work environments that could pose special risks to personnel working within that environment. For purposes of this appendix, NNSA has selected a representative facility accident that has been previously analyzed by the U.S. Army in the *Final Programmatic Environmental Impact Statement Biological Defense Research Program* (Army 1989). NNSA believes that this accident scenario bounds any potential scenarios associated with the BioSafety Level-3 Facility (BSL-3), Building 368, at LLNL.

This accident scenario is being presented in order to provide a clear understanding of the BSL-3 activities and the extent of the potential impacts that could arise from these activities under unusual circumstances. The best available credible information has been applied to calculation of the results of this accident scenario using assumptions that yield the potential for more severe consequences. The U.S. Army has previously determined that releases of aerosols of biological materials from facilities such as the BSL-3 facility under appropriate containment conditions are not reasonably foreseeable (Army 1989). For the purpose of perspective and information, this appendix presents estimates of the extent of potential impacts resulting from accidental releases of biological aerosols from the BSL-3 facility. These findings are presented even though the event or series of events are not considered to be reasonably foreseeable and have never occurred within the U.S. Army Biological Defense Research Program (Army 1989). In summary, aerosolization and release of this agent would be very difficult, even under the assumed sequence of events described below.

D.5.1 Description of the Organisms

The organism selected for this scenario is *Coxiella burnetii*, the rickettsial causing Q fever, a disease of varying degrees of incapacitation. *Coxiella burnetii* grows to high concentrations in chicken embryos. It is a hardy organism that withstands laboratory manipulation with little or no loss in viability. It is highly stable in aerosol and undergoes a biological decay rate of about 1 percent per minute over a wide range of humidities. *Coxiella burnetii* is extremely infectious in a small particle aerosol. These properties (high concentration of rickettsial agent, low rate of biological decay, low infective dose for man) make *Coxiella burnetii* an ideal organism to use in a hypothetical, maximum credible laboratory accident.

D.5.2 Description of the Hypothetical Accident

An immunized laboratory worker would be processing 1 liter of *Coxiella burnetii* slurry that would be used to prepare an experimental vaccine. In this scenario, the laboratory worker would fail to use rubber O-rings to seal the centrifuge tubes, and all six bottles would leak, allowing some of the slurry into the rotor. Because the worker would also fail to properly tighten the safety centrifuge caps designed to prevent such a leak, some of the slurry would also escape into the centrifuge compartment that houses the rotor. This compartment is not sealed against the release of organisms in a small particle aerosol. The leakage of six bottles is highly improbable, but could potentially occur as a result of operator error as described above. This scenario assumes that most of the solution would remain in the centrifuge tubes. Of the solution that leaks, most would be contained within the covered rotor and not aerosolized (99 percent). Of the solution that escapes into the centrifuge cabinet, only a fraction would be aerosolized, and of that which is aerosolized, approximately 90 percent would settle as liquid droplets on the inside of the chamber.

A few minutes after the rotor stops, the worker would open the centrifuge door and reach in to remove the rotor. The worker would notice that there has been a leak of the slurry within the centrifuge. Two coworkers would provide assistance in managing the spill. Four other coworkers would enter the lab shortly after the incident, and thus are also accidentally exposed to the uncontained infectious organisms.

This scenario is based on an unlikely cascade of sequential events: the failure to seal properly both the centrifuge tubes and the safety centrifuge cups, the leakage of not one but six centrifuge bottles containing *Coxiella burnetii*, and the inappropriate behavior of the laboratory worker. The possibility of an accident of this degree, which is based on the sequential or simultaneous failure of multiple operational and procedural controls, is remote.

D.5.3 Impact of the Accident on the Noninvolved Worker and the Offsite Population

Potentially, the most serious consequence of the laboratory accident would be the release of enough infectious doses to override the building filter system and allow the subsequent release of a concentrated aerosol into the surrounding community. It is therefore necessary to calculate the maximum number of aerosol infectious doses presented to the filter. It is assumed that 10 percent leaked from the tubes, of which 99 percent remained in the rotor cup. Of that which escaped from the cup, 0.1 percent was aerosolized by the rotor and of that aerosolized, 90 percent settled as liquid droplets on the inside of the chamber. Thus, the total is 0.00001 percent aerosol escape into the room, which equals 9.9×10^6 HID_{50}[1] aerosolized. The building exhaust filter is 95 percent efficient, thus approximately 5×10^5 HID_{50} would have escaped from the building exhaust stack (Army 1989). Because laboratory work is normally performed during the day, ultraviolet rays from the sun would also destroy a large number of these rickettsiae.

The quantity of human infectious doses, by simple Gaussian plume dispersion models, is expected to be dissipated to less than 1 HID_{50} per liter of air in less than 2 meters from the stack, less than 0.1 HID_{50} per liter of air at 16 meters, and less than 0.01 HID_{50} per liter of air at 38 meters (Army 1989). Thus, this level of escape of *Coxiella burnetii* from the containment laboratory, even under the worst-case meteorological conditions, does not represent a credible hazard to the noninvolved worker or offsite population.

D.5.4 Impact of the Accident on Laboratory Workers

The centrifuge operator would be at the greatest risk of becoming ill with Q fever. In opening the centrifuge, the infectious aerosol would be released initially and momentarily into a very confined area. The concentration of airborne infectious doses, seconds after the lid was opened, was calculated as 1.3×10^3 HID_{50} per liter of air. Assuming that the centrifuge operator was in the area for no more than 5 minutes, the operator could have inhaled approximately 100,000 infectious doses. The two coworkers who came to the operator's assistance would be exposed to only slightly fewer doses.

Studies (Army 1989) reported that previously vaccinated men, when exposed to defined aerosols of 150 or 150,000 infectious doses of virulent *Coxiella burnetii*, did not consistently become ill. Because the centrifuge operator would receive about the same dose reported in these studies, it is problematical whether the operator would become sick, since he would be, by required procedures, immunized. These studies further indicate that if a non-immunized person were exposed to 150 or 150,000 infectious doses, the disease could be avoided by giving one milliliter of vaccine within 24 hours after exposure and by instituting antibiotic therapy.

[1] The term "HID_{50}" refers to the dose causing infection 50 percent of the time for man.

The other four laboratory workers also would be exposed for less than 1 minute to the aerosol after it was dispersed in the room and would be unlikely to have been exposed to more than 100 to 300 infectious doses. These four laboratory workers, since they also would have been vaccinated, should not develop Q fever. The two coworkers who came to the operator's assistance would also have been vaccinated and should not develop Q fever.

D.6 MULTIPLE-BUILDING EVENT

This section addresses the potential releases and consequences of a situation involving multiple source terms (both radiological and chemical) stemming from a single event affecting LLNL. An earthquake with a return period of 5,000 years (i.e., 2×10^{-4} per year) was postulated as the initiator for this accident scenario. This earthquake is assumed to have a horizontal ground acceleration of 0.8 *g*. As a rough comparison, the January 24 and January 27, 1980, Livermore earthquakes, recorded as 5.4 and 5.6 on the Richter Scale, generated maximum measured peak ground accelerations of 0.26 *g* at a distance of 18 kilometers from the epicenter.

D.6.1 Building Selection and Assumptions

The selection process described in Section D.1.1 is also the basis for buildings selected for seismic analysis. In all cases, buildings were evaluated based on a 0.8-*g* horizontal acceleration. In addition to those buildings identified as having a potential release initiated by an earthquake, all buildings identified for accident analysis were also subjected to seismic analysis. In some instances, the postulated scenario could not be initiated by a seismic event, and the locations and associated releases were not considered as part of the multiple-building event scenario.

For the cases analyzed, a secondary fire was eliminated from consideration because of the installation of seismic shutoff valves throughout the natural gas pipeline system and the limited amounts of combustible and flammable materials in the evaluated areas. This does not mean that an earthquake of this severity will not cause major fires at the various facilities. After the 1989 Loma Prieta earthquake, many fires burned uncontrolled in the city of San Francisco due to the failure of natural gas pipelines. The major cause for failure of the pipelines was the nature of the ground (landfill) in the affected areas. Specific information concerning the seismic stability of the area surrounding LLNL is contained in Appendix H. While fires may result from an earthquake such as that postulated for the initiating event in this section, the number and magnitude of the fires would not be expected to be as severe as those experienced in 1989. The fires would generally be expected to involve offices and administrative areas where fire loadings are higher than in rated buildings and where fire suppression capabilities are generally not as extensive.

D.6.2 Description of Potential Releases Following an Earthquake

This section provides a general description of the radiological and chemical releases that may occur as a direct result of an earthquake. Scenarios and consequences are discussed in general terms only. For specific information concerning individual scenarios, refer to the referenced sections.

D.6.2.1 *Radiological Releases*

Tables D.6.2–1 and D.6.2–2 present those facilities for which a radiological release has been postulated to be initiated by the earthquake for the Proposed Action and the No Action Alternative, respectively. Each of these individual facility releases was analyzed in Section D.2. Tables D.6.2–3 and D.6.2–4 present the results of the analysis for each of these facility releases for the Proposed Action for median and unfavorable meteorological conditions, respectively. Tables D.6.2–5 and D.6.2–6 present this same information for the No Action Alternative. As can be seen in these tables, under the multiple-building release scenario, the consequences to the offsite MEI and to the population within 50 miles of LLNL are primarily attributable to releases from Buildings 251, 331, and 334.

The offsite MEI for releases from the facilities listed in Table D.6.2–1 would not be at the same location. Therefore, summing the doses for each of the individual facilities as in Table D.6.2–2 is conservative. Taking this conservative approach results in a total radiation dose at the site boundary under median meteorological conditions of 1.03 rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the MEI dose has a probability of 6.02×10^{-4} (or one chance in 1,620) of the development of a fatal cancer.

The collective radiation dose to the approximately 6,900,000 people living within 50 miles of LLNL under the multiple-building release scenario for median meteorology was calculated to be 417 person-rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the collective population dose is estimated to result in an additional 0.24 LCF to this population.

Under unfavorable meteorological conditions, the radiation dose to the MEI for the multiple-building release scenario of 20.4 rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the MEI dose has a probability of 0.011 (or 1 chance in 95) of the development of a fatal cancer.

The collective radiation dose to the approximately 6,900,000 people living within 50 miles of LLNL under the multiple-building release scenario for unfavorable meteorological conditions was calculated to be 4,320 person-rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the collective population dose is estimated to result in 1.76 LCFs to this population.

For the No Action Alternative, as shown in Table D.6.2–5, the multiple-building release results in a total radiation dose at the site boundary under median meteorological conditions of 0.88 rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the MEI dose has a probability of 5.28×10^{-4} (or one chance in 1,894) of the development of a fatal cancer.

The collective radiation dose to the approximately 6,900,000 people living within 50 miles of LLNL under the multiple-building release scenario for median meteorology was calculated to be 296 person-rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the collective population dose is estimated to result in an additional 0.18 LCF to this population.

Under unfavorable meteorological conditions, the radiation dose to the MEI for the multiple-building release scenario for the No Action Alternative is 17.5 rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the MEI dose has a probability of 0.01 (or 1 chance in 95) of the development of a fatal cancer.

TABLE D.6.2–1.—*Facilities and Radiological Releases Under the Proposed Action Multiple-Building Accident Scenario*

Building	Accident	Source Term
Building 194, 100-MeV Electron-Positron LINAC Facility	Design basis earthquake and fire	0.0012 Ci C-11 0.047 Ci N-13 0.903 Ci O-15 3.4×10^{-4} g weapons grade Pu
Building 239, Radiography Facility	Uncontrolled oxidation of plutonium at elevated temperatures (weapons grade plutonium)	4.5×10^{-2} g weapons grade Pu
	Fire involving SNM	50 g HEU
	Release of tritium	0.2 g tritium
Building 251, Heavy Element Facility	Evaluation basis fire	0.081 Ci (Am-241 equivalent)
Building 331, Tritium Facility	Tritium release during earthquake	30 g tritium gas (0.3 g as HTO)
Building 332, Plutonium Facility	Plutonium release during earthquake (filtered)	1.4×10^{-5} g fuel-grade Pu
Building 334, Hardened Engineering Test Building	Fire involving HEU (unmitigated)	100 g HEU
	Uncontrolled oxidation of plutonium at elevated temperatures	0.185 g fuel-grade Pu
	Release of tritium	0.2 g HTO
Building 514/612/625/693, Hazardous Waste Management Complex	Earthquake	1.6×10^{-4} Ci transuranic waste (use Am-241 as a surrogate) 5,000 Ci tritium 6.0×10^{-4} Ci aqueous low-level waste (Pu-equivalent Ci)
Building 581, National Ignition Facility	Earthquake during plutonium without yield experiment	0.003 g weapons grade Pu plus 500 Ci tritium plus fission products plus activated gases and particulates
Building 625, Container Storage Unit	Crane fall during severe earthquake	0.022 Pu-equivalent Ci

Source: Original.
Am = americium; Ci = curie; g = gram; HEU = highly enriched uranium; HTO = tritiated water; LINAC = Liner Accelerator; Pu = plutonium; SNM = special nuclear materials.

TABLE D.6.2–2.—*Facilities and Radiological Releases Under the No Action Alternative Multiple-Building Accident Scenario*

Building	Accident	Source Term
Building 194, 100-MeV Electron-Positron LINAC Facility	Design basis earthquake and fire	3.4×10^{-4} g weapons grade Pu
Building 239, Radiography Facility	Uncontrolled oxidation of plutonium at elevated temperatures (weapons grade plutonium)	4.5×10^{-2} weapons grade Pu
	Fire involving SNM	25 g HEU
	Release of tritium	0.2 g tritium
Building 251, Heavy Element Facility	Evaluation basis fire	0.081 Ci (Am-241 equivalent)
Building 331, Tritium Facility	Tritium release during earthquake	3.5 g tritium gas (0.035 g as HTO)
Building 332, Plutonium Facility	Plutonium release during earthquake (filtered)	1.4×10^{-5} g fuel-grade Pu
Building 334, Hardened Engineering Test Building	Fire involving HEU (unmitigated)	100 g HEU
	Uncontrolled oxidation of plutonium at elevated temperatures	0.185 g fuel-grade Pu
	Release of tritium	0.2 g HTO
Building 514/612/625/693, Hazardous Waste Management Complex	Earthquake	1.6×10^{-4} Ci transuranic waste (use Am-241 as a surrogate) 5,000 Ci tritium 6.0×10^{-4} Ci aqueous low-level waste (Pu-equivalent Ci)
Building 581, National Ignition Facility	Earthquake during plutonium without yield experiment	500 Ci tritium plus activated gases and particulates
Building 625, Container Storage Unit	Crane fall during severe earthquake	0.0072 Pu-equivalent Ci

Source: Original.
Am = americium; Ci = curie; g = gram; HEU = highly enriched uranium; HTO = tritiated water; LINAC = Linear Accelerator; Pu = plutonium; SNM = special nuclear materials.

TABLE D.6.2–3.—*Potential Lawrence Livermore National Laboratory Multi-Building Accident Scenario Radiological Consequences for the Proposed Action (Median Meteorology)*

	MEI		Offsite Population[a]		Individual Noninvolved Worker		Noninvolved Worker Population	
Source Term	**Dose (rem)**	**LCFs[b]**	**Dose (person-rem)**	**LCFs[c]**	**Dose (rem)**	**LCFs[b]**	**Dose (person-rem)**	**LCFs[c]**
Building 194, 100 MeV Electron-Positron LINAC Facility								
3.4×10^{-4} g weapons grade Pu	8.66×10^{-4}	5.20×10^{-7}	2.23×10^{-1}	1.34×10^{-4}	3.43×10^{-3}	2.06×10^{-6}	5.83×10^{-1}	3.50×10^{-4}
Building 239, Radiography Facility								
4.5×10^{-2} g weapons grade Pu plus 5.0×10^{1} g HEU plus 2.0×10^{-1} g tritium	2.34×10^{-2}	1.40×10^{-5}	8.97	5.38×10^{-3}	3.34×10^{-1}	2.00×10^{-4}	3.51×10^{1}	2.11×10^{-2}
Building 251, Heavy Element Facility								
8.1×10^{-2} Ci Am-241 equivalent	6.01×10^{-1}	3.61×10^{-4}	1.88×10^{2}	1.13×10^{-1}	5.70	3.42×10^{-3}	8.26×10^{2}	4.96×10^{-1}
Building 331, Tritium Facility								
3.0×10^{1} g tritium gas (0.3 g as HTO)	1.63×10^{-1}	9.78×10^{-5}	1.13×10^{2}	6.78×10^{-2}	2.11	1.27×10^{-3}	2.73×10^{2}	1.64×10^{-1}
Building 332, Plutonium Facility								
1.4×10^{-5} g fuel-grade Pu	8.22×10^{-6}	4.93×10^{-9}	5.22×10^{-3}	3.13×10^{-6}	9.21×10^{-5}	5.53×10^{-8}	1.74×10^{-2}	1.04×10^{-5}
Building 334, Hardened Engineering Test Building								
1.0×10^{2} g HEU plus 1.85×10^{-1} g fuel-grade Pu plus 2.0×10^{-1} g HTO	1.73×10^{-1}	8.63×10^{-5}	7.20×10^{1}	3.60×10^{-2}	3.42	1.37×10^{-3}	2.43×10^{2}	1.46×10^{-1}
Building 514/612/625/693, Hazardous Waste Management Complex								
1.6×10^{-4} Ci Am-241 plus 5.0×10^{3} Ci tritium plus 6.0×10^{-4} Pu-equivalent Ci	5.84×10^{-2}	3.50×10^{-5}	3.17	1.90×10^{-3}	1.10×10^{-1}	6.61×10^{-5}	2.03	1.22×10^{-3}
Building 581, National Ignition Facility								
3.0×10^{-3} g weapons grade Pu	1.65×10^{-3}	9.89×10^{-7}	3.34	3.28×10^{-4}	4.99×10^{-3}	3.00×10^{-6}	7.41×10^{-1}	4.45×10^{-4}
Building 625, Container Storage Unit								
2.2×10^{-2} Pu-equivalent Ci	1.14×10^{-2}	6.84×10^{-6}	3.17×10^{1}	1.90×10^{-2}	3.10×10^{-2}	1.86×10^{-5}	1.45	8.71×10^{-4}
Total								
	1.03	6.02×10^{-4}	4.20×10^{2}	2.43×10^{-1}	1.17×10^{1}	6.35×10^{-3}	1.38×10^{3}	8.29×10^{-1}

Source: Original.
Am = americium; Ci = curie; g = gram; HEU = highly enriched uranium; HTO = tritiated water; LCF = latent cancer fatalities; LINAC = Linear Accelerator; MEI = maximally exposed individual; Pu = plutonium; SNM = special nuclear materials.
[a] Based on the population of approximately 6,900,000 person residing within 50 miles of LLNL.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

TABLE D.6.2–4.—*Potential Lawrence Livermore National Laboratory Multi-Building Accident Scenario Radiological Consequences for the Proposed Action (Unfavorable Meteorology)*

	MEI		Offsite Population[a]		Individual Noninvolved Worker		Noninvolved Worker Population	
Source Term	**Dose (rem)**	**LCFs[b]**	**Dose (person-rem)**	**LCFs[c]**	**Dose (rem)**	**LCFs[b]**	**Dose (person-rem)**	**LCFs[c]**
Building 194, 100 MeV Electron-Positron LINAC Facility								
3.4×10^{-4} g weapons grade Pu	1.30×10^{-2}	7.80×10^{-6}	1.81	1.09×10^{-3}	3.30×10^{-2}	1.98×10^{-5}	3.47	2.08×10^{-3}
Building 239, Radiography Facility								
4.5×10^{-2} g weapons grade Pu plus 5.0×10^{1} g HEU plus 2.0×10^{-1} g tritium	4.97×10^{-1}	2.98×10^{-4}	1.42×10^{2}	8.54×10^{-2}	4.02	2.41×10^{-3}	2.67×10^{2}	1.60×10^{-1}
Building 251, Heavy Element Facility								
8.1×10^{-2} Ci Am-241 equivalent	1.18×10^{1}	7.10×10^{-3}	1.22×10^{3}	7.34×10^{-1}	6.46×10^{1}	3.88×10^{-2}	4.52×10^{3}	2.71
Building 331, Tritium Facility								
3.0×10^{1} g tritium gas (0.3 g as HTO)	3.26	2.28×10^{-4}	1.56×10^{3}	1.10×10^{-1}	2.55×10^{1}	1.79×10^{-3}	2.05×10^{3}	1.44×10^{-1}
Building 332, Plutonium Facility								
1.4×10^{-5} g fuel-grade Pu	1.57×10^{-4}	9.41×10^{-8}	6.08×10^{-2}	3.65×10^{-5}	8.33×10^{-4}	5.00×10^{-7}	1.46×10^{-1}	8.74×10^{-5}
Building 334, Hardened Engineering Test Building								
1.0×10^{2} g HEU plus 1.85×10^{-1} g fuel-grade Pu plus 2.0×10^{-1} g HTO	3.88	2.33×10^{-3}	1.08×10^{3}	6.51×10^{-1}	4.62×10^{1}	2.77×10^{-2}	2.19×10^{3}	1.31
Building 514/612/625/693, Hazardous Waste Management Complex								
1.6×10^{-4} Ci Am-241 plus 5.0×10^{3} Ci tritium plus 6.0×10^{-4} Pu-equivalent Ci	8.95×10^{-1}	5.37×10^{-4}	2.60×10^{1}	1.56×10^{-2}	1.40	8.41×10^{-4}	3.66×10^{1}	2.20×10^{-2}
Building 581, National Ignition Facility								
3.0×10^{-3} g weapons grade Pu	2.16×10^{-2}	3.69×10^{-6}	8.33	1.83×10^{-3}	4.69×10^{-2}	8.01×10^{-6}	8.23	1.33×10^{-3}
Building 625, Container Storage Unit								
2.2×10^{-2} Pu-equivalent Ci	3.08×10^{-2}	1.85×10^{-5}	2.77×10^{2}	1.66×10^{-1}	1.29	7.76×10^{-4}	3.08×10^{1}	1.85×10^{-2}
Total								
	2.04×10^{1}	1.05×10^{-2}	4.33×10^{3}	1.76	1.43×10^{2}	7.24×10^{-2}	9.10×10^{3}	4.37

Source: Original.
Am = americium; Ci = curie; g = gram; HEU = highly enriched uranium; HTO = tritiated water; LCF = latent cancer fatalities; LINAC = Linear Accelerator; MEI = maximally exposed individual; Pu = plutonium; SNM = special nuclear materials.
[a] Based on the population of approximately 6,900,000 person residing within 50 miles of LLNL.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

TABLE D.6.2–5.—*Potential Lawrence Livermore National Laboratory Multi-Building Accident Scenario Radiological Consequences for the No Action Alternative (Median Meteorology)*

	MEI		Offsite Population[a]		Individual Noninvolved Worker		Noninvolved Worker Population	
Source Term	**Dose (rem)**	**LCFs[b]**	**Dose (person-rem)**	**LCFs[c]**	**Dose (rem)**	**LCFs[b]**	**Dose (person-rem)**	**LCFs[c]**
Building 194, 100 MeV Electron-Positron LINAC Facility								
3.4×10^{-4} g weapons grade Pu	8.66×10^{-4}	5.20×10^{-7}	2.23×10^{-1}	1.34×10^{-4}	3.43×10^{-3}	2.06×10^{-6}	5.83×10^{-1}	3.50×10^{-4}
Building 239, Radiography Facility								
4.5×10^{-2} g weapons grade Pu plus 2.5×10^{1} g HEU plus 2.0×10^{-1} g tritium	2.34×10^{-2}	1.40×10^{-5}	8.97	5.38×10^{-3}	3.34×10^{-1}	2.00×10^{-4}	3.51×10^{1}	2.11×10^{-2}
Building 251, Heavy Element Facility								
8.1×10^{-2} Ci Am-241 equivalent	6.01×10^{-1}	3.61×10^{-4}	1.88×10^{2}	1.13×10^{-1}	5.70	3.42×10^{-3}	8.26×10^{2}	4.96×10^{-1}
Building 331, Tritium Facility								
3.5 g tritium gas (0.035 g as HTO)	1.90×10^{-2}	1.14×10^{-5}	1.32×10^{1}	7.91×10^{-3}	2.46×10^{-1}	1.48×10^{-4}	3.19×10^{1}	1.91×10^{-2}
Building 332, Plutonium Facility								
1.4×10^{-5} g fuel-grade Pu	8.22×10^{-6}	4.93×10^{-9}	5.22×10^{-3}	3.13×10^{-6}	9.21×10^{-5}	5.53×10^{-8}	1.74×10^{-2}	1.04×10^{-5}
Building 334, Hardened Engineering Test Building								
1.0×10^{2} g HEU plus 1.85×10^{-1} g fuel-grade Pu plus 2.0×10^{-1} g HTO	1.73×10^{-1}	1.04×10^{-4}	7.20×10^{1}	4.32×10^{-2}	3.42	2.05×10^{-3}	2.43×10^{2}	1.46×10^{-1}
Building 514/612/625/693, "Hazardous Waste Management Complex"								
1.6×10^{-4} Ci Am-241 plus 5.0×10^{3} Ci tritium plus 6.0×10^{-4} Pu-equivalent Ci	5.84×10^{-2}	3.50×10^{-5}	3.17	1.90×10^{-3}	1.10×10^{-1}	6.61×10^{-5}	2.03	1.22×10^{-3}
Building 581, National Ignition Facility								
5.0×10^{2} Ci tritium plus activated gases and particulates	4.78×10^{-4}	2.87×10^{-7}	1.96×10^{-1}	1.18×10^{-4}	1.43×10^{-3}	8.60×10^{-7}	2.08×10^{-1}	1.25×10^{-4}
Building 625, Container Storage Unit								
7.2×10^{-3} Pu-equivalent Ci	3.73×10^{-3}	2.24×10^{-6}	1.04×10^{1}	6.22×10^{-3}	1.01×10^{-2}	6.09×10^{-6}	4.75×10^{-1}	2.85×10^{-4}
Total								
	8.80×10^{-1}	5.28×10^{-4}	2.96×10^{2}	1.78×10^{-1}	9.83	5.90×10^{-3}	1.14×10^{3}	6.84×10^{-1}

Source: Original.
Am = americium; Ci = curie; g = gram; HEU = highly enriched uranium; HTO = tritiated water; LCF = latent cancer fatalities; LINAC = Linear Accelerator; MEI = maximally exposed individual; Pu = plutonium; SNM = special nuclear materials.
[a] Based on the population of approximately 6,900,000 person residing within 50 miles of LLNL.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

TABLE D.6.2–6.—*Potential Lawrence Livermore National Laboratory Multi-Building Accident Scenario Radiological Consequences for the No Action Alternative (Unfavorable Meteorology)*

	MEI		Offsite Population[a]		Individual Noninvolved Worker		Noninvolved Worker Population	
Source Term	**Dose (rem)**	**LCFs[b]**	**Dose (person-rem)**	**LCFs[c]**	**Dose (rem)**	**LCFs[b]**	**Dose (person-rem)**	**LCFs[c]**
Building 194, 100 MeV Electron-Positron LINAC Facility								
3.4×10^{-4} g weapons grade Pu	1.30×10^{-2}	7.80×10^{-6}	1.81	1.09×10^{-3}	3.30×10^{-2}	1.98×10^{-5}	3.47	2.08×10^{-3}
Building 239, Radiography Facility								
4.5×10^{-2} g weapons grade Pu plus 2.5×10^{1} g HEU plus 2.0×10^{-1} g tritium	4.97×10^{-1}	2.98×10^{-4}	1.42×10^{2}	8.54×10^{-2}	4.02	2.41×10^{-3}	2.67×10^{2}	1.60×10^{-1}
Building 251, Heavy Element Facility								
8.1×10^{-2} Ci Am-241 equivalent	1.18×10^{1}	7.10×10^{-3}	1.22×10^{3}	7.34×10^{-1}	6.46×10^{1}	3.88×10^{-2}	4.52×10^{3}	2.71
Building 331, Tritium Facility								
3.5 g tritium gas (0.035 g as HTO)	3.80×10^{-1}	2.28×10^{-4}	1.83×10^{2}	1.10×10^{-1}	2.98	1.79×10^{-3}	2.39×10^{2}	1.44×10^{-1}
Building 332, Plutonium Facility								
1.4×10^{-5} g fuel-grade Pu	1.57×10^{-4}	9.41×10^{-8}	6.08×10^{-2}	3.65×10^{-5}	8.33×10^{-4}	5.00×10^{-7}	1.46×10^{-1}	8.74×10^{-5}
Building 334, Hardened Engineering Test Building								
1.0×10^{2} g HEU plus 1.85×10^{-1} g fuel-grade Pu plus 2.0×10^{-1} g HTO	3.88	2.33×10^{-3}	1.08×10^{3}	6.51×10^{-1}	4.62×10^{1}	2.77×10^{-2}	2.19×10^{3}	1.31
Building 514/612/625/693, Hazardous Waste Management Complex								
1.6×10^{-4} Ci Am-241 plus 5.0×10^{3} Ci tritium plus 6.0×10^{-4} Pu-equivalent Ci	8.95×10^{-1}	5.37×10^{-4}	2.60×10^{1}	1.56×10^{-2}	1.40	8.41×10^{-4}	3.66×10^{1}	2.20×10^{-2}
Building 581, National Ignition Facility								
5.0×10^{2} Ci tritium plus activated gases and particulates	6.15×10^{-3}	3.69×10^{-6}	3.05	1.83×10^{-3}	1.33×10^{-2}	8.01×10^{-6}	2.22	1.33×10^{-3}
Building 625, Container Storage Unit								
7.2×10^{-3} Pu-equivalent Ci	1.01×10^{-2}	6.05×10^{-6}	9.07×10^{1}	5.44×10^{-2}	4.23×10^{-1}	2.54×10^{-4}	1.01×10^{1}	6.05×10^{-3}
Total								
	1.75×10^{1}	1.05×10^{-2}	2.75×10^{3}	1.65	1.20×10^{2}	7.18×10^{-2}	7.27×10^{3}	4.36

Source: Original.
Am = americium; Ci = curie; g = gram; HEU = highly enriched uranium; HTO = tritiated water; LCF = latent cancer fatalities; LINAC = Linear Accelerator; MEI = maximally exposed individual; Pu = plutonium; SNM = special nuclear materials.
[a] Based on the population of approximately 6,900,000 person residing within 50 miles of LLNL.
[b] Increased likelihood of a latent cancer fatality.
[c] Increased number of latent cancer fatalities.

The collective radiation dose to the approximately 6,900,000 people living within 50 miles of LLNL under the multiple-building release scenario for unfavorable meteorological conditions was calculated to be 2,750 person-rem. Using the dose-to-risk conversion factor of 6×10^{-4} per person-rem, the collective population dose is estimated to result in 1.65 LCFs to this population.

D.6.2.2 *Chemical Releases*

Table D.6.2–7 presents those facilities for which a chemical release has been postulated to be initiated by the 0.8-*g* earthquake. Each of these individual facility releases was analyzed in Section D.3. Tables D.6.2–8 and D.6.2–9 present the results of the analysis for each of these facility releases for median and unfavorable meteorological conditions, respectively. As can be seen in Table D.6.2–8, under the multiple-building release scenario, the consequences at the site boundary would be dominated by the chlorine rupture and release from Building 332 (median meteorology), and the toxic gas release (nitrogen dioxide) from Building 334 (unfavorable meteorological conditions). The chemical releases in this scenario apply for all alternatives.

TABLE D.6.2–7.—*Facilities and Chemical Releases Under the Multiple-Building Accident Scenario*

Building	Accident	Source Term
Building 191, High Explosives Application Facility	Chemical dispersion	0.1 lb 1,2-Dichloroethane
Building 231, Vault Materials Management Complex	Spill release of toxic materials	2,256 g LiOH
Building 239, Radiography Facility	Toxic gas release	10,000 g NO_2
Building 322, Plating Shop	Multiple Container Liquid Spill	100 lb hydrofluoric acid
Building 331, Tritium Facility actinide activities	Nitric acid spill	38 L nitric acid
Building 332, Plutonium Facility	Unmitigated chlorine rupture	100 lb chlorine
Building 334, Hardened Engineering Test Building	Toxic gas release	40,000 g NO_2
Building 514/612/693, Radioactive and Hazardous Waste Management Complex	Earthquake	422 lb Freon-22 (chlorodifluoromethane)
Building 581, National Ignition Facility	Materials spill	400 L nitric acid solution (70%)

Source: Original.
g = gram; L = liter; lb = pound; LiOH = lithium hydroxide; NO_2 = nitrogen dioxide.

For this accident, under median meteorological conditions, concentrations above the ERPG-2 level would exist as far out as 1.7 kilometers from Building 332, which would extend about 900 meters beyond the site boundary. At the site boundary, the concentration would be below ERPG-3 values, but above ERPG-2 values, indicating that persons exposed to this concentration could experience irreversible or other serious health effects or symptoms that could impair their ability to take protective action. At the noninvolved worker location, the concentration would be above ERPG-3 values, indicating that individuals exposed to this concentration could experience or develop life-threatening health effects.

For this accident, under unfavorable meteorological conditions, concentrations above the ERPG-2 level would exist as far as 2.9 kilometers from Building 334. At the site boundary and at the noninvolved worker location, the concentration would be above ERPG-3 values, indicating that individuals exposed to this concentration could experience or develop life-threatening health effects.

TABLE D.6.2–8.—*Potential Multi-Building Accident Scenario Chemical Consequences (Median Meteorology)*

		Noninvolved Worker		Site Boundary		
ERPG-2 Concentration (ppm)	**ERPG-3 Concentration (ppm)**	**Average Predicted Concentration (ppm)**	**Fraction of ERPG-2**	**Average Predicted Concentration (ppm)**	**Fraction of ERPG-2**	**ERPG-2 Distance (meters)**
Building 191, High Explosives Application Facility – Chemical dispersion (1,2-Dichloroethane)						
200	300	0.108	5.4×10^{-4}	0.0175	8.8×10^{-5}	11
Building 239, Radiography Facility – Toxic gas release (NO_2)						
5	20	27.5	5.5	0.81	0.16	246
Building 322, Plating Shop – Multiple Container Liquid Spill (Hydrofluoric Acid)						
20	50	371	18.6	4.86	0.24	475
Building 331, Tritium Facility actinide activities – Nitric acid spill						
6	78	24	4	0.24	0.04	205
Building 332, Plutonium Facility – Chlorine release						
3	20	593	198	11.6	3.9	1,700
Building 334, Hardened Engineering Test Building – Toxic gas release (NO_2)						
5	20	110	22	2.02	0.40	529
Building 514/612/693, Radioactive and Hazardous Waste Management Complex – Earthquake release of Freon-22						
7,500	7,500	415	0.06	169	0.023	19
Building 581, National Ignition Facility – Release of nitric acid solution						
6	78	130	21.7	12.3	2.1	536

Source: Original.
ERPG = Emergency Response Planning Guideline; NO_2 = nitrogen dioxide; ppm = parts per million.

TABLE D.6.2–9.—*Lawrence Livermore National Laboratory Multi-Building Accident Scenario Chemical Consequences (Unfavorable Meteorology)*

		Noninvolved Worker		Site Boundary		
ERPG-2 Concentration (ppm)	**ERPG-3 Concentration (ppm)**	**Average Predicted Concentration (ppm)**	**Fraction of ERPG-2**	**Average Predicted Concentration (ppm)**	**Fraction of ERPG-2**	**ERPG-2 Distance (meters)**
Building 191, High Explosives Application Facility – Chemical dispersion (1,2-Dichloroethane)						
200	300	1.41	7.1×10^{-3}	0.272	1.4×10^{-3}	11
Building 239, Radiography Facility – Toxic gas release (NO_2)						
5	20	1,430	286	35.2	7.04	1,600
Building 322, Plating Shop – Multiple Container Liquid Spill (Hydrofluoric Acid)						
20	50	4,680	234	46.4	2.32	1,400
Building 331, Tritium Facility – Nitric Acid Spill						
65	78	68	11.3	1.1	0.18	358
Building 332, Plutonium Facility – Chlorine release						
3	20	5,220	1,740	16.9	5.64	1,900
Building 334, Hardened Engineering Test Building – Toxic gas release (NO_2)						
5	20	5,720	1,140	77.8	15.6	2,900
Building 514/612/693, Radioactive and Hazardous Waste Management Complex – Earthquake release of Freon-22						
7,500	7,500	4,080	0.54	1,312	0.17	75
Building 581, National Ignition Facility – Release of Nitric Acid Solution						
6	78	438	73	51.4	8.57	1,400

Source: Original.
ERPG = Emergency Response Planning Guideline; NO_2 = nitrogen dioxide; ppm = parts per million.

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