DOE/EIS-0236
Vol. 3 of 4

Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management

Volume III

United States Department of Energy

September 1996

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Stockpile Stewardship and Management / Volume III

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ABSTRACT: In response to the end of the Cold War and changes in the world's political regimes, the United States is not producing new-design nuclear weapons. Instead, the emphasis of the U.S. nuclear weapons program is on reducing the size of the Nation's nuclear stockpile by dismantling existing nuclear weapons. The Department of Energy (DOE) has been directed by the President and Congress to maintain the safety and reliability of the reduced nuclear weapons stockpile in the absence of underground nuclear testing. In order to fulfill that responsibility, DOE has developed a Stockpile Stewardship and Management Program to provide a single highly integrated technical program for maintaining the continued safety and reliability of the nuclear stockpile. The Stockpile Stewardship and Management PEIS describes and analyzes alternative ways to implement the proposed actions for the Stockpile Stewardship and Management Program.

Stockpile stewardship refers to activities associated with research, design, development and testing of nuclear weapons and the assessment and certification of the safety and reliability. The stockpile stewardship portion of the PEIS evaluates the potential impacts of three proposed facilities: the National Ignition Facility (NIF), the Contained Firing Facility (CFF), and the Atlas Facility. The stockpile stewardship alternatives involving these facilities could affect four sites: Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL), Sandia National Laboratories (SNL), and Nevada Test Site (NTS).

Stockpile management refers to activities associated with the production, maintenance, surveillance, refurbishment, and dismantlement of the nuclear weapons stockpile. The stockpile management portion of this PEIS evaluates the potential impacts of carrying out stockpile management alternatives at eight sites: Oak Ridge Reservation (ORR), Savannah River Site (SRS), Kansas City Plant (KCP), Pantex Plant (Pantex), LANL, LLNL, SNL, and NTS. The stockpile management alternatives are assessed for nuclear weapons assembly/disassembly and for fabricating pits, secondaries and cases, high explosives, and nonnuclear components.

The Stockpile Stewardship and Management PEIS also evaluates the No Action alternative of relying on existing facilities and continuing the missions at current sites to achieve both the stockpile stewardship and management missions. The No Action alternative assesses the environmental impacts of the on-going Stockpile Stewardship and Management Program and provides a baseline against which alternatives can be evaluated.

DOE has identified the following preferred alternative for the Stockpile Stewardship and Management Program:

Stockpile Stewardship:
- Construct and operate NIF at LLNL
- Construct and operate CFF at LLNL
- Construct and operate the Atlas Facility at LANL

Stockpile Management:
- Secondary and Case Component Fabrication—downsize the Y-12 Plant at ORR
- Pit Component Fabrication—reestablish capability and appropriate capacity at LANL

- Assembly/Disassembly—downsize at Pantex
- High Explosives Fabrication—downsize at Pantex
- Nonnuclear Component Fabrication—downsize at KCP
- Based on the analyses performed to support this PEIS, the preferred alternatives for strategic reserve storage are as follows: (1) highly enriched uranium strategic reserve storage at Y–12; and (2) plutonium pit strategic reserve storage in Zone 12 at Pantex. The preferred alternatives for strategic reserve storage could change based upon decisions to be made in regard to the *Storage and Disposition of Weapons-Usable Fissile Materials Final PEIS*. Decisions on strategic storage will not be made in the upcoming ROD for the Stockpile Stewardship and Management Program. Storage decisions are not expected to be made until both the *Stockpile Stewardship and Management Final PEIS* and the *Storage and Disposition of Weapons-Usable Fissile Materials Final PEIS* are completed.

The preferred alternative for plutonium-242 oxide at SRS is to transport the material to LANL for storage.

Evaluation of impacts on land resources, site infrastructure, air quality, water resources, geology and soils, biotic resources, cultural and paleontological resources, socioeconomics, waste management, environmental justice, as well as radiological and hazardous chemical impacts during normal operation and accidents to workers and the public are included in the assessment. The PEIS presents unclassified information only. A classified appendix has also been prepared to support the PEIS.

PUBLIC COMMENTS: The public comment period on the Draft PEIS was conducted from March 8, 1996 to May 7, 1996. During the comment period, public hearings were held in Los Alamos, NM; Albuquerque, NM; Las Vegas, NV; Oak Ridge, TN; Kansas City, MO; Livermore, CA; Washington, DC; Amarillo, TX; Santa Fe, NM; and North Augusta, SC. The Draft PEIS was made available through mailings, requests to DOE's Office of Reconfiguration, and at DOE Public Reading Rooms. In preparing the Final PEIS, DOE considered comments received by mail, fax, handed in at hearings, transcribed from messages recorded by telephone, and those transcribed via Internet. In addition, comments and concerns identified during discussions at public hearings were considered.

In response to comments submitted after issuance of the Draft PEIS and due to additional technical details not available at the time of issuance of the Draft, Volumes I, II, and III of the Final PEIS contain revisions and changes. The revisions and changes made since the issuance of the Draft document are indicated by a double underline for minor word changes or by a sidebar in the margin for paragraph or larger changes. In addition, Volume I and each appendix in Volume III provide a unique reference list to enable the reader to further review and research selected topics. Volume IV (Comment Response Document) of the PEIS contains the comments received during public review of the Draft PEIS and the DOE responses to those comments. DOE has public reading rooms near each affected site and in Washington, DC where these referenced documents may be reviewed or obtained for review.

APPENDIX I

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ACRONYMS, ABBREVIATIONS, CHEMICAL SYMBOLS, AND UNITS OF MEASURE

Acronyms and Abbreviations

ABAG	Association of Bay Area Governments
APCR	Air Pollution Control Regulations (District Board of Clark County)
AQCR	air quality control region
AQMD	Air Quality Management District
BAAQMD	Bay Area Air Quality Management District
BACT	best available control technology
BART	Bay Area Rapid Transit
BEA	Bureau of Economic Analysis
CAA	*Clean Air Act*
CFR	Code of Federal Regulations
CNR	composite noise rating
CTBT	*Comprehensive Test Ban Treaty*
CWA	*Clean Water Act*
D&D	decontamination and decommissioning
DOE	Department of Energy
DOT	Department of Transportation
DP	DOE Office of the the Assistant Secretary for Defense Programs
EIB	Environmental Improvement Board
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERPG-2	Emergency Response Guidelines-2
FR	*Federal Register*
HLW	high-level waste
HSWA	*Hazardous Solid Waste Amendments* of 1984
ICF	inertial confinement fusion
ICRP	International Commission on Radiological Protection
ISCST2	Industrial Source Complex Short Term Model, Version 2 (computer code)
LANL	Los Alamos National Laboratory
LEPC	Local Emergency Planning Committee
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAC	Nevada Administrative Code
NEPA	*National Environmental Policy Act*
NIF	National Ignition Facility
NLVF	North Las Vegas Facility

NMAQCR	New Mexico Air Quality Control Region
NMAQD	New Mexico Air Quality District
NMR	New Mexico Regulations
NMSR	New Mexico State Road
Nova	laser facility at Lawrence Livermore National Laboratory
Novette	laser system at Lawrence Livermore National Laboratory
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NTS	Nevada Test Site
OSHA	Occupational Safety and Health Administration
PEIS	Programmatic Environmental Impact Statement
PSA	Project-Specific Analysis
PSD	Prevention of Significant Deterioration
R&D	research and development
RCRA	*Resource Conservation and Recovery Act*
ROD	Record of Decision
ROI	region of influence
SAAQS	State Ambient Air Quality Standards
SARA	*Superfund Amendments and Reauthorization Act* of 1986
Shiva	laser system at Lawrence Livermore National Laboratory
SNL	Sandia National Laboratories
SR	state road or state route
START I	Strategic Arms Reduction Talks I Treaty
START II	Strategic Arms Reduction Talks II Protocol
TA	technical area
TRU	transuranic
TSCA	*Toxic Substances Control Act*
UC	University of California
ULI	Urban Land Institute
USC	United States Code

Chemical Symbols

NOx	nitrogen oxides
PCB	polychlorinated biphenyl
PM	particulate matter
PM_{10}	particulate matter of aerodynamic diameter equal to or less than 10 micrometers
TNT	trinitrotoluene
TSP	total suspended particulates
VOCs	volatile organic compounds

Units of Measure

Btu	British thermal unit(s)
Ci	Curie(s)
cm	centimeter(s)
cm^2	square centimeter(s)
dB	decibel(s)
dBA	decibel(s), a-weighted
dpm	disintegration(s) per minute
ft	foot (feet)
ft^2	square foot (feet)
ft^3	cubic foot (feet)
gal	gallon(s)
ha	hectare(s)
hr	hour(s)
in	inch(es)
in^2	square inch(es)
J	joule(s)
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
kph	kilometers per hour
kV	kilovolt
L	liter(s)
lb	pound(s)
µg	microgram(s) (one-millionth of a gram)
µm	micrometer(s)
µs	microsecond(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
m/s	meters per second
MBtu	thousand British thermal unit(s)
mg	milligram(s)
MGY	million gallons per year
MLY	million liters per year
mi	mile(s)
mi^2	square mile(s)
MJ	megajoule(s)
mph	mile(s) per hour
mrem	millirem
MW	megawatts
ng	nanograms
person-rem	radiation dose equivalent to population
ppm	part(s) per million

rad	unit of absorbed dose
rem	unit of radiation dose equivalent
s	second(s)
t	metric ton(s) (1,000 kg)
W	watts
yr	year(s)
°C	degree(s) Celsius
°F	degree(s) Fahrenheit

Metric Conversion Chart and Metric Prefixes

To Convert to Metric			To Convert from Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
square inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.43560	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32, then multiply by 5/9	Celsius	Celsius	Multiply by 9/5, then add 32	Fahrenheit

Prefix	Symbol	Multiplication Factor
exa-	E	$1\,000\,000\,000\,000\,000\,000 = 10^{18}$
peta-	P	$1\,000\,000\,000\,000\,000 = 10^{15}$
tera-	T	$1\,000\,000\,000\,000 = 10^{12}$
giga-	G	$1\,000\,000\,000 = 10^{9}$
mega-	M	$1\,000\,000 = 10^{6}$
kilo-	k	$1\,000 = 10^{3}$
hecto-	h	$100 = 10^{2}$
deka-	da	$10 = 10^{1}$
deci-	d	$0.1 = 10^{-1}$
centi-	c	$0.01 = 10^{-2}$
milli-	m	$0.001 = 10^{-3}$
micro-	μ	$0.000\,001 = 10^{-6}$
nano-	n	$0.000\,000\,001 = 10^{-9}$
pico-	p	$0.000\,000\,000\,001 = 10^{-12}$
femto-	f	$0.000\,000\,000\,000\,001 = 10^{-15}$
atto-	a	$0.000\,000\,000\,000\,000\,001 = 10^{-18}$

SUMMARY

I-S.1 INTRODUCTION

The U.S. Department of Energy (DOE) proposes to construct and operate the National Ignition Facility (NIF). The goals of NIF are to achieve fusion ignition in the laboratory for the first time by using inertial confinement fusion (ICF) technology based on an advanced design solid-state laser and to conduct high-energy-density experiments in support of national security and civilian applications.

The purpose of this project-specific analysis is to assess the environmental impacts of construction and operation of NIF. This document describes the project and its purpose and need, considers site alternatives and project design options, delineates the affected environments, assesses potential environmental impacts, and suggests mitigation measures. This analysis, as an appendix to the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, is equivalent to a stand-alone environmental impact statement on the proposed NIF.

I-S.2 PURPOSE AND NEED

NIF would provide a unique capability for DOE's science-based stewardship of the nuclear weapons stockpile. The goal of obtaining fusion ignition and burn would attract and challenge top scientific and engineering talent with a problem containing many of the same elements of physical understanding as those necessary for stewardship of the nuclear stockpile. Planned experiments with NIF, at temperatures and pressures near those that occur in nuclear weapon detonations, would provide the data needed to verify certain aspects of sophisticated computer models. These models are needed to simulate weapons physics and to provide insights on the reliability of the Nation's nuclear weapons stockpile. Specially designed NIF experiments could also address specific issues of modeling or physics that are of concern because of changes in weapons due to aging or remanufacture. Finally, NIF experiments could provide a unique source of radiation for studies on nuclear weapon effects.

NIF experiments could address, to various degrees, certain weapons issues connected with fusion ignition and boosting; weapon effects; radiation transport; and secondary implosion, ignition, and output. Most of these processes occur at very high energy density (i.e., at high temperatures and pressures) and are relevant to a weapon's reliability. NIF would achieve higher temperatures and pressures, albeit in a very small volume, than any other existing or proposed stockpile stewardship facility. It is also the only facility that would achieve fusion ignition. Safety issues principally connected with the high explosive and fissile material implosion in a weapon would not be addressed by NIF.

Present computer codes are not adequate to calculate all the high-energy-density phenomena that occur in an exploding nuclear weapon. The high temperatures and pressures achievable with NIF would be used to measure properties of matter at the extreme conditions expected and, thus, verify aspects of advanced computer models. If an unanticipated change relevant to the high-energy-density phase of weapon operation is observed in the weapon surveillance program, specially designed NIF experiments could aid weapons scientists in validating aspects of their integrated computer models to assess whether that change would adversely impact the weapon's reliability. It is important to have NIF operating well before the period 2005 to 2010, as weapons age beyond their original design lifetime.

As a multipurpose facility, NIF would also be important to the Nation's energy, basic science, and technology missions. Its data would determine whether ICF can be a viable source of electric power in the future. Achieving ignition, optimizing the various target gain curves, and providing initial data on fusion reactor materials would allow sound decisions to be made concerning inertial fusion energy development.

NIF experiments would also achieve the same temperatures and pressures that exist in the sun and other stars, providing new laboratory capabilities for exploring basic high-energy-density sciences such as astrophysics and plasma physics. As the world's largest optical instrument, NIF could spur high technology industries in such areas as optics, lasers, materials, high-speed instrumentation, semiconductors, and precision manufacturing.

Achievement of fusion ignition at NIF would fulfill a major goal of the ICF program. Both the National Academy of Sciences in 1990 and the Inertial Confine-

ment Fusion Advisory Committee have recommended proceeding with an ignition facility based upon solid-state laser technology.

I-S.3 PROJECT DESCRIPTION

Conventional construction techniques would be used to build NIF. The extent and exact nature of such activities as site clearing, infrastructure improvements, and support facility construction required would depend on the specific location selected for NIF. Construction of NIF would be organized in the following sequential phases: (1) initial building construction, (2) special equipment structures installation, (3) final building construction, (4) final installation preparation, (5) clean component installation, and (6) final laser/target systems installation.

Once operational, NIF would provide the capability to perform the full range of target physics experiments leading up to and including ignition and burn. It would also allow researchers to design experiments studying weapons effects, weapons physics, fusion energy, and the basic sciences. NIF would consist of two main components: a collection of 192 laser generation and transport systems and a target area including a target chamber and associated equipment. An advanced, integrated sensor and computer system would control the lasers and collect data from diagnostic equipment. These elements would all be housed in one central facility. Required support facilities, such as assembly areas, maintenance areas, machine and mechanical shops, and offices would be located nearby. General site requirements would include control by DOE Office of the Assistant Secretary for Defense Programs (DP), significant ICF infrastructure, protection of the public and the environment, hazardous and radioactive waste management capability, and transportation services. The total land area requirement for NIF, including direct-support buildings, would be about 20 hectares (ha) (50 acres). Depending on the site selected, many of the NIF needs may be served by existing facilities, reducing the requirements of new land area to 3.2 to 18.2 ha (7.9 to 45 acres).

I-S.4 ALTERNATIVES

The alternatives considered in this analysis consist of five candidate locations at four DP sites (Lawrence Livermore National Laboratory [LLNL], Los Alamos National Laboratory [LANL], Nevada Test Site [NTS] - Area 22 main site location, North Las Vegas f [NLVF] location near NTS, and Sandia National ratories [SNL]), the No Action alternative, a design capabilities. The designs under consid consist of two operational capabilities, the Co Design Option and the Enhanced Option.

I-S.4.1 Alternative Sites

DOE has selected one preferred (LLNL) and alternative (LANL, NTS, and SNL) NIF sites tha most of the following site criteria: DP-con Federal site, significant ICF infrastructure, ad protection of the public and the enviro hazardous and radioactive waste managemen ity, and adequate transportation services for tra targets. While the two NTS locations, Area NLVF, do not currently have ICF infrastruct have been included to ensure that DOE exam potential lost efficiencies that might arise by advantage of the infrastructure that must be ma at these sites in accordance with the pres mandate to maintain a test-readiness posture.

Lawrence Livermore National Laboratory. LL located about 64 kilometers (km) (40 miles [of San Francisco in southern Alameda County occupies 332 ha (821 acres). NIF would be situ an 8.1-ha (20-acre) disturbed grassland area northeastern quadrant of LLNL, adjacent to ex ICF facilities.

Los Alamos National Laboratory. LANL is loca Los Alamos County, in north-central New M approximately 97 km (60 mi) north-northeast of querque. LANL occupies 11,300 ha (28,000 a NIF would be located on a 4-ha (10-acre) ar Technical Area (TA) 58, an undeveloped forest adjacent to TA-3, the hub for LANL administra support activities.

Nevada Test Site. Area 22 at NTS is located in sou Nye County in southern Nevada, about 105 km (northwest of Las Vegas. NTS occupies about 35 ha (867,000 acres). NIF would be located on an 18 (45-acre) area within Area 22 in undeveloped des bush habitat, southwest of Mercury Base Camp southeastern portion of the NTS. NLVF is loca the city of North Las Vegas, Nevada, and occup

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of construction and operation of NIF at the alternative candidate sites. The comparison is based on the assessments in section I.4 of this analysis. Factors analyzed include land use and visual resources; air quality and noise; water resources; biotic resources; cultural and paleontological resources; socioeconomics; and radiological and chemical health, safety, and risk. Where they would differ, the potential impacts of the two operational scenarios (Conceptual Design Option and Enhanced Option), are also compared in table I-S.5–1. Table I-S.5–2 compares waste management issues for each candidate site.

The analyses in this appendix indicate that there would be few significant differences in the adverse environmental impacts among the candidate sites analyzed. The maximum 24-hour particulate matter 10 microns or smaller (PM_{10}) concentration in the air during site clearing would exceed applicable standards at LLNL and NLVF (table I-S.5–1). However, the ambient air quality impacts would be localized and of short duration. Uncommitted land requirements would be greatest at NTS (18.2 ha [45.0 acres]), although this acreage is less than 1 percent of the uncommitted land at NTS. Conversely, the least amount of uncommitted land that would be required for NIF would be 3.2 ha (7.9 acres) at NLVF. However, this acreage represents the largest percentage of uncommitted land at a candidate site (56 percent). Of greater significance would be the quality of the habitat of the uncommitted land that would be affected by NIF construction. The highest-quality habitats that would be affected would be forest (4.0 ha [9.9 acres]) at LANL or desert (18.2 ha [45 acres]) at NTS. At the other candidate sites, habitat disturbance would occur to grassland (LLNL and SNL) or to an area of sparse vegetation (NLVF) (table I-S.5–1). The risk of cancer to members of the public from a facility accident involving the release of radioactive material would be greatest at NLVF and SNL (table I-S.5–1), although the potential for the actual occurrence of such an accident would be extremely low.

NIF will comply with all applicable Federal, state, and local environmental regulatory requirements, including the *California Environmental Quality Act* if NIF is sited in the State of California. The candidate sites have also enacted several mitigative measures for construction actions that would also be applicable to NIF construction. While each of these mitigative measures may be minor, in combination they could significantly reduce impacts to the environmental resources of the selected site. The evaluations of environmental consequence NIF construction and operation summarized in ta I-S.5–1 and I-S.5–2 are based on the assumption the mitigative measures would be carried out if proposed action were undertaken.

Even with mitigation, construction and operation NIF could result in unavoidable residual adve effects. These effects would include the disturbance up to 18.2 ha (45 acres) of land to construct NIF provide additional supporting infrastructure and acc roads (table I-S.5–1). However, land required for N at any of the candidate sites would not conflict with development or land use plans. Concentrations PM_{10} and total suspended particulates in the air expected to be close to or exceed the 24-hour ambi PM_{10} and total suspended particulates standards dur peak construction periods under dry and windy cond tions. Such exceedances are not uncommon for la construction projects. Loss of wildlife habitat wit the disturbed areas would be unavoidable, th resulting in some localized effects on biota. Fo unavoidable adverse socioeconomic impacts wo occur in any of the regions of influence for N candidate sites. No adverse disproportionate enviro mental justice concerns would be expected at any of candidate sites, except for a minor potential to disp portionately impact minority populations in the regi of influence for NLVF.

Over the 30-year operational life of NIF, the pub would be exposed to a very small dose of radiatio (table I-S.5–1). No cancer fatalities would be expect to occur from exposures associated with routine N operations under either the Conceptual Design Enhanced options. A radiological accident at N would not cause any cancer fatalities to the pub except possibly at NLVF (1 and 2 estimated cance fatalities for the conceptual design option and enhanc option, respectively) and SNL (1 estimated cance fatality for the enhanced option) (table I-S.5–1). Th cancer fatality risk (cancer fatality per year) associat with radiological exposure from an accident involvi transport of NIF tritium targets would range fro $1x10^{-8}$ to $8x10^{-10}$; whereas the nonradiological fatal risks associated with vehicular emissions and accide would be in the range of 10^{-3} to 10^{-4} (table I-S.5–1).

Although each candidate site would implement was minimization practices, the generation of additiona wastes would be unavoidable. All candidate sites hav

TABLE I-S.5–1.—*Comparison of Alternatives for the Proposed National Ignition Facility* [Page 1 of 4]

Environmental Resource Parameter	No Action	LLNL[a]	LANL[a]	NTS[a]	NLVF[a]	SNL[a]
Land Resources						
Uncommitted land requirements[b] (hectares)	None	8.1	4.0	18.2	3.2	10.5
Uncommitted land requirements (%)	None	11	1	<1	56	7
Number of buildings to be constructed	None	2	3	5	5	7
Conflicts with site development or land-use plans	No	No	No	No	No	No
Air Quality and Noise						
Predicted maximum 24-hour particulate matter 10 microns or smaller concentration during site clearing ($\mu g/m^3$)[c]/national standard ($\mu g/m^3$)	None	130/50[d]	124/150	175/150	183/150	52/150
Baseline emissions (t/yr)/baseline emissions plus NIF emissions (t/yr) during operation[c]						
Particulate matter 10 microns or smaller	Variable	3.36/3.52	2.56/2.74	86.8/86.9	0.78/0.99	3.76/3.96
Volatile organic compounds	Variable	13.10/13.66	2.89/3.45	ND/NA	3.45/4.02	1.65/2.22
Carbon monoxide	Variable	3.99/4.42	21.58/22.04	ND/NA	0.23/0.79	0.23/0.75
Nitrogen dioxide	Variable	23.50/25.29	53.88/55.79	ND/NA	1.07/3.35	1.07/3.22
Sulfur dioxide	Variable	0.37/0.40	0.70/0.73	71.1/71.1	0.07/0.11	0.07/0.11
Noise (qualitative)	No Effect	Minor[f]	Minor[f]	Minor[f]	Minor[f]	Minor[f]
Water Resources						
Construction						
Water requirement (MLY)	None	2.95	2.95	2.95	2.95	2.95
Water requirement as percent of current usage (%)	None	0.31	0.05	0.12	4.20	0.21
Operation						
Water requirement (MLY)	None	152	152	152	152	152
Water requirement as percent of current usage (%)	None	16	2.8	6.3	220[g]	11

TABLE I-8.5-1.—Comparison of Alternatives for the Proposed National Ignition Facility [Page 2 of 4]

Environmental Resource Parameter	No Action	LLNL[a]	LANL[a]	NTS[a]	NLVF[a]	SNL[a]
Biotic Resources						
Maximum habitat reduction[b] (hectares)	None	8.1	4.0	18.2	3.2	10.5
Habitat to be impacted	None	Grassland	Forest	Creosote bush desert	Sparse vegetation	Grassland
Wildlife disturbance[c]	None	Minor	Moderate	Moderate	Negligible	Minor
Potential impact to rare, threatened, or endangered species	None	Loss of noncritical, low-quality habitat for several species. Minor risk (mitigable) to white-tailed kite.	Loss of noncritical habitat for several species.	Loss of noncritical habitat for several species. Minor risk (mitigable) to desert tortoise.	None	Loss of noncritical, low-quality habitat for several species.
Cultural Resources (Qualitative)	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
Socioeconomics						
Construction[d]						
Total jobs	None	2,870	1,130	1,640	1,640	1,770
In-migrating population	None	1,600	2,200	2,340	2,340	3,065
Number of housing units	None	580	800	850	850	1,120
Number of trips generated (per day)	None	902	518	538	538	538
Public finance (% change over 1995 fund balance)	None	-0.03	4.40	0.21	0.21	0.06
Public services (increase in number of workers)	None	15	50	47	47	81
Environmental justice disproportionate impacts on:						
- minority populations	None	None	None	None	Low	None
- low-income populations	None	None	None	None	None	None
Operation[e]						
Total jobs	0 to -153	890	600	620	620	670
In-migrating population	None	360	610	440	440	660
Number of housing units	None	130	220	160	160	240

TABLE I-S.5–1.—*Comparison of Alternatives for the Proposed National Ignition Facility* [Page 3 of 4]

Environmental Resource Parameter	No Action	LLNL[a]	LANL[a]	NTS[a]	NLVF[a]	SNL[a]
Socioeconomics (Continued)						
Number of trips generated per day	0 to -190	630	630	630	630	630
Public finance (% change over 1995 fund balance)	None	-0.02	0.71	0.04	0.04	0.01
Public services (increase in number of workers)	None	4	15	7	7	21
Environmental justice-disproportionate adverse health/environmental impacts on:						
- minority populations	None	None	None	None	Low	None
- low-income populations	None	None	None	None	None	None
Human Health (Radiological)						
Public (30-yr life of project)						
MEI dose (mrem)	None	1(3)	0.09 (0.3)	0.003 (0.01)	6 (18)	0.03 (0.1)
Population dose (person-rem)	None	2(6)	0.6 (2)	0.009 (0.03)	6 (18)	2 (6)
Cancer fatalities	None	None	None	None	None	None
Facility Accidents (Radiological)						
Public dose (person-rem)	None	260 (440)	290 (490)	41 (70)	3,000 (4,900)[l]	1,100 (1,800)
Cancer fatalities	None	None	None	None	1 (2)	0 (1)
Facility Accidents (Chemical)						
Distance to end of hazard zone from accident[m] (m)	None	237 (778)	237 (778)	239 (784)	237 (778)	237 (778)
Transportation Accidents[n] ***(Radiological)***						
Public dose risk (person-rem/yr)	None	2.2×10^{-6} (1.8×10^{-5})	2.6×10^{-6} (2×10^{-5})	2.4×10^{-6} (1.9×10^{-5})	2.4×10^{-6} (1.9×10^{-5})	1.6×10^{-6} (1.2×10^{-5})
Cancer fatalities risk	None	1×10^{-9} (9×10^{-9})	1×10^{-9} (1×10^{-8})	1×10^{-9} (9×10^{-9})	1×10^{-9} (9×10^{-9})	8×10^{-10} (6×10^{-9})

TABLE I-S.5–1.—*Comparison of Alternatives for the Proposed National Ignition Facility* [Page 4 of 4]

Environmental Resource Parameter	No Action	LLNL[a]	LANL[a]	NTS[a]	NLVF[a]	SNL[a]
Transportation Impacts (Nonradiological) (Fatalities/Year)[o]						
Vehicular emissions	None	$1x10^{-3}$ ($2x10^{-3}$)	$8x10^{-4}$ ($2x10^{-3}$)	$8x10^{-4}$ ($2x10^{-3}$)	$8x10^{-4}$ ($2x10^{-3}$)	$2x10^{-3}$ ($4x10^{-3}$)
Accidents	None	$2x10^{-3}$ ($4x10^{-3}$)	$2x10^{-3}$ ($4x10^{-3}$)	$2x10^{-3}$ ($6x10^{-3}$)	$2x10^{-3}$ ($5x10^{-3}$)	$2x10^{-3}$ ($4x10^{-3}$)

[a] Value for Enhanced Option is given in parentheses only for parameters that differ from the Conceptual Design Option.

[b] Uncommitted land, as defined by each of the sites, is land that is currently open and available for NIF development. An additional 2 hectares would be temporarily required for a construction laydown area at LLNL. Construction laydown areas for the other sites would be located within the area designated for NIF.

[c] Estimated by combining baseline concentrations and NIF contributions based on dust control measures using water spray twice a day (with continuous water spraying and/or chemical dust suppressants for LLNL and NLVF sites).

[d] The 24-hour California state standards for particulate matter (50 $\mu g/m^3$) are more stringent than the national standards (150 $\mu g/m^3$).

[e] No action emissions would be equivalent to baseline emissions provided under the candidate site columns.

[f] Noise levels may be annoying during the peak construction activity associated with site clearing but would not require a hearing conservation plan.

[g] Current water supply capacity would be adequate to meet the additional requirements for NIF.

[h] Areas would be maximum habitat loss assuming total site clearing before any site revegetation or landscaping. An additional 2 hectares would be temporarily cleared for the construction laydown area at LLNL.

[i] Qualitative estimate of wildlife disturbance based on quality of habitat at and surrounding NIF location, which influences the number of wildlife species that may be present and the habituation of wildlife to human activities.

[j] Values provided are for the peak construction year only.

[k] The No Action alternative would not have measurable impacts on socioeconomics at the NTS or NLVF sites. However, at LLNL, LANL, and SNL, No Action could result in slightly reduced employment and associated effects. No Action could result in a reduction of 153 jobs (direct and indirect) and 190 fewer trips generated per day at LLNL; a reduction of 27 jobs and 38 fewer trips generated at LANL; and 29 fewer jobs and 38 fewer trips generated at SNL.

[l] Higher public dose for NLVF is due to higher population density near NLVF.

[m] The hazard zone refers to the area downwind of an accident where concentrations would be above emergency planning levels.

[n] Risks are presented from the manufacturing site yielding the largest risks.

[o] Collective population fatalities were calculated for 145 shipments (Conceptual Design Option) and 335 shipments (Enhanced Design). For example, a reported value of $4x10^{-3}$ fatalities suggests that no fatalities are expected for the proposed action. However, one single fatality out of the entire affected population might be expected over the course of 250 years if the same number of shipments were to continue for that length of time.

Note: ND – No data available; NA – Not applicable.

Source: Derived from tables and text contained in appendix I.

TABLE I-S.5–2.—*Comparison of Waste Management at the Candidate Sites*

Category	LLNL		LANL		NTS		NLVF		SNL	
	Current Capacity (m^3)	Adequate Current or Planned Capacity for NIF	Current Capacity (m^3)	Adequate Current or Planned Capacity for NIF	Current Capacity (m^3)	Adequate Current or Planned Capacity for NIF	Current Capacity (m^3)	Adequate Current or Planned Capacity for NIF	Current Capacity (m^3)	Adequate Current or Planned Capacity for NIF
Treatment										
Low-level										
Liquid	3,736 (34.1 per treatment episode)	Yes	9,000/yr (45/hr)	Yes	None	Yes	None	Yes[a]	Included in mixed low-level	Yes
Solid	None	Yes[a]	76	Yes	None	Yes	None	Yes[a]	Included in mixed low-level	Yes
Mixed										
Liquid	8,750[b]	Yes	None	Yes	None	Yes	None	Yes[a]	Data not available	Yes
Solid	11,800	Yes	None	Yes	None	Yes	None	Yes[a]	Data not available	Yes
Hazardous										
Liquid	97	Yes	Varies	Variable[b]	None	Yes[a]	None	Yes[a]	Data not available	Yes[a]
Solid	None	Yes[a]	Varies	Variable	None	Yes[a]	None	Yes[a]	Data not available	Yes[a]
Disposal										
Low-level										
Liquid	None	Yes[a]	None	Yes	None	Yes	None	Yes[a]	None	Yes
Solid	None	Yes[a]	24-28 ha area available	Yes	650,000	Yes	None	Yes[a]	None	Yes
Mixed										
Liquid	None	Yes[a]	None	Yes	None	Yes	None	Yes[a]	None	Yes
Solid	None	Yes[a]	None	Yes	90,626	Yes	None	Yes[a]	None	Yes
Hazardous										
Liquid	None	Yes[a]	None	Yes	None	Yes[a]	None	Yes[a]	None	Yes[a]
Solid	None	Yes[a]	None	Yes	None	Yes[a]	None	Yes[a]	None	Yes[a]

[a] Shipped offsite.

[b] Varies depending on the waste stream.

Source: Andrews and Tobin 1995; Bowers 1995; NTS 1996.

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APPENDIX I: NATIONAL IGNITION FACILITY PROJECT-SPECIFIC ANALYSIS

I.1 INTRODUCTION

I.1.1 The National Ignition Facility Proposal

As part of its Stockpile Stewardship and Management Program, the U.S. Department of Energy (DOE) proposes to construct and operate the National Ignition Facility (NIF) (DOE 1995b). NIF would contain the world's largest solid-state laser system, which would be used to achieve ignition of nuclear fusion in the laboratory for the first time. NIF would perform fusion, high-energy-density, and radiation-effects experiments in support of stewardship of the Nation's stockpile of nuclear weapons and other basic and applied science objectives.

NIF would consist of 192 laser beams that would be focused into a small target containing a spherical capsule of fusion fuel, positioned in the center of a large spherical target chamber. The energy of the lasers would be deposited into the target in a few billionths of a second, causing the fuel capsule inside the target to implode, thereby compressing and heating the fuel. This process would force atomic nuclei sufficiently close together so that the rate of fusion reactions would become very large. This reaction rate would, in fact, be so rapid that a significant fraction of the fuel would burn up before the target flew apart in a miniature explosion; that is, while the target was held together only by its own inertia. This method for achieving fusion ignition and energy gain is called inertial confinement fusion (ICF). Ignition occurs when the fusion reactions become self sustained; i.e., a significant portion of the fusion reactions result from self heating of the fuel beyond that achievable by the lasers alone. Energy gain occurs when the amount of fusion energy produced by the target exceeds the amount of laser energy supplied to ignite the target. The NIF capsule's fusion yield is expected to be up to 10 times the laser driver energy required to produce fusion ignition.

In January 1993, the Secretary of Energy confirmed the need for NIF and authorized a collaborative effort by the three DOE defense laboratories and the University of Rochester's Laboratory for Laser Energetics to produce the Conceptual Design Report for NIF. The Conceptual Design Report was completed in April 1994. In October 1994, the Secretary of Energy approved initiation of the next phase of the NIF Project, including preliminary design, safety analysis, cost and schedule validation, and *National Environmental Policy Act* (NEPA) analysis preparation that would include public involvement. This NIF Project-Specific Analysis (PSA), prepared as part of the *Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (PEIS), represents that NEPA analysis. This PSA is equivalent to a project-specific EIS. However, it is referred to as a PSA to avoid confusion with the term PEIS. As a part of the Stockpile Stewardship and Management PEIS, this PSA shares certain elements (such as data) common to the main document. However, some of the data described in this PSA are necessarily more detailed than some of the data cited in the Stockpile Stewardship and Management PEIS analysis.

I.1.2 History and Background

Three decades of research and development by U.S. laboratories and private industry has led to the design of NIF. Soon after the invention of the laser in the early 1960s, scientists recognized that the laser might be used to drive an ICF capsule to ignition and that this technology could be used to achieve some of the high-energy-density conditions (such as high temperatures and pressures) that occur in the detonation of nuclear weapons. It was also recognized that if more energy could be produced than that required to ignite a target, such fusion technology might one day also be used to generate electrical power.

Since then, a series of laser systems, each several times more powerful than its predecessor, have been constructed and operated. The first of these laser systems, a single beam system called Longpath, was completed in 1970 and was used experimentally for 5 years, until a two-beam system called Janus was completed in 1974. Janus demonstrated laser-driven

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construction and operation of NIF and from the No Action alternative. This chapter also addresses mitigation commitments and recommendations, adverse effects that cannot be avoided, irreversible and irretrievable commitments of resources, the relationship between short-term uses and long-term productivity, and cumulative impacts. Chapter I.5 (Environmental, Occupational Safety and Health Permits, and Compliance Requirements) discusses environmental regulations, Executive Orders, permits, and laws applicable to NIF construction and operation.

Chapter I.6 (List of Preparers) includes a list (including credentials) of the technical staff who prepared the NIF PSA. Chapter I.7 (Glossary) defines selected technical terms used within this PSA. Chapter I.8 includes a list of references.

I.2 PURPOSE AND NEED FOR THE NATIONAL IGNITION FACILITY

I.2.1 General Background

Under the *Atomic Energy Act* of 1954, as amended (42 *United States Code* 2011 et seq.), the U.S. Department of Energy (DOE) is charged with providing nuclear weapons to support the Nation's nuclear deterrent policy. Thus, DOE must maintain a Complex with sufficient capabilities and capacity to meet current and future weapons requirements. This mission is accomplished in a way that protects the environment and the health and safety of workers and the public.

Recent changes in the global political situation and in national security needs have necessitated corresponding changes in the way DOE must meet its responsibilities regarding the Nation's nuclear weapons. As a result of international arms control agreements (the Strategic Arms Reduction Talks [START I] Treaty and the START II protocol and unilateral decisions by the U.S. Government), the Nation's stockpile will be significantly reduced by 2003. Consequently, the Nation has halted the development of new nuclear weapons, begun closing portions of the DOE weapons complex, and is considering further consolidation and downsizing of the remaining elements in the Complex. In addition, the Nation is observing a moratorium on nuclear testing and is pursuing a *Comprehensive Test Ban Treaty* (CTBT). However, international nuclear dangers remain and, as the President has emphasized, nuclear deterrence will continue to be an important element of the U.S. national security posture. Thus, DOE's responsibilities for ensuring the safety and reliability of the Nation's nuclear stockpile and for maintaining expertise in nuclear weapons generally will continue for the foreseeable future.

In announcing the indefinite extension of the nuclear test moratorium in July 1993, President Clinton reaffirmed the importance of maintaining confidence in the enduring U.S. stockpile by alternative means and the need to ensure that the Nation's nuclear deterrent remains safe, secure, and reliable during a test ban. In 1994, by Presidential Decision Directive and Act of Congress (Public Law 103-160), DOE was directed to establish a Stockpile Stewardship and Management Program to ensure the continued safety and reliability of the remaining weapons and the preservation of the core intellectual and technical competencies of the United States in nuclear weapons in the absence of nuclear testing. Subsequent Presidential decisions established that the United States would seek a "zero-yield" CTBT (August 1995) and that all three of the Nation's nuclear weapons laboratories would be required to ensure the highest continued confidence in the stockpile.

Thus, DOE was required to develop a Stockpile Stewardship and Management Program that would not include any level of nuclear testing but would support the following objectives:

- Full support at all times of the Nation's nuclear deterrent with safe and reliable nuclear weapons while transforming the current Complex (laboratories and production facilities) to one that is more appropriate for a smaller stockpile

- Preservation of the core of intellectual and technical competencies of the weapons laboratories. Without nuclear testing, confidence in the Nation's nuclear stockpile will depend largely on the continued availability of competent people who must make the scientific and technical judgments related to the safety and reliability of nuclear weapons

- Ensurance that the activities needed to maintain the Nation's nuclear deterrent are consistent with the Nation's arms-control and nonproliferation objectives

The purpose and need section that follows (section I.2.2) discusses the National Ignition Facility's (NIF) role in supporting objectives 1 and 2 above. Objective 3 (nonproliferation) was evaluated for NIF in a recent DOE study—*The National Ignition Facility and the Issue of Nonproliferation* (DOE 1995a). That study, prepared by the Office of Arms Control and Nonproliferation of DOE, has been the subject of extensive public involvement, interagency review, and review by outside experts. The study concludes that (1) the technical proliferation concerns at NIF are manageable and therefore can be made acceptable, and (2) NIF can contribute posi-

tively to U.S. arms control and nonproliferation policy goals.

To ensure the continued safety and reliability of the enduring stockpile while achieving a CTBT, the President and the Department of Defense have emphasized the importance of a strong science-based stockpile stewardship program, including NIF. It is important to establish a firm commitment to this program before the issue of ratification of a CTBT arises.

I.2.2 Purpose and Need

I.2.2.1 *Stockpile Stewardship and Management Program*

Although DOE is confident today that the Nation's nuclear weapons stockpile is safe and reliable, it is expected that problems could develop in the future. A recent interlaboratory study, *Stockpile Surveillance: Past and Future* (Johnson et al. 1995), documents the historical evidence. Nuclear weapons, of necessity, contain materials that react with one another slowly even when the weapon is simply being stored. These slow interactions can and have, over time, caused defects in weapons that adversely affect safety and/or reliability. These processes are called "aging." Also, design or manufacturing defects have been found after a weapon enters the stockpile or is remanufactured. The DOE historical database on such incidents shows that there have been hundreds of cases that have necessitated some kind of corrective action because of safety or reliability concerns. Because nuclear weapons in the future will be expected to remain in the stockpile beyond their designed lifetimes, it is to be expected that such incidents will increase.

The Stockpile Stewardship and Management Program (DOE 1995b) defines a science-based program intended to satisfy the three program objectives stated in section I.2.1. Science-based stockpile stewardship would provide the expert judgment, underpinned by scientific understanding, advanced calculations, and modern experimental facilities, to predict, identify, evaluate, and render solutions to problems that affect safety and reliability of the remaining stockpile in the absence of underground testing. The stockpile stewardship program would not replace nuclear testing completely because complex interactions between processes cannot be experimentally simulated. However, for we that have been tested before (and all the we expected to remain in the stockpile have tested), the previous nuclear test databas provide a benchmark that can be used to ev future problems with the stockpile.

Building upon existing capabilities, the science-based stockpile stewardship pro includes an accelerated strategic computing ini and several new experimental facilities th required to provide the data needed to veri models and help assess specific problems that The stewardship program consists of three components that are used to evaluate stockpil veillance data: (1) experimental capabilitie facilities, (2) scientific evaluation by compete entists of the information from the experi capabilities and facilities, and (3) validation computer models using the accelerated st computing initiative. These three components the development of a corrective action to res identified problem.

I.2.2.2 *Physical Processes in Nuclear We*

Because nuclear tests would not be availab sophisticated and comprehensive computer would be needed to conduct essential eva For confidence to be established in these new experimental facilities must be able to pro on all processes in the relevant physical reg occur in weapons. The relevant physical reg be divided into the following groups:

1. Detonation of high explosive implosion of fissile material
2. Conditions for criticality of fi material
3. Fusion ignition and boosting
4. Radiation transport
5. Secondary implosion
6. Secondary ignition, burn, and outp
7. Nuclear weapon effects on other s

The DOE program proposes a set of experimental facilities, each designed to address one or more of these areas in a complementary fashion.

A general understanding of a nuclear weapon would be helpful to better understand these seven categories and their relationship to stockpile stewardship and management and NIF. Modern thermonuclear weapons consist of two stages: a primary stage (fission trigger) and a secondary stage (fusion). The purpose of the primary is to produce x rays to implode the secondary, thereby causing ignition. The secondary is the stage that produces high yields for modern U.S. strategic weapons–typically hundreds of kilotons. The primary contains a subcritical pit of fissile material, generally plutonium, surrounded by a layer of chemical high explosive. The high explosive is detonated, burns rapidly, and compresses the pit. The implosion of the pit increases the density of the fissile material to super criticality, leading to a fission chain reaction and rapid heating. X rays from the hot exploding primary are then channeled by a radiation case to the secondary, where they implode the secondary, creating temperatures and pressures great enough to ignite a fusion reaction in the secondary.

To increase their efficiency, modern primaries can employ a process called boosting. In boosted primaries, the pit contains the hydrogen isotopes deuterium and tritium gas that is compressed and heated. The deuterium and tritium gas undergoes fusion, producing copious quantities of energetic neutrons that flood the compressed pit. The extra burst of neutrons causes significant additional fission reactions that "boost" the primary yield to a much higher value. If the primary fails to boost properly, its yield may be inadequate to drive the secondary, resulting in weapon failure.

I.2.2.3 *The National Ignition Facility as Part of the Stockpile Stewardship and Management Program*

NIF would provide an essential capability for the DOE's science-based stewardship of the nuclear weapons stockpile. The basic goal of NIF is to achieve ignition of thermonuclear fusion in the laboratory by imploding and igniting a small capsule containing a mixture of deuterium and tritium. The goal of obtaining fusion ignition and burn at NIF would attract and challenge top scientific and engineering talent with a problem containing many of the same elements of physical understanding as those necessary for stewardship of the nuclear stockpile. Achieving fusion ignition and conducting experiments at such high temperatures and densities in NIF would make it possible to study the properties of material under conditions close to those they would be subjected to in a nuclear weapon detonation. Thus, specific experiments can be conducted with weapons materials to measure relevant equations of state (what pressures are created at high temperature), opacity (how a material absorbs and emits radiation), and hydrodynamics (how a material moves in response to forces applied). These experiments apply to several of the regimes of interest listed in section I.2.2.2. The following discussion focuses on how NIF can be used to evaluate weapons concerns relevant to the physical regimes in that list.

NIF experiments could examine the growth and control of hydrodynamic instabilities, which are important both in making inertial confinement fusion (ICF) targets ignite and burn and in making nuclear weapons perform reliably. Hydrodynamic instabilities ultimately lead to mixing of some quantity of one material with another. This mix can affect both ignition and burn processes (regimes 3 and 6). NIF experiments can determine how fusion fuels ignite and what helps and what hinders the ignition process (such as how much mix is tolerable).

High-temperature transport of radiation in complex geometries and materials (regime 4) can be examined to test the ability of computer models to predict this transport. Deposition and re-emission of radiation and the general transport problem constitute a very complex process. This process must be understood in order to predict the transport of radiation necessary to ignite ICF targets. In addition, radiation transport experiments can be designed to simulate weapons radiation transport conditions more closely than those in the basic ICF ignition target.

Output calculations must be done on the ICF ignition targets so that the performance of the target can be properly measured. Again, however, specific targets can be designed to alter the output radiation. These experiments can be used to test the computer codes used to calculate the output of weapons.

NIF targets, either the basic type for ignition or specially altered ones, would produce copious x rays, neutrons, gamma rays, and other radiation. These emissions can be used to assess the consequences of nuclear effects (regime 7) in electronic systems or other hardware intentionally exposed to these radiations. The survivability of military hardware subjected to various nuclear effects is an important factor in assuring reliability of that hardware.

In addition to its role in attracting and maintaining core scientific and engineering capability and in helping to verify the calculational capability of the more sophisticated computer models, NIF would also play a role in evaluating specific problems that arise in the stockpile, as mentioned in section I.2.2.2. As the stockpile surveillance program reveals an unanticipated change due to aging or remanufacture, a weapons expert will estimate which of the weapons physics processes listed in section I.2.2.3 could be affected. If any of the high-energy-density process (regimes 3 through 7) could be affected, then a NIF experiment may be designed to measure the physical properties of the change. For example, if the chemical composition of a material (such as a glue joint) has changed for some reason, it may be necessary to determine the opacity (how a material absorbs and emits radiation) of the changed material. Computer models are not able to predict the opacity of all materials under all temperatures and pressures. Thus, it may be necessary to put some of the changed material into a NIF target, raise its temperature and pressure to near those that would occur when the weapon is exploded, and measure its opacity (regime 4). These measurements would then be compared with the computer model predictions, and the physics model would be refined until an agreement was reached. The computer model could then be used to evaluate whether the given change in properties causes an integrated change in performance that adversely affects the reliability of the weapon. This evaluation would determine whether the altered weapon could remain in the stockpile (or be placed in the stockpile in the case of a remanufactured weapon).

In conclusion, NIF would address, to some degree, weapons processes that occur in physical regimes 3 through 7 in the list in section I.2.2.2. These processes are the ones that occur at very high energy density (high temperatures and pressures). These processes are very important in assessing a weapon's reliability. NIF would achieve higher temperatures and pressures, albeit in a very small volume, than any other proposed stockpile stewardship facility. It would also be the only facility that would achieve fusion ignition. The principal safety issues for a nuclear weapon that involve the high explosive and fissile material implosion, relevant physical regimes 1 and 2, could not be addressed in NIF.

The nuclear weapons expected to remain in the stockpile will age beyond their original design lifetime between the years 2005 and 2010. It is important to have NIF in place and operating successfully well before this period so that the facility can be used to help verify the new computer models before problems may begin arising more rapidly. The goals of completing construction of NIF in 2002 and achieving ignition by 2005 would allow this to happen, first with nonignition target experiments and later with ignition experiments.

I.2.3 Other Benefits of the National Ignition Facility

NIF would be a multipurpose facility used for both national security and civilian applications. The most significant potential long-term civilian application of ICF is the generation of electric power. DOE is pursuing two distinct approaches to fusion energy: magnetic fusion energy and inertial fusion energy. Development of inertial fusion as a source of electrical power depends upon achieving ignition in NIF. This approach to inertial fusion energy is consistent with the recommendations of the National Academy of Science's *Second Review of the Department of Energy's Inertial Confinement Fusion Program* (NAS 1990) and the *Fusion Policy Advisory Committee Report* (DOE 1990). Many studies (such as Meier 1994; Moir 1994) have described viable power plant designs that could be developed once high-gain targets are understood. Furthermore, the International Atomic Energy Agency report, *Energy from Inertial Fusion* (IAEA 1995), describes possible engineering development paths to a demonstration fusion power plant once ignition is established on NIF. These development paths are most efficiently accomplished if NIF can first be used to (1) determine the beam energy required for ignition, (2) map out the target gain curves, and (3) understand the post-ignition dynamics of the environment in

a reaction chamber. Thus, early achievement of ignition in NIF is needed to allow the pursuit of an efficient, timely, inertial fusion energy development program.

NIF would also establish new capabilities for the basic sciences. Because fusion targets would provide temperatures and pressures similar to those found in the sun and other stars, data from NIF high-energy-density experiments would interest scientists working in such fields as astrophysics, material sciences, nonlinear optics, x-ray sources, plasma physics, and computational physics. For example, astrophysicists could do experiments that study some of the processes that occur during primordial nucleosynthesis (the original formation of all elements), stellar evolution, and spectacular events such as a supernova explosion.

As the world's largest optical instrument, NIF could spur high-technology industries in the areas of optics, lasers, materials, high-speed instrumentation, semiconductors, and precision manufacturing. Past ICF developments, for example, have led to manufacturing capabilities for precision optics that enabled the development of correcting optics to fix the initial problem of the Hubble space telescope. The ICF need for high-speed target diagnostics led to the development of a low-cost micro-impulse radar that has many commercial applications (12 industrial licenses have already been granted). Commercial applications derived from NIF could include flexible, low-cost, laser-based manufacturing; advanced x-ray lithography for integrated circuit manufacturing; high-density information storage; improved flat-panel display technology; advanced health care technologies; new materials; and new scientific instrumentation.

NIF would play a major role in U.S. science and technology early in the next century. Its civilian and defense missions would maintain weapons technology and expertise for continuing national security objectives, assess a new energy option, contribute to the basic high-energy-density sciences, and enhance industrial competitiveness through numerous technology advances.

I.2.4 Relationship of the National Ignition Facility to Other Department of Energy Environmental Impact Statements

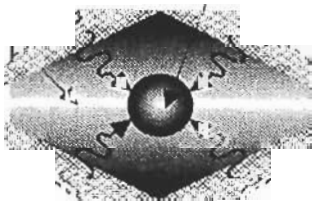
DOE prepared this programmatic environmental impact statement (PEIS) to assess the alternatives for conducting the Stockpile Stewardship and Management Program, including the action described in this NIF Project-Specific Analysis (PSA). The PEIS also evaluates the No Action alternative and provide an assessment of environmental impacts to support programmatic and siting decisions.

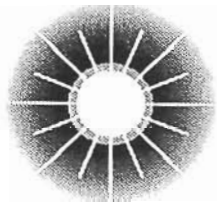
However, for NIF and certain other facilities, the PEIS includes both a programmatic assessment and site-specific assessments of the construction and operation impacts at the reasonable candidate sites. The site-specific assessments consider the environmental impacts associated with siting of these facilities and provide a basis for deciding whether or not to proceed with construction.

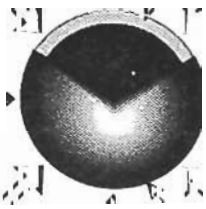
DOE is currently preparing site-wide EISs for two of the five sites proposed as alternative locations for NIF: the Nevada Test Site (NTS) and the Los Alamos National Laboratory (LANL). The projected completion dates for these EISs are late 1996 for LANL and NTS. A site-wide EIS for the Lawrence Livermore National Laboratory, the preferred NIF location, was issued in 1992. The site-wide EISs address the continued operation of the sites, including near-term (within 5 to 10 years) proposed projects. The site-wide EISs provide an opportunity to address the cumulative impacts of all reasonably-foreseeable activities and provide a mechanism for coordinating site and agency planning for complex facilities by providing an opportunity for review of the potential collective environmental effects associated with large, diverse facilities. The EISs evaluate a range of different alternatives, including the alternative of continuing current operations.

DOE's *Draft Waste Management Programmatic Environmental Impact Statement*, issued in August 1995, addresses the long-term management and safe treatment, storage, and disposal of radioactive, hazardous, and mixed wastes. NIF would generate these types of wastes, and the treatment, disposal, and storage of NIF wastes would be compatible with any decisions resulting from the waste management PEIS.

DOE is proceeding with two other actions related to the Stockpile Stewardship and Management Program: the Dual-Axis Radiographic Hydrodynamic Test Facility EIS (DOE 1995c) and the Tritium Supply and Recycling PEIS (DOE 1995d). DOE determined that implementing the ROD on these two facilities will not prejudice any decisions in the Stockpile Stewardship and Management Program.







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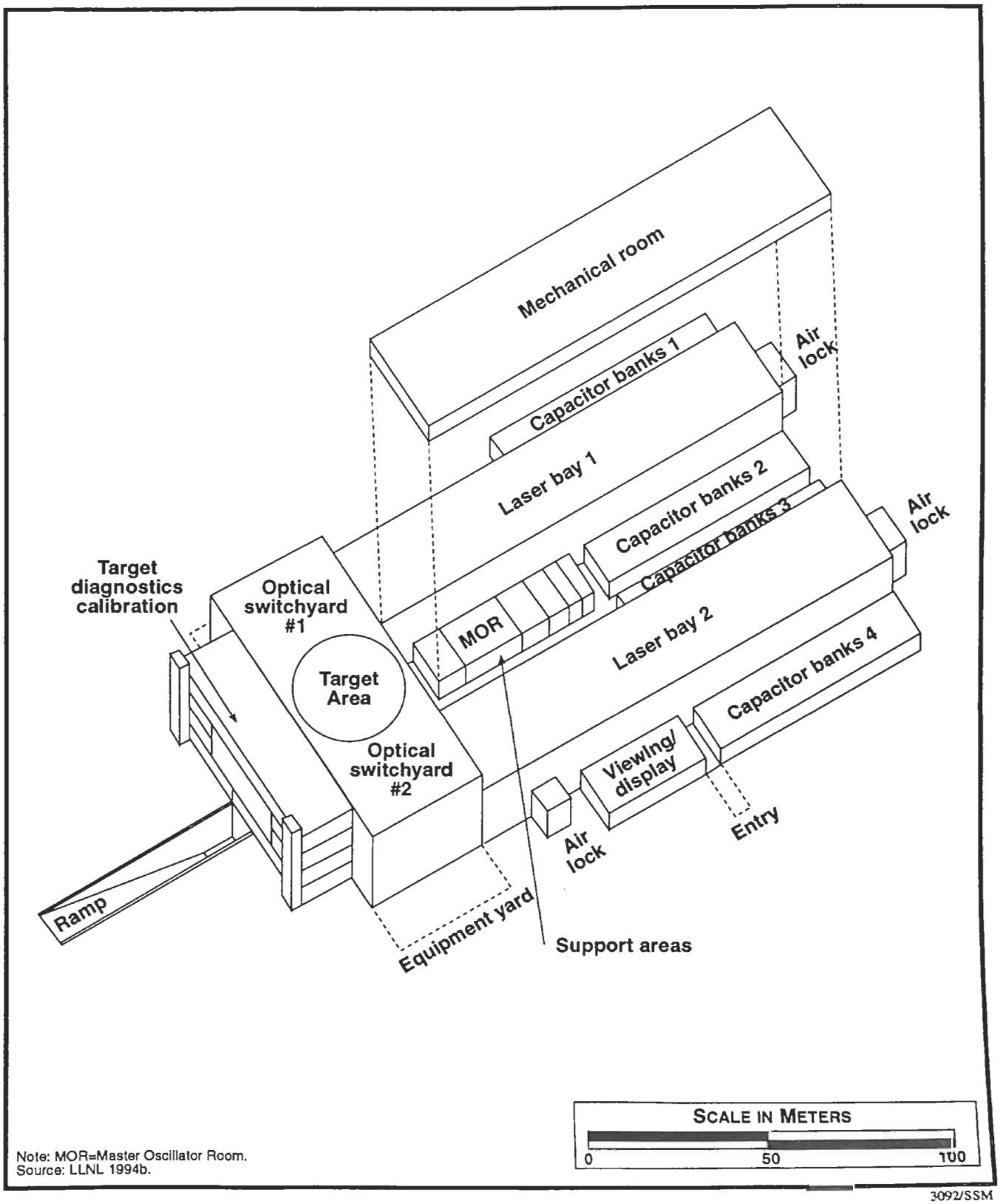
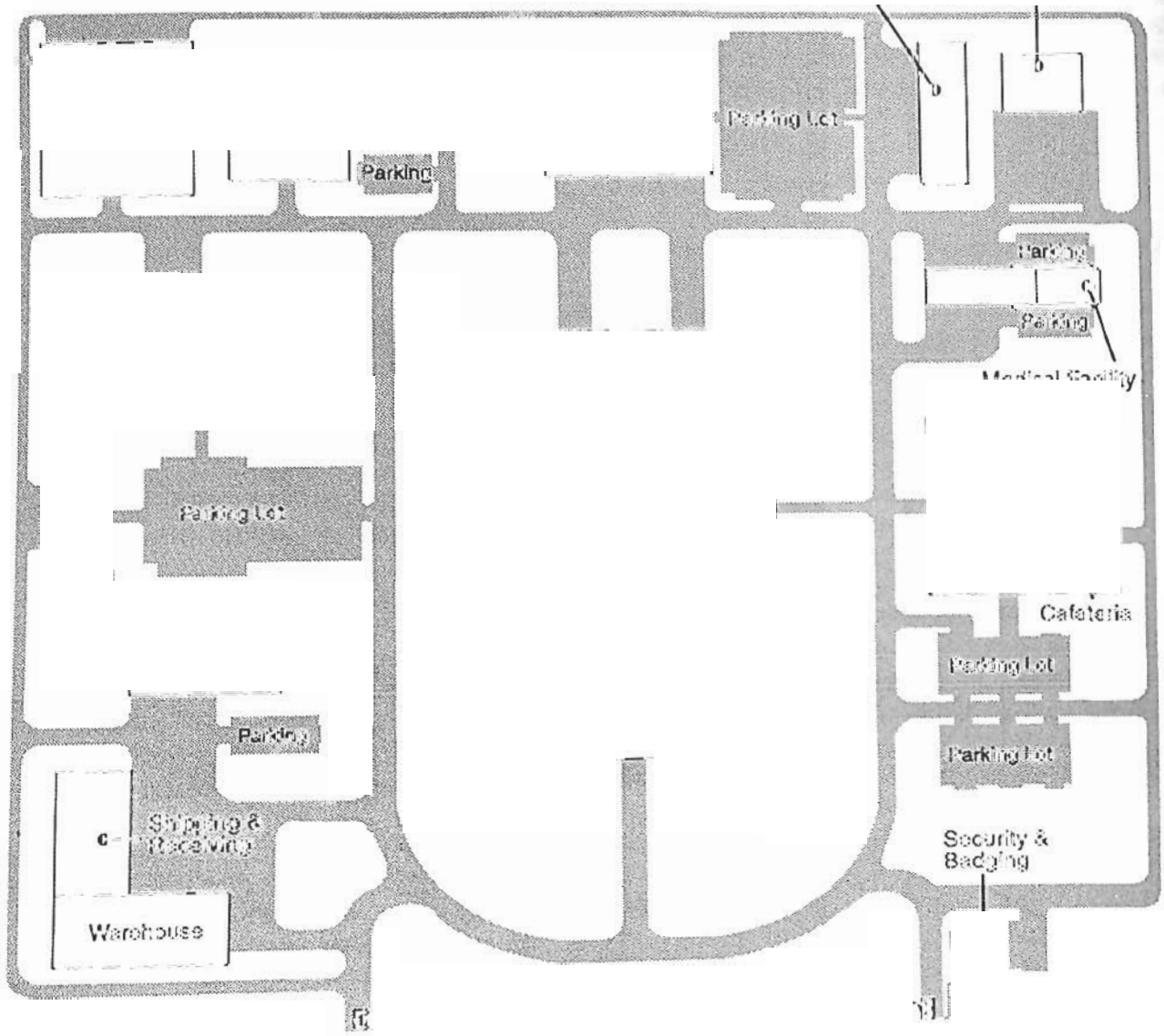


FIGURE I.3.2.1–1.—*Overview of the National Ignition Facility Laser and Target Area Building.*


Parking Lot
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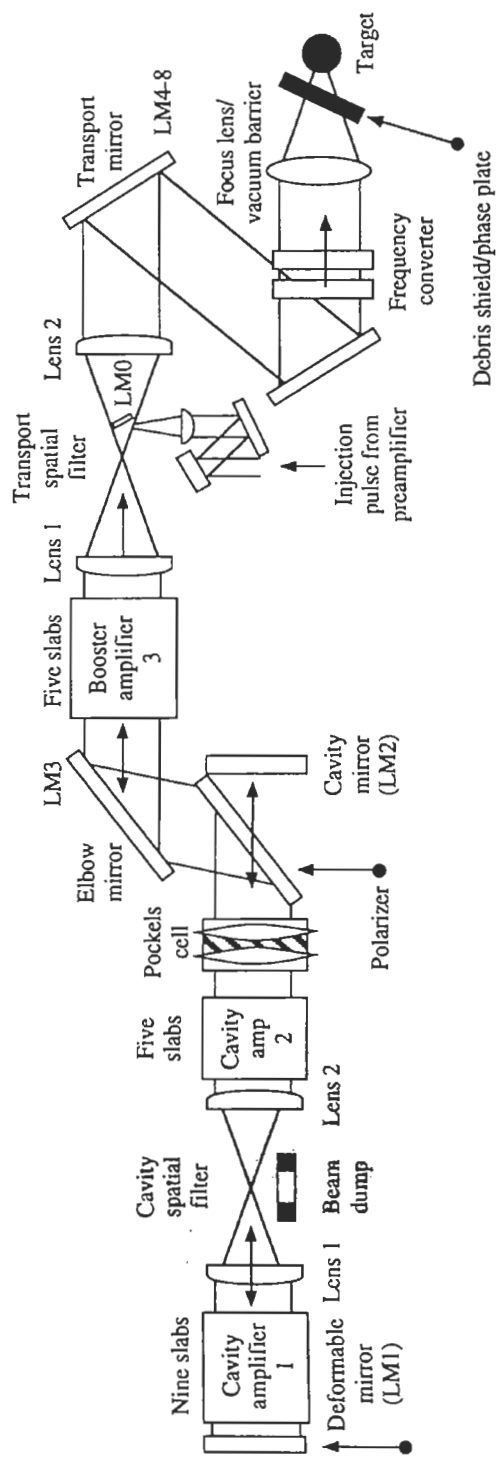
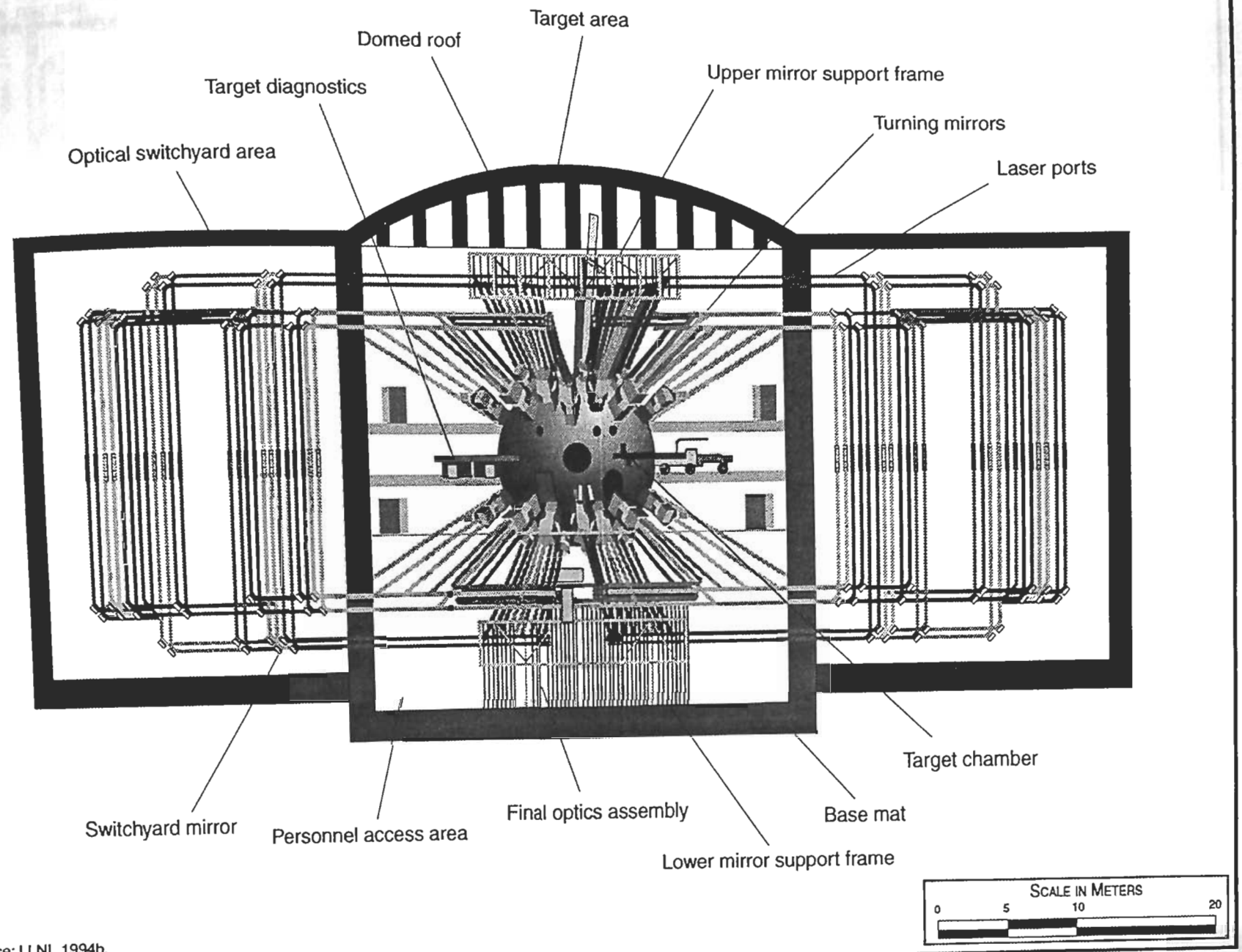


3094SSM

Note: LM – laser mirror.
Source: LLNL 1994a.

FIGURE I.3.2.1.1.1–1.—*Schematic Diagram of the Path of One Beamlet of the National Ignition Facility Laser.*



Source: LLNL 1994b.

chamber. The secondary tritium confinement would be the Target Area Building structure, which would be provided with a heating, ventilation, and air conditioning system capable of operating at a negative pressure during and immediately after shots of greater than 1 megajoule (MJ). The building structure would act as the confinement for air activation products. The final exhaust release point from the heating, ventilation, and air conditioning system would be elevated. The airborne radiation releases at the building release points would be measured and the target area would have monitors to allow detection of conditions requiring corrective or protective actions.

Environmental protection systems, including tritium-handling systems, target storage, and decontamination equipment used to clean the target chamber components, would be located adjacent to the target chamber and target chamber room. X-ray, optical, and neutron measurement instruments would be arranged around the chamber to help evaluate the success of each target experiment. Structural support of the target diagnostics, as well as of the target positioner, final optic assemblies, and turning mirrors, would be provided by target area structures. The target area would also provide the following subsystems: the target area auxiliary systems, material handlers, the chamber personnel transporter, and the diagnostics and classified control rooms.

I.3.2.1.1.3 *Target Chamber*

The NIF target chamber would be a 10-meter (m) (33-feet [ft]) internal-diameter spherical aluminum shell with walls 10 cm (4 in) thick (figure I.3.2.1.1.3–1), and the exterior of the chamber would be encased in 40 cm (16 in) of concrete to provide neutron shielding. The target chamber would be supported vertically by a hollow concrete pedestal and horizontally by radial joints connected to the cantilevered floors. The aluminum wall of the chamber would provide a vacuum barrier and mounting surface for the first wall panels, which protect the aluminum from soft x rays and shrapnel. The vacuum system would provide a 10^{-6} torr vacuum level for target experiments (LLNL 1994b).

The laser beams would enter the chamber in two conical arrays from the top and two conical arrays from the bottom. At the poles and in the equatorial regions of the chamber, diagnostic equipment would be inserted through the chamber wall. Unconverted laser light that hit the opposite wall would be absorbed by the light-absorbing panels located adjacent to and slightly smaller than the opposing beam port. The target chamber would also include the target emplacement and positioning/alignment systems and planned diagnostics.

I.3.2.1.1.4 *Integrated Computer Control System*

The computer control system would be an integrated network of conventional computer systems providing the hardware and software needed to support full operational activities. The system would include the computer controls to manage the complex laser optical system and would have to meet security requirements to handle classified information.

I.3.2.1.1.5 *Sequence of Events During an Ignition Shot*

A shot would begin as weak laser pulses at four separate frequencies (or colors of light) in the master oscillator room (figure I.3.2.1–1). Each pulse is launched into an optical fiber system that amplifies and splits the pulse into 192 separate fibers, 48 of each color. The four colors are used to smooth the intensity (power per unit area) of the laser spot on the target. The power in the laser pulse at this point is a little less than a watt. Typical pulses are a few nanoseconds long, so the energy is a few nanojoules. The optical fibers carrying the pulses then spread out to 192 preamplifiers. The preamplifiers are located beneath the focal plane at the center of the large transport spatial filters, which are located between the laser components and the target chamber (figure I.3.2.1.1.1–1). Within the preamplifier, the pulse is amplified by a factor of about one million, to about a millijoule. The laser pulse then enters spatial beam-shaping optics and a flashlamp-pumped, four-pass rod amplifier, which converts it to about a 1-joule pulse with the spatial intensity profile needed for injection into the main laser cavity.

Source: LLNL 1996b.

The pulse of laser light from the preamplifier reflects from a small mirror (labeled LM0, figure I.3.2.1.1.1–1). The laser light comes to a focus at the focal plane of the transport spatial filter, and passes through booster amplifier 3, reflects from the polarizer, is amplified further in cavity amplifier 2, goes through a second spatial filter (the cavity spatial filter), then passes through cavity amplifier 1, and reflects from the deformable mirror (mirror LM1, figure I.3.2.1.1.1–1). The beam then reflects back through cavity amplifier 1, the cavity spatial filter, and cavity amplifier 2.

In the interim, the Pockels cell (figure I.3.2.1.1.1–1) is energized. This component rotates the plane of polarization of the laser light from horizontal to vertical. Therefore, the laser light pulse passes through the polarizer and strikes cavity mirror LM2, which redirects the pulse back to the Pockels cell, which rotates the polarization back to horizontal. The pulse then continues towards the deformable mirror LM1. It then reflects back from LM1, through cavity amplifier 1, the cavity spatial filter, and cavity amplifier 2 again. By this time the Pockels cell has been de-energized so that it no longer rotates the polarization of the pulse. Thus, the laser pulse reflects from the polarizer and is further amplified by booster amplifier 3 to an energy of about 17 kilojoules for a typical ignition target pulse shape. The pulse then passes through the transport spatial filter on a path slightly displaced from the input path, thus just missing the injection mirror LM0.

The laser pulse then travels through a long beam path reflecting from several transport mirrors (LM 4 through 8) until it reaches the target chamber. (For simplicity, figure I.3.2.1.1.1–1 does not show all of these mirrors.) Mounted on the target chamber is a frequency converter that changes the infrared laser pulses to ultraviolet light. The focusing lens then brings the four color pulses (192 separate fibers or 48 for each color pulse) to a focus at a single spot at the center of the target chamber. The debris shield/phases plate (figure I.3.2.1.1.1–1) protects the focusing lens from any target fragments, and it may also have a pattern etched into its surface to reshape the distribution of laser intensity in the focal spot on the target.

The target would be a small spherical capsule whose hollow interior would contain a thin annular layer of liquid or solid DT fuel (a mixture of deuterium and tritium isotopes of hydrogen). The outer surface of the capsule is rapidly heated and evaporated, either by the absorption of soft x rays under indirect drive or by direct heating by lasers under direct drive (see figure I.3.2.–1). The rocket effect caused by the evaporated outer capsule creates an inward pressure causing the capsule to implode in about 4 nanoseconds. The implosion heats the DT fuel in the core of the capsule to about 50 million degrees Celsius (90 million degrees Fahrenheit), sufficient to cause the innermost core of the DT fuel to undergo fusion. The fusion reaction products deposit energy in the capsule, further increasing the fuel temperature and the fusion reaction rate. Core fuel ignition occurs when the self-heating of the core DT fuel due to the fusion reaction product deposition becomes faster than the heating due to compression. The ignition of the core would then propagate the fusion burn into the compressed fuel layer around the core. This will result in the release of much more fusion energy than the energy required to compress and implode the core.

The energy in one pulse would be about equal to the caloric energy in one candy bar (1.8 MJ, or 400 food calories). However, the peak power for a few nanoseconds would be equal to about 500 terawatts (500×10^{12} watts), instantaneously exceeding the steady-state power capacity in the entire United States by about a factor of 1,000 (LLNL 1994a).

I.3.2.1.2 Target Receiving/Inspection Area

NIF would require a facility at which to receive and inspect targets fabricated at another site (LLNL 1995b). This area would require several Class 100 (Airborne Particulate Cleanliness Class) clean rooms and inspection laboratories in a vibration-free environment. This facility would also include cryogenic laboratories and a central chemical waste system. The facility would have to meet security requirements to handle classified equipment.

I.3.2.1.3 Other Areas

Optics Assembly Area/Clean Room. The optics assembly area/clean room would be used to clean, coat (for example, with Sol-gel as an optics dielectric), inspect, and assemble the NIF's optics and crystals (LLNL 1995b).

General Assembly Area. The general assembly area would be used to assemble mechanical and electrical components not requiring a clean-room environment (LLNL 1995b). The facility would be equipped to handle large and heavy assemblies. This area would also be used for assembly welding.

Optics Maintenance Area. The optics maintenance area would be used for refurbishing, cleaning, and coating of both laser glass and optical components (LLNL 1995b). This specialized area would require vibration isolation, temperature and humidity controls, and Class 100 clean rooms.

Optics Storage Area. During the NIF operational phase, spare parts would be stored in the optics storage area. Because of the size and mass of many of these components the storage area would provide for truck and forklift access (LLNL 1995b).

Radioactive Storage Area. The radioactive storage area would be an intermediate storage area used to store components that come out of the target area before they can be decontaminated.

Electrical and Mechanical Shops. The electrical and mechanical shops would house the machine tools to be used for repairs, maintenance, and special fabrication required for daily operations of the NIF laser and its auxiliary systems (LLNL 1995b).

Support Facilities. NIF would require the following additional support facilities (LLNL 1995b): (1) shipping, receiving, and central stores; (2) medical building; (3) cafeteria; (4) garage and gas station; (5) fire station; and (6) security and badging. All of these services currently exist within the infrastructures of the candidate sites and could be used by NIF.

I.3.2.1.4 Facility Construction

Conventional construction techniques would used to build NIF. The extent and exact nature such activities as site clearing, infrastructu improvements, and support facility constructi required would depend on the specific locati selected for NIF. Construction of NIF would organized in the following sequential phase (1) initial building construction, (2) speci equipment structures installation, (3) final buildi construction, (4) final installation preparatio (5) clean component installation, and (6) fin laser/target systems installation.

As conceptually designed, about 20 ha (50 acres) land area would be required for NIF. Figu I.3.2.1–2 shows an overall conceptual plan o generic NIF site, including all required buildi and improvements. Within this area, all direct support buildings for NIF would require 4.7 (11.6 acres). There would also be 4.1 ha (1 acres) of access roads and 1.9 ha (4.7 acres parking space (LLNL 1995b). The remaining 9 (23.0 acres) would consist of open space (e.g., l scaped lawns). The actual amount of land req at the selected host site would be less, as all c candidate sites have existing facilities that c meet some of the infrastructure requiremen NIF (see section I.3.4). During construction, 2.0 ha (4.9 acres) of land would be required construction laydown area. The laydown would be located within or near the location nated for the NIF (see section I.3.4). Foll construction, the laydown area would be rest its preconstruction condition or incorporat the landscaping design selected for the site.

I.3.2.2 *Facility Operations*

The NIF experimental plan comprises stages:

- Start-up experiments to activate cc diagnostics and to validate laser perf mance
- Hohlraum tuning experiments to att minimum asymmetry in x-ray dr

(indirect-drive approach only, laser symmetry experiments for direct drive)

- Cryogenic pre-ignition experiments for detailed study of capsule implosions
- User experiments for weapons physics, weapons effects, and other user groups
- Ignition experiments
- Ignited burn experiments to obtain basic data for inertial confinement energy development, basic scientific research on high-density plasmas, and research relative to various military-related applications

When the laser "fires" on a target, all 192 laser beams are synchronized such that after grouping in 48 2x2 groupings at the chamber, they simultaneously "hit" the target. The target is compressed and heated, creating intense fusion reactions. Ignition is defined as occurring when heating of the compressed target by fusion products is just adequate to create an advancing front, or wave, of fusion reactions across the target, heating or "igniting" the entire fuel in the target to reaction conditions.

The numbers and types of "shots" needed to achieve ignition have been estimated on the basis of experience with other large laser systems–such as Nova (many of the activities for NIF would have parallels with Nova, such as hohlraum symmetry and plasma diagnostic activation) and the NIF Beamlet Demonstration Project. Relatively low laser energies would be required for most of the early shots; shaped pulses greater than 1 MJ would be required for very few shots before the demonstration of ignition. It is estimated that approximately 1,600 target shots, in addition to approximately three months of downtime for installation of a cryogenic target positioner, would be required to attain ignition (LLNL 1994b). Concurrently, other target experiments would be carried out for various user communities.

I.3.2.2.1 Conceptual Design Operations

It is expected that once ignition is achieved, NIF would be operated within the constraints specified for an operational baseline in the Conceptual Design. This baseline, or Conceptual Design Option, is the 192-beam, indirect drive operation mode for NIF. The estimated parameters for the Conceptual Design Option are as follows:

- Maximum design yield: 20 MJ
- Annual total yield: 385 MJ/year (yr)
- Tritium throughput: 600 Curies (Ci)/yr
- Maximum tritium inventory: 300 Ci
- Tritium effluent: 10 Ci/yr

I.3.2.2.2 Enhanced Option Operations

The enhanced NIF operational capabilities, or Enhanced Option, would include the indirect drive and user capabilities described above plus direct-drive capabilities and additional test-specific capabilities that might be desired by the user communities. In addition, the Enhanced Option would include the ability to perform an increased number of yield experiments per year to accommodate greater user needs. Enhanced capability operations would involve some design changes to the Conceptual Design Option Facility. By diverting the 24 beamlines (96 beamlets) from the indirect-drive configuration for direct drive, an additional 24 beam ports would be placed evenly spaced half above and half below the chamber equator. Final optics assemblies already modified for direct drive would be placed permanently at these ports. The final turning mirrors that direct the laser beams to their final optics assemblies would be adjusted with motors to direct the selected beams away from their usual final optics assemblies and toward another final mirror that would send the beams through the new final optics assemblies in a direct-drive mode. A different target positioner would be required for direct-drive target insertion and positioning. A new target shroud that could be removed much more quickly than that for indirect drive would also be required. Equipment decontamination systems

would also be upgraded for the Enhanced Option. The Enhanced Option Facility would use the same utilities and consumables (for example, electricity, water, fuel, and oil) as the Conceptual Design Option Facility.

Under the Enhanced Option, NIF would have the capability to do both direct and indirect drive target experiments (although several days would be necessary to switch from one mode to another). The facility would also have the capacity to handle more experiments per year (both yield and no-yield types) to accommodate greater user needs than permitted by the Conceptual Design Option operations. The estimated operating parameters for the Enhanced Option are as follows:

- Maximum design yield: 20 MJ[1]
- Annual total yield: 1,200 MJ/yr
- Tritium throughput: 1,750 Ci/yr
- Maximum tritium inventory: 500 Ci
- Tritium effluent: 30 Ci/yr

I.3.2.2.3 Security

Both classified and unclassified activities would be conducted at NIF, and appropriate security and badging requirements would be implemented. Because many uncleared visitors are expected to use the facility, security features would be designed to allow easy access for visitors while at the same time maintaining effective physical and technical security where necessary.

Security requirements would include those for physical protection of classified matter; physical protection of Department of Energy (DOE) property and unclassified facilities; protective program operations; and personnel security, including issuance, control, and use of badges, passes, and credentials. In addition, telecommunication services would be designed to be capable of handling both classified and unclassified information.

[1] Maximum credible yield is 45 MJ for bounding accident evaluation.

I.3.3 No Action Alternative

Under the No Action alternative, NIF would not be constructed or operated. NIF's experiments related to science-based stockpile stewardship (see section I.2.2) would not be realized. If NIF were not built, the ability of the Stockpile Stewardship and Management Program to obtain the fusion and high temperature/density data that would have been available with NIF would be hampered or delayed. The Stockpile Stewardship and Management Program would continue to use Nova and other facilities for as long as they produced useful data, but the existing facilities are not capable of reaching the temperatures and pressures that are anticipated for NIF. If other technologies were proposed to obtain higher temperatures and pressures than those available from existing facilities, such technologies would not be operational by the period 2005 to 2010. When enduring stockpile weapons age beyond their original design lifetimes, confidence in the reliability of such weapons may decrease significantly, and the probability would increase that the United States might have to invoke "supreme National interest" and withdraw from any test moratorium or *Comprehensive Test Ban Treaty*.

Under the No Action alternative, many operations at LLNL, LANL, SNL, and NTS would continue as described in the existing environment subsections of chapter I.4. However, all existing NIF-dependent functions of the ICF program would be discontinued at LLNL, LANL, and SNL. The number of employees at each of these sites would decrease somewhat as a result. For the purposes of the socioeconomic analysis in this PSA, it is assumed that employment at LLNL would decrease by 20, employment at LANL would decrease by 20, and employment at SNL would decrease by 20. There would be no change in employment at NTS or NLVF related to the No Action alternative.

I.3.4 Alternative Sites

This PSA evaluates the impacts of construction and operations of NIF at five locations at four alternative sites: LLNL in California, LANL in New Mexico, Area 22 and NLVF associated with NTS in Nevada, and SNL in New Mexico. The selection of these four sites was based on a two-step process. Three alternative sites were identified on the basis of the following primary site criteria (LLNL 1995b):

- Federal site controlled by the U.S. Department of Energy Office of the Assistant Secretary for Defense Programs (DP)
- Significant ICF programs consisting of ICF-related experimental facilities and personnel working on ICF studies (also called ICF infrastructure)
- Adequate protection of the public and the environment
- Hazardous and radioactive waste management capability
- Adequate transportation services for transportation of targets

Three sites met the first two criteria: LLNL, LANL, and SNL. Significant ICF infrastructure exists at LANL, LLNL, and SNL and the University of Rochester; however, the latter is not a DP facility. All three DP sites have locations that could accommodate NIF; all three sites have the capabilities to construct and operate NIF with adequate protection of the public and environment; all three sites manage both hazardous and radioactive wastes; and all three sites have adequate transportation services for transporting targets. No other sites within the DOE system meet these criteria.

In her October 1994 approval letter for Key Decision 1, Energy Secretary Hazel O'Leary announced LLNL as the preferred NIF site and LANL, NTS, and SNL as alternative sites. NTS meets four of the above five criteria, lacking only a significant ICF infrastructure. However, NTS has a long history of nuclear weapons testing and was added as an alternative site, on the basis of the presidential mandate to maintain a test readiness posture. NTS has proposed two possible locations for NIF. One is NTS Area 22 in the southeastern area of the site, and the other is NLVF, located in the city of North Las Vegas. These two locations, one remote and one within an urban area, well represent alternatives for locating NIF at NTS. The other alternative sites do not have such diversity of alternative locations, and each has selected one proposed location for NIF.

LLNL has been selected as the preferred site because of its prominence as a leading center for laser science, engineering, and technology. The laboratory has been in the forefront of laser and fusion technology, having constructed several large lasers and fusion experiments, including Shiva, Nova, the Atomic Vapor Laser Isotope Separation project, and the Magnetic Fusion Test Facility. LLNL has the required combination of existing facilities, equipment, infrastructure, and technical and management personnel required to build and operate NIF (LLNL 1994c).

Final site selection will result from this PSA and the Record of Decision (ROD), which will also include consideration of the information and evaluations presented in the *Stockpile Stewardship and Management Programmatic Environmental Impact Statement*. For clarity, the following terminology is used in this document: the word site refers to a DOE-controlled Federal site, such as LANL or NTS; the word location refers to the proposed location of NIF within the larger DOE-controlled Federal site. Table I.3.4–1 lists the facilities required for NIF operations at each site.

I.3.4.1 *Lawrence Livermore National Laboratory*

I.3.4.1.1 Location Description

LLNL is a multipurpose scientific engineering research facility operated by the University of California for DOE. LANL was founded on the site of a former U.S. Navy maintenance base in 1952. LLNL's mission is to serve as a national resource of scientific, technical, and engineering capability with a special focus on national security. Over the years, this mission has evolved to include a wide variety of activities, including ICF, laser isotope separation, magnetic fusion energy, biomedical and environmen-

TABLE I.3.4–1.—*Facilities Required for National Ignition Facility Operations at Each of the Candidate Sites* [Page 1 of 2]

Required Facility	Size Required (m^2)	LLNL	LANL	NTS	NLVF	SNL
Laser and target area bldg.	16,722	New facility	New facility TA-58	New facility	New facility	New facility
Target receiving/inspection	1,393	B298 ICF Target Development, Receiving, and Inspection	TA-35-213	New facility	C-3 High Intensity Source Laboratory	New facility
Optics assembly area	1,858	New facility and B391 High Bay	New facility TA-58	New facility	New facility	New facility
General assembly area	2,787	B166 ICF High Bay and B391 High Bay	New facility TA-58	6-800 Heavy Duty Shop (1,866 m^2), 6-624 Heavy Duty Shop (1,187 m^2)	A-1 High Bay	New facility
Optics maintenance area	3,716	B391 Nova, B321 Optics Fabrication, B392 ICF R&D and Storage Area, B432 High Bay and Optics Metrology Area, new facility (same as Optics Assembly Area)	TA-3-287 (upgrade)	New facility	New facility	New facility
Optics storage area	2,090	B392 ICF R&D and storage area, B381 High Bay	TA-3-105 (upgrade)	New facility	New facility	New facility
Radiological storage area	127	B331 Tritium Facility	Existing facility in TA-54	Building 610 about 3.2 km from NIF location	New facility	Existing facility in Technical Area III
Office building	7,432	B481 ICF Office Building	TA-3-40, TA-3-287, TA-3-105, TA-3-100 New facility (1,860 m^2)	23-117 A&E Bldg. (2,104 m^2) 23-600 L.L. & Eng. (3,498 m^2) 23-113 REECo Trn. (962 m^2) 23-112 REECo Safety (889 m^2)	Conversion of B-1 or new facility	New facility and shared space (3,716 m^2) with Buildings 952 and 960 of Technical Area IV
Electrical and mechanical shops	1,115	B511 Maintenance Shop, B383 Machine Shop, B321 Machine	TA-3-39	23-710 Crafts Bldg. (1,919 m^2)	A-1 Low Bay	Building 840 of Technical Area I

TABLE I.3.4–1.—*Facilities Required for National Ignition Facility Operations at Each of the Candidate Sites* [Page 2 of 2]

Required Facility	Size Required (m^2)	LLNL	LANL	NTS	NLVF	SNL
Warehouse	2,787	B041 Warehouse, B531 Warehouse, and other onsite storage areas	TA-3-30 TA-3-142	23-W1, W2, W3, W3A, W4, W4A, W5	A-2 Warehouse	New facility
Shipping, receiving, and stores	1,300	B411 Central Stores	TA-3-30	23-W6 (1,300 m^2) W5A, W7	A-2 Warehouse	Building 857 of Technical Area-I
Medical facility	278	B663 Medical Services	TA-43	23-650 Medical Facility	C-1 Medical Facility	Building 831 of Technical Area-I
Cafeteria	743	T4675 Central Cafeteria	TA-3-261	23-300 Cafeteria	C-1 Cafeteria	Building 861 of Technical Area I
Garage, gas station	223	B611 Garage	TA-3-36	23-750 Fleet Service	Not required onsite	Buildings 873, 874, 875, and 876 of Technical Area I
Fire station	650	B323 Fire Station	TA-3-41	23-425 Mercury Fire Station (929 m^2)	Not required onsite	Existing facility at Kirtland Air Force Base
Security and badge office	223	B071 West Badge Office, B271 Security	TA-3-490	23-1000 Badge Office	C-1 Administrative Security	Building 800 of Technical Area I

Source: LLNL 1996.

tal research, environmental restoration, and waste management.

The LLNL site is about 64 kilometers (km) (40 miles [mi]) east of San Francisco in southern Alameda County, California. Figure I.3.4.1.1–1 shows the regional location of LLNL. The site occupies an area of 332 ha (821 acres), including land that serves as a buffer zone around the northern and western borders of the site.

As proposed at LLNL, NIF would require construction of two buildings—the Laser and Target Area Building and the Optics Assembly Area—with the remaining building requirements met with existing facilities (see table I.3.4–1). Figure I.3.4.1.1–2 shows the proposed location for the Laser and Target Area Building and the Optics Assembly Building within the existing LLNL complex. The location was selected because it is accessible to the support facilities and functions that would be required to operate and maintain the NIF systems (LLNL 1995b).

The two new buildings would be situated on an 8.1-ha (20-acre) area in the northeastern quadrant of the LLNL site, adjacent to existing ICF facilities (figure I.3.4.1.1–2). The buildings would be constructed in an area where large laser and optical systems have been operating for several years.

Several existing facilities would be modified as necessary, and used to perform supporting functions for NIF. These facilities include: B166 (ICF High Bay), B298 (ICF Target Development, Receiving, and Inspection), B321 (Optics Fabrication), B331 (Tritium Facility), B381 (High Bay), B391 (Nova and High Bay), and B392 (ICF R&D and Storage Area). The current operation of these facilities is covered in the LLNL sitewide Environmental Impact Statement/Environmental Impact Report (DOE and UC 1992). The impacts of any modifications and operation of these facilities have also been evaluated in this PSA. The main impact of these facilities is the inventories of hazardous chemicals used for optics processing. These have been considered in the generation of wastes, effluents, and the postulated accidents for NIF described in chapter 4 of this PSA. The general use facilities (i.e., office building, electrical and mechanical shops, warehouses, shipping and receiving, stores, medical facility, garage, cafeteria, fire station, security, and badge office) serve LLNL as a whole and require no modification to accommodate the addition of NIF.

The LLNL site is located within the California Coast Ranges, an area of north-northwest trending ranges and valleys. The Livermore Valley, an exception to this trend, forms an east-west structural basin defined by branches of the San Andreas fault system. LLNL occupies a smooth land surface that slopes gently to the northwest. Several fault zones traverse the Livermore Valley. LLNL lies within Seismic Zone 4, and the area's seismicity makes earthquake-resistant construction a necessity (LLNL 1995a). The proposed NIF location has been subjected to geological, soil, and vibrational studies, and the site characteristics were determined to be sufficient for the proposed NIF building and equipment designs (LLNL 1994d, 1995b).

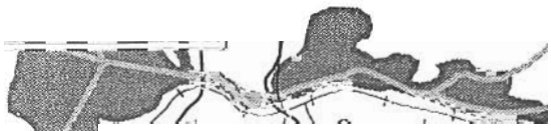
I.3.4.1.2 Infrastructure Requirements

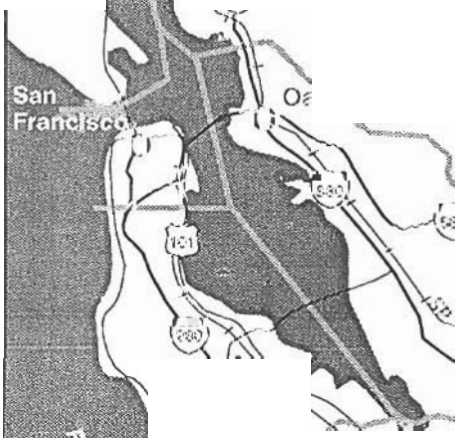
Existing utilities at LLNL include electrical power, natural gas, domestic water, cooling water, demineralized water, sewer, compressed air, life-safety alarms, and a voice/data communications system. Most of the utility systems are configured as loops to provide increased reliability and isolation for repair and maintenance. All utilities meet the requirements of current LLNL missions and have the capacity to support NIF (LLNL 1995c).

I.3.4.1.3 Construction and Operations

The construction of the Laser and Target Area Building and the Optics Assembly Building at LLNL would require the relocation of an underground storm drain; currently no other buildings or structures exist at the proposed NIF location. Construction would require decontamination and decommissioning (D&D) of existing structures, and the area contains no known contaminated soils or previous waste dumps that would require remediation. It is anticipated that the small, incremental amounts of waste that would be generated during construction would be handled by the existing waste treatment and management systems.

During construction a staging area of about 2 (4.9 acres) would be required. There are three site options for this staging area. The staging area would be graded and covered with a chip seal over

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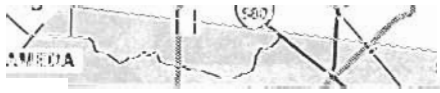
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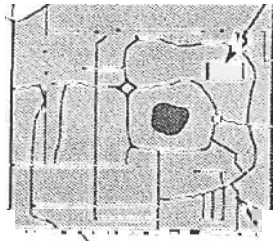

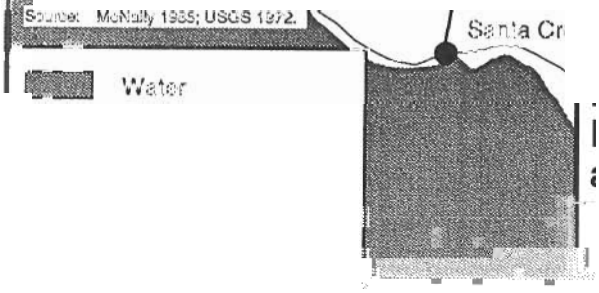
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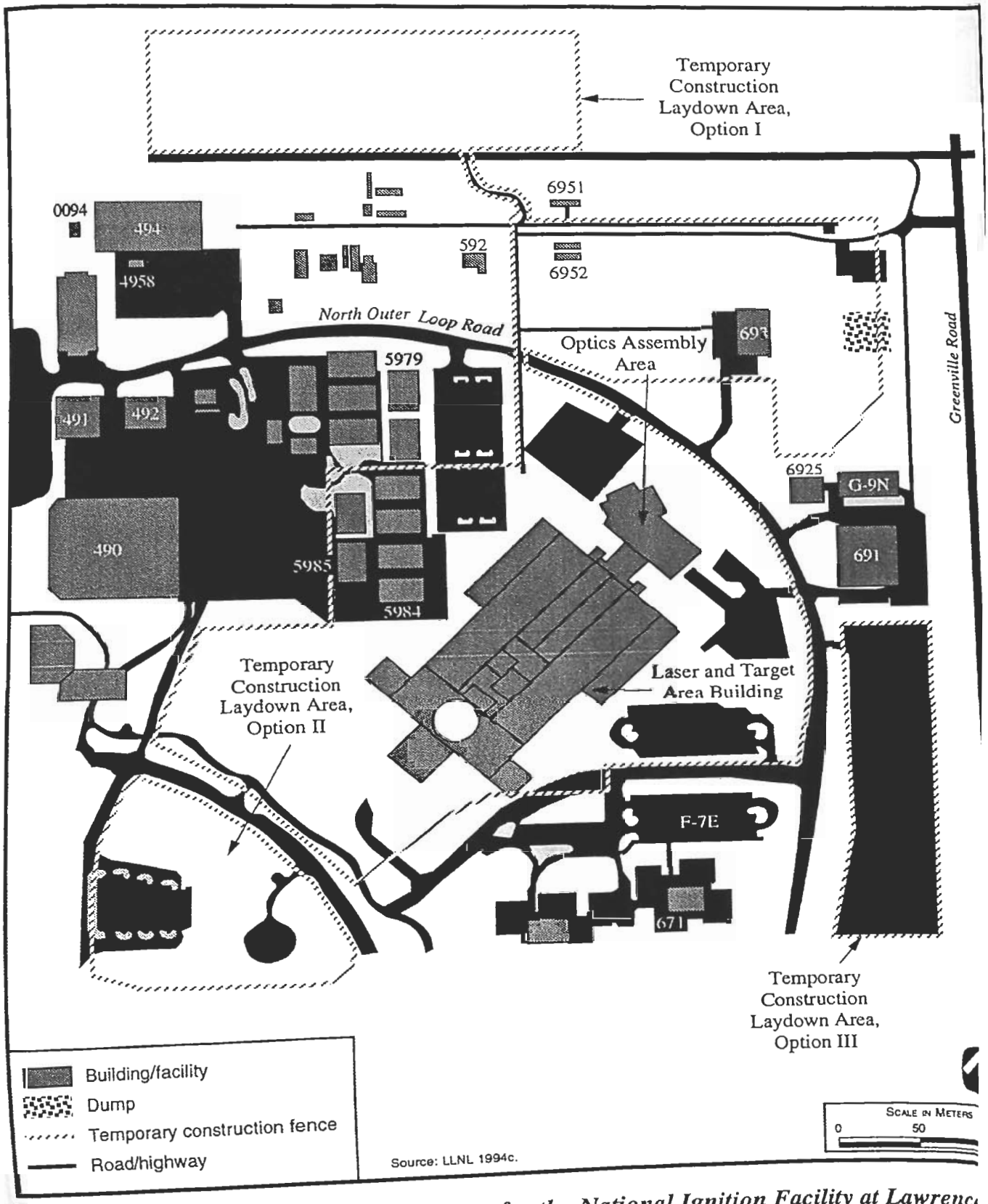


FIGURE I.3.4.1.1–2.—*Proposed Location for the National Ignition Facility at Lawrence Livermore National Laboratory.*

aggregate base. The selected staging area would be cleared and fenced during the construction period. Staging Area option I is across Arroyo Las Positas from the proposed NIF location. A temporary access road, including a bridge across the arroyo, would also be required for movement of construction materials between the option I laydown area and the NIF site. The proposed access road would connect the county's Patterson Pass Road with LLNL's existing Avenue T. Avenue T and other existing LLNL roadways would also be improved to handle the increased traffic. A security post would be installed along the access road. The proposed access road would be 7.3 m (24 ft) wide with 1 m (3 ft) shoulders, and would be about 152 m (500 ft) long. It would be constructed using asphalt over an aggregate base. The bridge would be about 12-18 m (40-60 ft) long and 7.3 m (24 ft) wide. All supporting structures would be located on the tops of the channel banks, out of Arroyo Las Positas. The bridge would be designed so as not to reduce the capacity of the arroyo or increase the risk of flooding. The 100-year floodplain is contained within the channel of the arroyo which is approximately 12-18 m (40-60 ft) wide. Option II would require the removal of a small helipad, while option III would require elimination of a recreational field. The chip seal and fencing at the staging area would be removed upon completion of NIF construction, and the area would be returned to its pre-project condition. If option I is selected, the present plans are to remove the bridge and access road. However, they are being designed as permanent structures so that they could be left in place and used as another entrance to LLNL. The security post would also be removed unless needed for continued use. The arroyo channel banks would be restored to their pre-project condition after the bridge is removed.

I.3.4.2 *Los Alamos National Laboratory*

I.3.4.2.1 Location Description

LANL is a DOE research and technology development facility operated under contract by the University of California. LANL was established in 1943 to provide facilities for research, design, and testing of nuclear weapons and nuclear materials. Over the past 50 years, LANL's mission has evolved in response to national policy to include research in energy, materials science, nuclear safeguards and security, biomedical science, computational science, environmental protection and cleanup, and other basic science research (DOE 1995c).

LANL and the associated residential areas of Los Alamos and White Rock are located in Los Alamos County, in north-central New Mexico, approximately 97 km (60 mi) north-northeast of Albuquerque, 40 km (25 mi) northwest of Santa Fe, and 32 km (20 mi) southwest of Espanola, New Mexico (figure I.3.4.2.1–1).

The proposed LANL location for NIF is Technical Area (TA)-58, which is an undeveloped area adjacent to TA-3, the hub for LANL administration and support activities (figure I.3.4.2.1–2). The new construction proposed at this location includes the Laser and Target Area Building, the Optics Assembly Area, the General Assembly Area, and office space required for NIF.

Table I.3.4–1 lists the existing LANL facilities that satisfy NIF space requirements. Two of the existing facilities listed, TA-3-287 and TA-3-105, would be adequate to support additional NIF functions after significant modification and upgrading. These two buildings, the Scyllac Building (TA-3-287) and the Sherwood Building (TA-3-105), would be designated for use as the Optics Maintenance Area and the Optics Storage Area, respectively. Both of these facilities are in fair to good condition, have been well maintained, and contain no contamination or other environmental hazards (ICF Kaiser Engineers and LANL 1994a). An existing facility in TA-54 could serve as the Radiological Storage Area.

LANL lies within Seismic Zone 2. LANL operates a seismic hazards program that monitors seismicity through a seismic network and conducts studies in paleoseismology. Potential earthquake magnitude and intensity values are used in design considerations at the site.

I.3.4.2.2 Infrastructure Requirements

LANL's existing utility network includes 600 km (400 mi) of lines for six primary utilities: electricity, telecommunications, water, sanitary sewer, radioactive liquid waste, and natural gas. LANL's Long Range Utilities Development Plan includes several proposed upgrades and improvements that would bring the system up to the standards required for the NIF systems. A utility corridor now extends along the

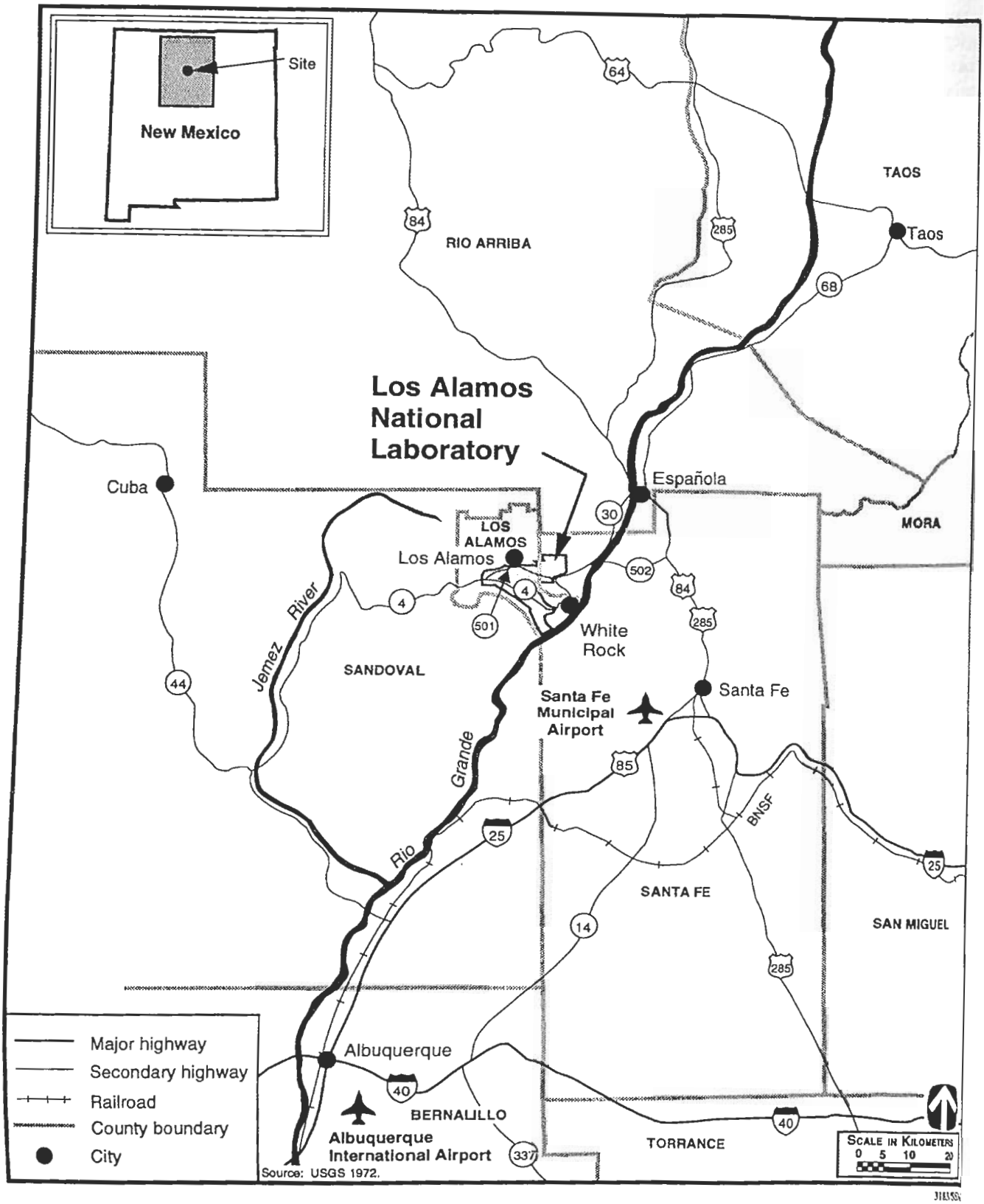


FIGURE I.3.4.2.1–1.—*Regional Location of Los Alamos National Laboratory.*

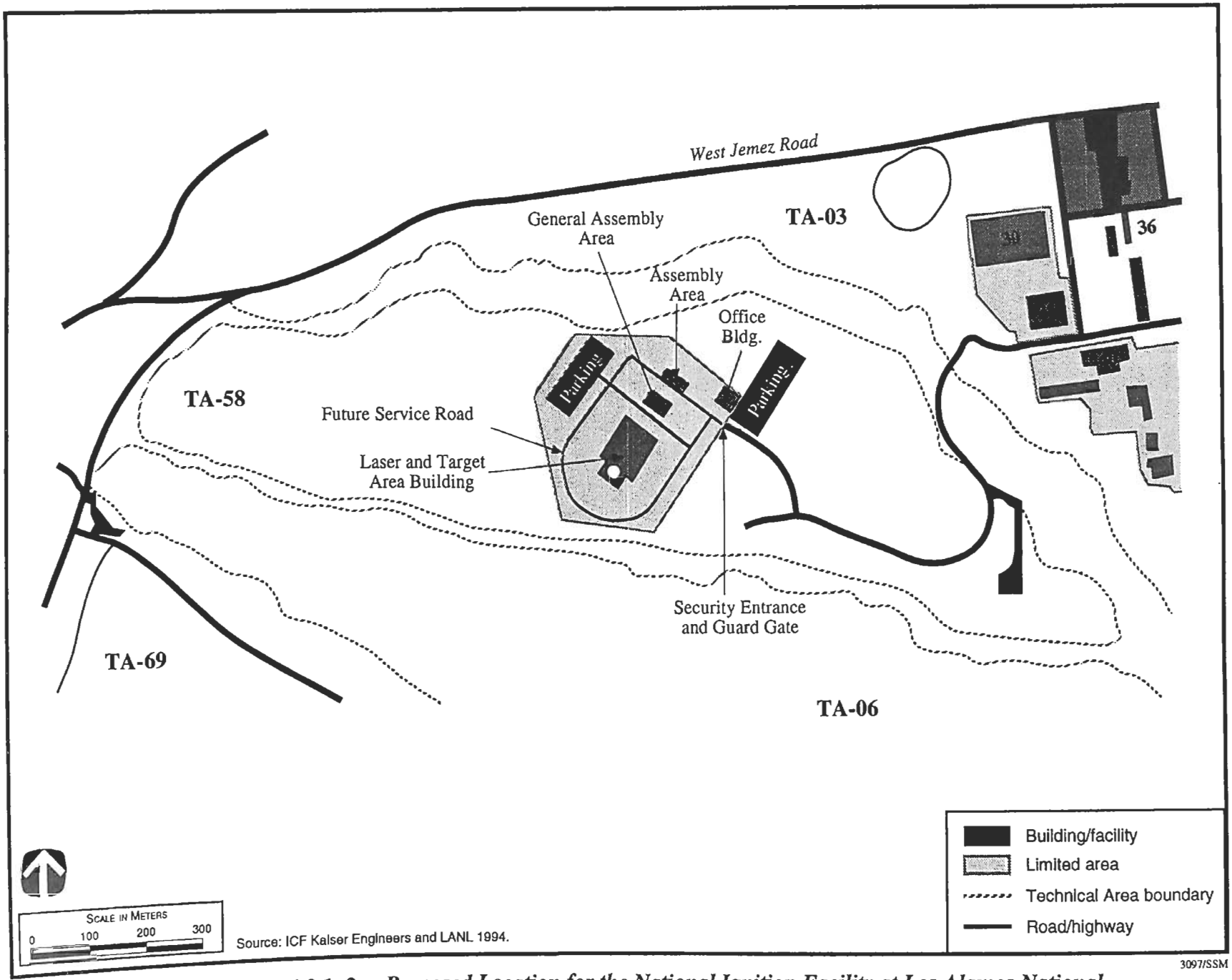


FIGURE I.3.4.2.1–2.—*Proposed Location for the National Ignition Facility at Los Alamos National Laboratory.*

eastern boundary of the proposed NIF location and, with some modifications and conditions noted below, would be sufficient to support NIF project requirements. This corridor presently includes lines for water, telecommunications, electricity, and natural gas (LANL 1990a).

I.3.4.2.3 Construction and Operations

The proposed NIF location at LANL is a large, undeveloped tree-covered area. Preparation of the TA-58 location would require tree removal and clearing and some leveling and filling to create a construction site suitable for NIF. The TA-58 location has no known solid waste management units that would require remediation. Because the volcanic Bandelier tuff underlying the area is an unusually strong foundation material, NIF buildings could be constructed entirely with concrete slabs on grade rather than with piers to stabilize the foundation of the target area. Present solid waste management facilities are adequate to handle the wastes generated during construction activities. The construction laydown area would be located within the area designated for NIF.

I.3.4.3 *Nevada Test Site*

I.3.4.3.1 Location Description

NTS was established in 1950 and has been used for underground testing of nuclear weapons and evaluation of the effects of nuclear weapons on military communications systems, electronics, satellites, sensors, and other items. Underground nuclear testing was halted in October 1992, but the site maintains the capability to resume testing if authorized by the President. In addition to maintaining underground nuclear testing program capabilities, NTS maintains nuclear emergency search team program capabilities, supports the Yucca Mountain Site Characterization Program, supports arms control and treaty verification activities, and provides support to other DOE and non-DOE missions. NTS is operated for DOE by several management and operating contractors.

NTS occupies approximately 350,000 ha (867,000 acres) in southern Nye County in southern Nevada, approximately 105 km (65 mi) northwest of Las Vegas, NV (figure I.3.4.3.1–1). The town of Indian Springs and the Indian Springs Air Force Auxiliary Field, in northwestern Clark County, NV, are 39 km (24 mi) southeast of the closest NTS boundary.

The proposed NTS location for NIF is Area 22, located southwest of Mercury Base Camp (figure I.3.4.3.1–2). This proposed location is a remote, flat desert setting with sparse vegetation. It is directly accessible by Jackass Flats Highway. Table I.3.4-1 lists the facilities that would be constructed at NTS Area 22 and those existing facilities that would be converted to meet NIF requirements. The Laser and Target Area Building, Optics Assembly Area, Target Receiving and Inspection, Optics Maintenance Area, and Optics Storage Area would be constructed as new facilities. Most other NIF requirements would be met by converting existing facilities at Mercury Base Camp. Building 610, located about 3.2 km from the NIF location, would be used for the Radiological Storage Area. In addition, two existing buildings in Area 6 (about 52 km [32 mi] from the NIF location) would be used for general maintenance (Raytheon Services Nevada 1995).

The region has been tectonically active in the near past and has numerous faults. NTS lies in an area of moderate historic seismicity on the southern margin of the Southern Nevada East-West Seismic Belt in Seismic Zones 2 and 3 (DOE 1995d).

I.3.4.3.2 Infrastructure Requirements

Major utilities, including telecommunications, natural gas, water, and electricity, are accessible to the proposed NIF location from Mercury Base Camp, located 3.2 km (2.0 mi) away. A 138-kilovolt overhead power line passes within 0.4 km (0.25 mi) of the NIF location, and adequate commercial power to NTS is available from the Nevada Power Company and the Valley Electric Association. A new electrical substation would have to be constructed for the project (Raytheon Services Nevada 1995). Water supply and storage are adequate to meet NIF requirements; supply is from six wells on NTS. An underground pipeline about 3.2 km (2 mi) long would have to be constructed to connect the NIF facilities to the site water supply system. Sewage disposal facilities would also have to be constructed for the project; adequate space exists for ponds or a sewage plant.

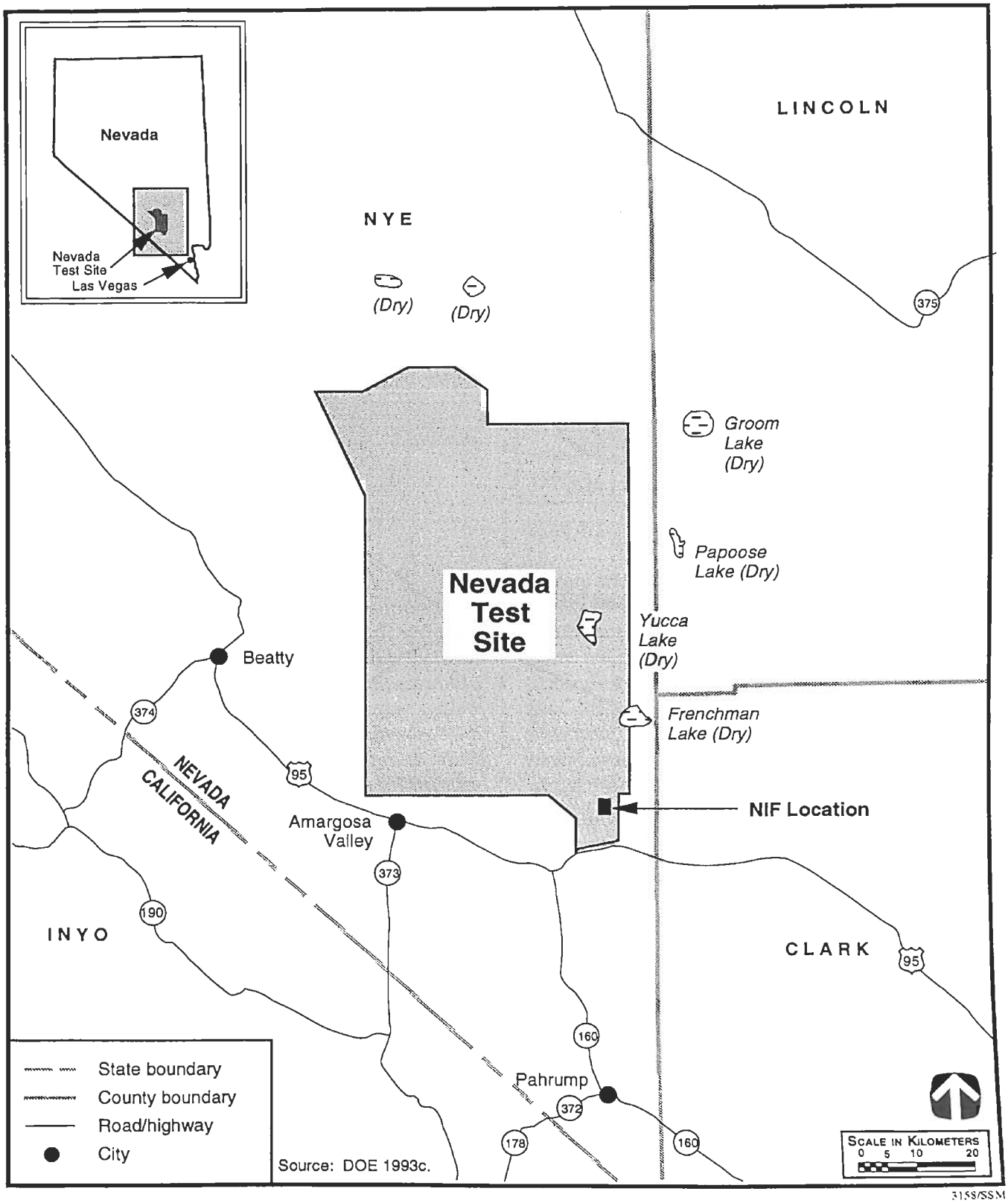


FIGURE I.3.4.3.1–1.—*Regional Location of Nevada Test Site.*

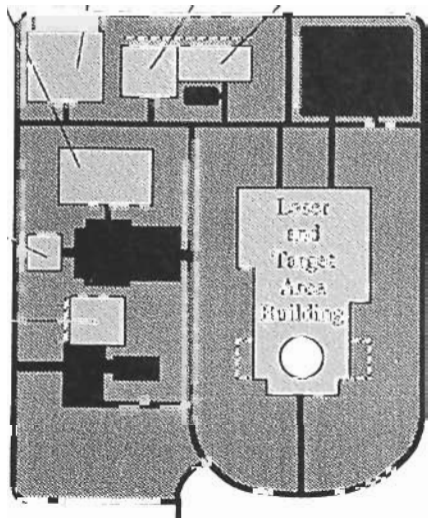


FIGURE I.3.4.3.1-2

I.3.4.3.3 Construction and Operations

During site preparation, the ground at Area 22 would have to be cleared of existing vegetation. The site is relatively level, undisturbed desert land and would require minimal site preparation. Currently, no buildings or other facilities are located in the vicinity. Construction would not require D&D of existing structures and there are no known contaminated soils or previous waste dumps in the area that would require remediation. Small amounts of waste generated during construction would be handled by the existing waste treatment and management systems. A cement batch plant would be set up in the area to accommodate construction needs and reduce transportation requirements. The construction laydown area would be located within the area designated for NIF.

I.3.4.4 *North Las Vegas Facility*

I.3.4.4.1 Location Description

The overall mission of NLVF is to support the Nevada Operations Office and the LLNL, LANL, and SNL weapons test programs. The mission includes prestaging activities, as well as fabrication, assembly, and testing of field diagnostic systems that collect data from underground nuclear detonations at NTS (DOE 1994b). NLVF is located in the city of North Las Vegas, NV, which is part of the three-city metropolitan area encompassing Las Vegas, Henderson, and North Las Vegas (figure I.3.4.4.1–1).

The proposed NIF location is within the NLVF perimeter, west of Losee Road, north of Carey Avenue, east of Commerce Street, and south of Brooks Road within the city limits of North Las Vegas, NV. New facilities that would be required at the NLVF for NIF include the Laser and Target Area Building, the Optics Assembly Area, the Optics Maintenance Area, the Optics Storage Area, Target Receiving and Inspection Area, Radiological Storage Area, and possibly office facilities (table I.3.4–1). As shown in figure I.3.4.4.1–2, the proposed layout would use a large portion of the existing open space to position NIF buildings (DOE 1992, 1995e). The immediate area is zoned for general industrial activity. The proposed location for NIF consists of previously graded land with sparse vegetation.

The NLVF is within the Las Vegas Valley. Rugged mountain ranges surround the low-lying alluvial filled valley. The valley consists primarily of fine-grained Miocene and Pliocene sedimentary rocks. NLVF is located within Seismic Zone 2.

I.3.4.4.2 Infrastructure Requirements

The proposed NIF location at NLVF is readily accessible to all utilities. Existing electrical, wastewater, and water supply capacities are adequate to meet NIF requirements, but connections would be necessary for the project. The nearest water supply is a city of Las Vegas well about 0.16 km (0.25 mi) south of the site. Although domestic water supplies appear to be adequate, a source of low-conductivity cooling water would have to be developed at the site. Connections with local sewer lines would also be necessary (DOE 1995e).

I.3.4.4.3 Construction and Operations

During site preparation for new facilities, the ground would have to be cleared of vegetation. Construction would not require D&D of existing structures, and there are no known contaminated soils or previous waste dumps in the area that would require remediation. Small amounts of waste generated during construction would be handled by the existing waste treatment and management systems in the city of Las Vegas. The construction laydown area would be located within the area designated for NIF.

I.3.4.5 *Sandia National Laboratories*

I.3.4.5.1 Location Description

SNL is a DOE research and development (R&D) facility at Albuquerque, NM. SNL was established in 1949. During more than four decades of existence, its mission has expanded from an original focus on nuclear weapons R&D to include research on other advanced military technologies, energy programs, arms verification, and applied research in numerous scientific fields, including an extensive program in materials research (IT Corporation 1992).

SNL is located 10.5 km (6.5 mi) east of downtown Albuquerque in Bernalillo County (figure I.3.4.5.1–1), within the boundaries of the 21,044-ha (52,000-acre)

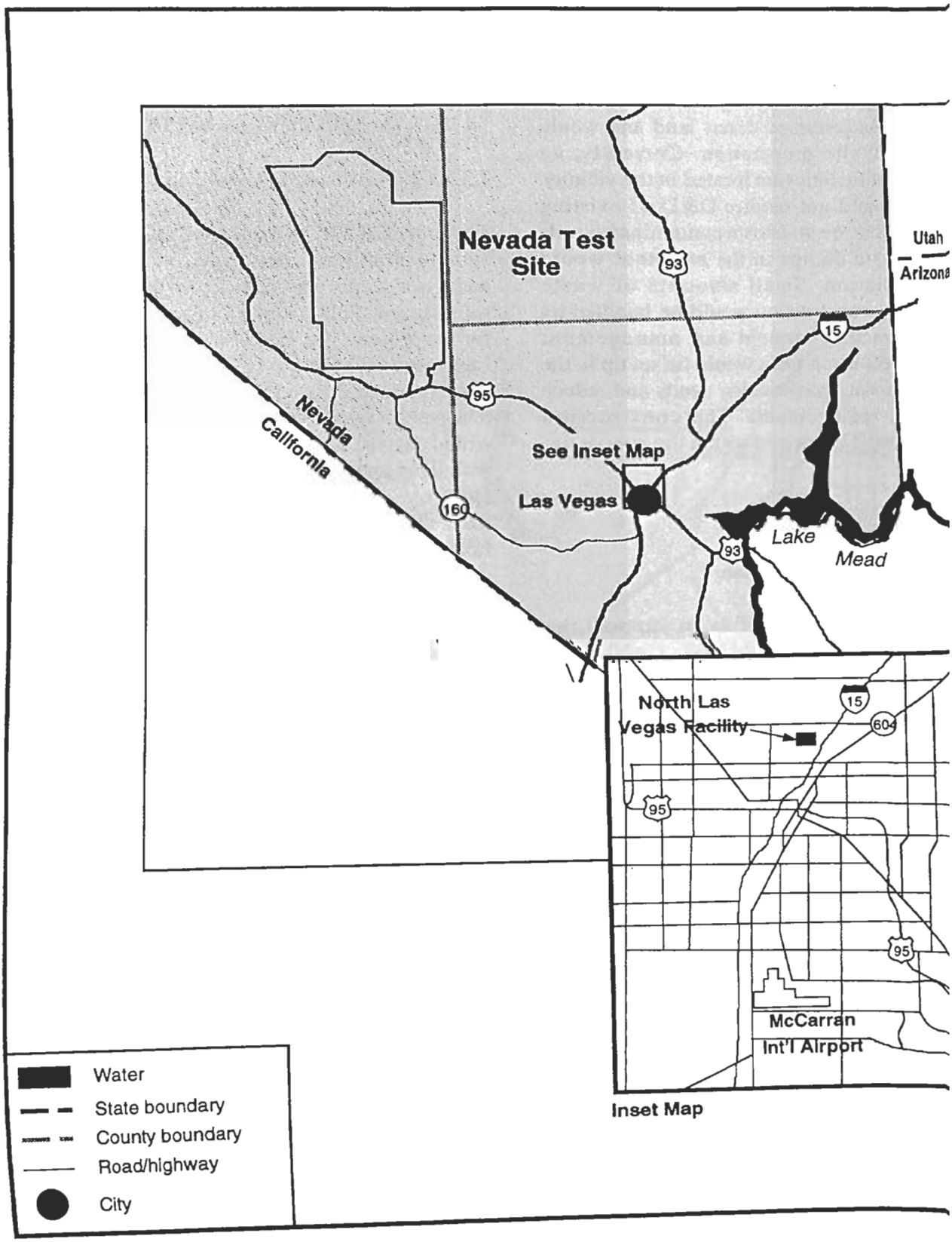
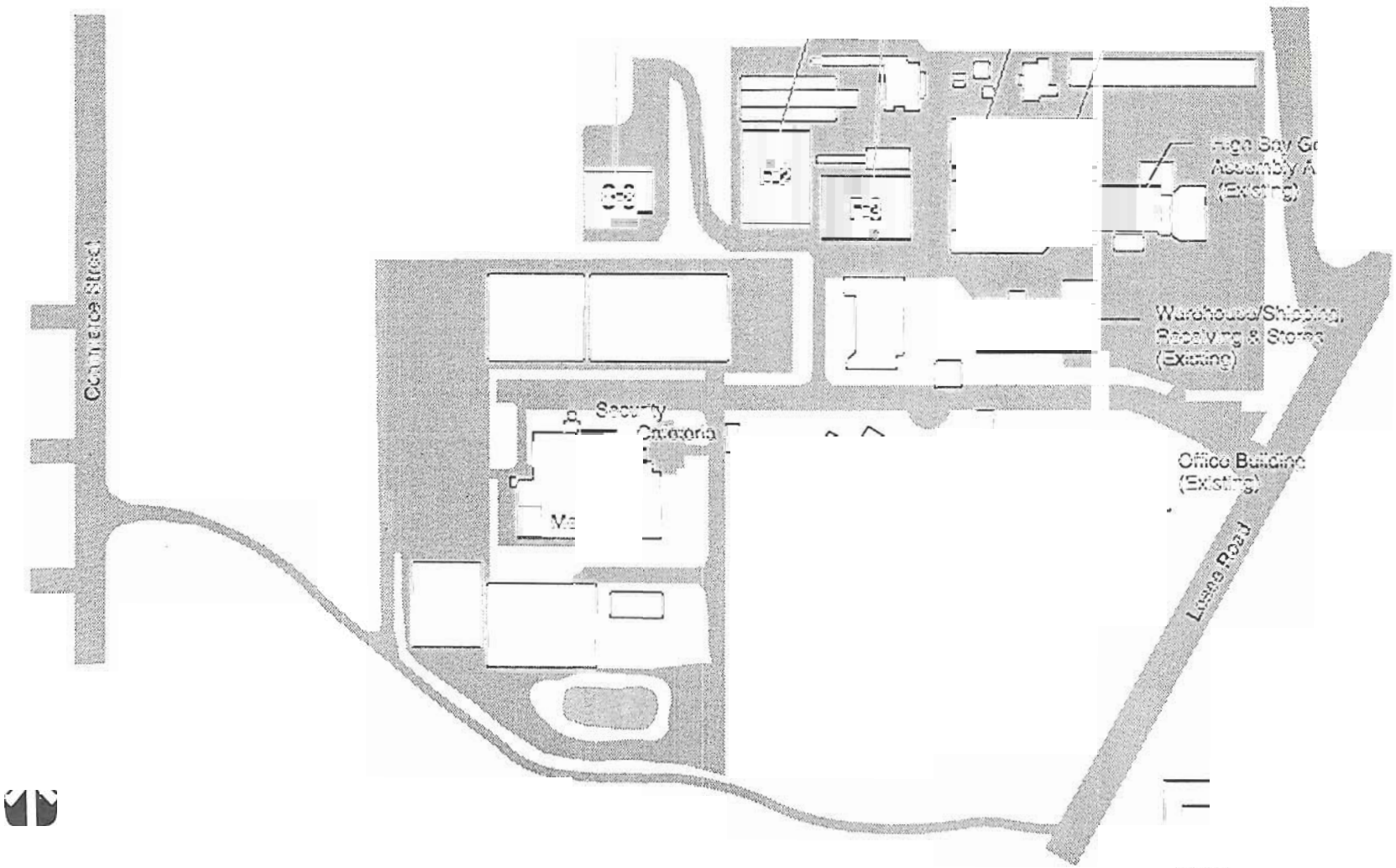
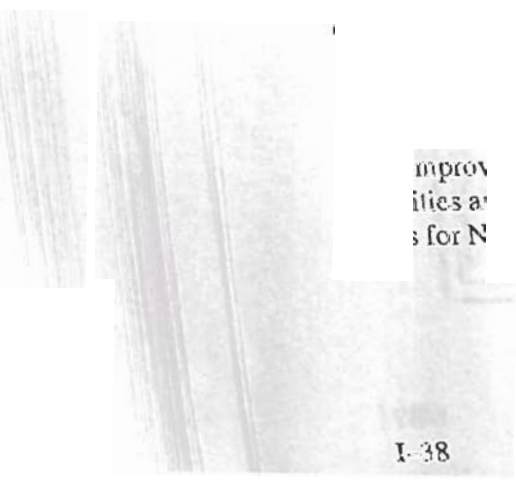
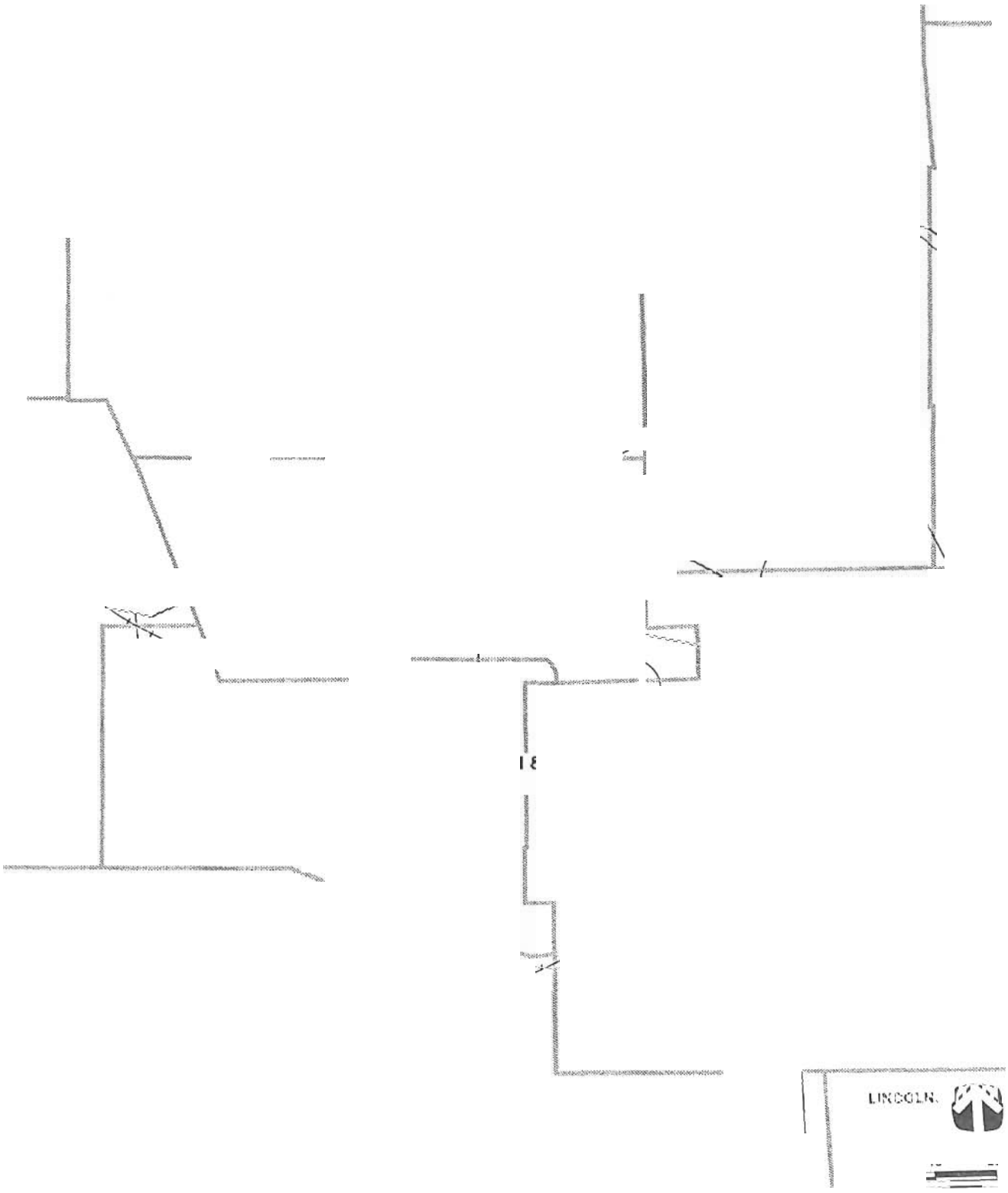


FIGURE I.3.4.4.1–1.—*Regional Location of the North Las Vegas Facility.*


Commerce Street
Security
Office Building
(Existing)
Lyons Road

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LINCOLN

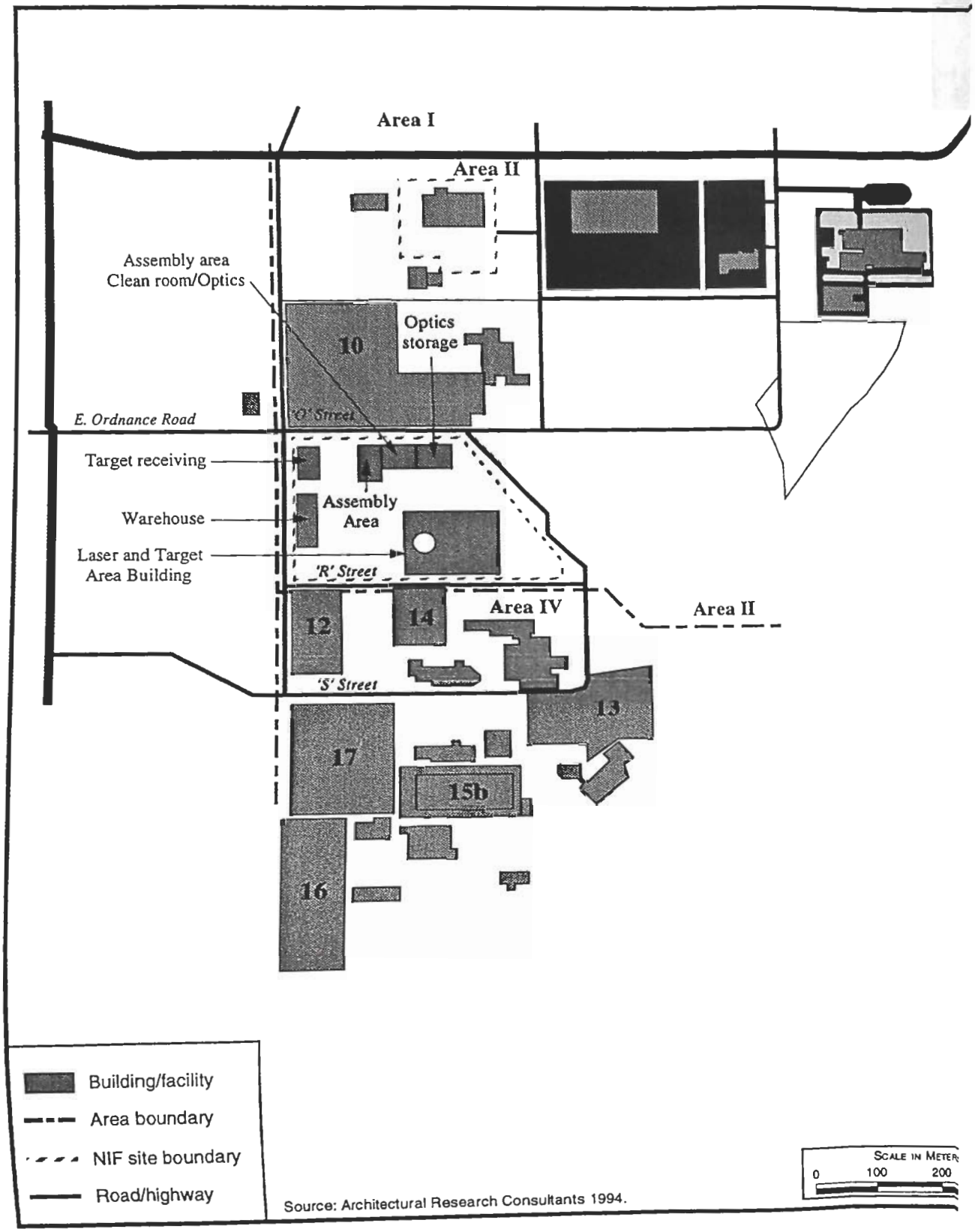


FIGURE I.3.4.5.1–2.—*Proposed Location for the National Ignition Facility at Sandia National Laboratories.*

Environmental Resource Parameter	No Action	LLN
Land Resources		
Uncommitted land requirements[b] (hectares)	None	
Uncommitted land requirements (%)	None	
Number of buildings to be constructed	None	
Conflicts with site development or land use plans	No	
Air Quality and Noise		
Predicted maximum 24-hour particulate matter concentration 10 microns or smaller during clearing ($\mu g/m^3$) / national standard ($\mu g/m^3$)		
Baseline emissions (t/yr)/baseline emissions		
NO_x emissions (t/yr) during operation[c]		
Particulate matter 10 microns or smaller		
Volatile organic compound		Variable
Carbon monoxide		Variable
Nitrogen dioxide		Variable
Sulfur dioxide		
Noise (Qualitative		No Effect
Water Resources		
Construction		
Water requirement (MLY		
Water requirement as percent of current usage		
Operation		
Water requirement (MLY		
[illegible] usage		

TABLE I.3.6.1–1.—*Comparison of Alternatives* [Page 2 of 4]

Environmental Resource Parameter	No Action	LLNL[a]	LANL[a]	NTS[a]	NLVF[a]	SNL[a]
Biotic Resources						
Maximum habitat reduction[h] (hectares)	None	8.1	4.0	18.2	3.2	10.5
Habitat to be impacted	None	Grassland	Forest	Creosote bush desert	Sparse vegetation	Grassland
Wildlife disturbance[i]	None	Minor	Moderate	Moderate	Negligible	Minor
Potential impact to rare, threatened, or endangered species	None	Loss of non-critical, low-quality habitat for several species. Minor risk (mitigable) to white-tailed kite.	Loss of non-critical habitat for several species.	Loss of non-critical habitat for several species. Minor risk (mitigable) to desert tortoise.	None	Loss of non-critical, low-quality habitat for several species.
Cultural Resources (Qualitative)	No impacts	No impacts	No impacts	No impacts	No impacts	No impacts
Socioeconomics						
Construction[j]						
Total jobs	None	2,870	1,130	1,640	1,640	1,770
In-migrating population	None	1,600	2,200	2,340	2,340	3,065
Number of housing units	None	580	800	850	850	1,120
Number of trips generated (per day)	None	902	518	538	538	538
Public finance (% change over 1995 fund balance)	None	-0.03	4.40	0.21	0.21	0.06
Public services (increase in number of workers)	None	7	50	47	47	81
Environmental justice						
- disproportionate adverse health/environmental impacts on:						
- minority populations	None	None	None	None	Low	None
- low-income populations	None	None	None	None	None	None

I.3.6.2 *Air Quality and Noise*

Short-term (i.e., 24-hour) fugitive dust emissions of particulate matter 10 microns or smaller (PM_{10}) during construction would vary among the candidate sites (table I.3.6.1–1). The PM_{10} from each construction site activity would depend on the local meteorology, soil conditions, and the amount of land disturbed during construction. Windy conditions, dry loose soil, and large area disturbance of land would result in the highest PM_{10} emissions. The construction activity contribution of ambient PM_{10} concentration is additive to the background concentration of PM_{10} when compared to the ambient air quality standard. Thus, the higher the background concentration for the same source contribution, the higher the total concentration. The maximum percent of the Federal or state standard that would occur at the candidate sites would range from a low of 35 percent at SNL to a high of 260 percent at LLNL (table I.3.6.1–1). The latter case is for the more stringent California state standard. Emissions for LLNL would be 87 percent of the Federal standard for PM_{10}.

Annual air pollutant emissions from NIF operations would be primarily from fuel combustion, which is assumed to be the same for all candidate sites. Boiler fuel, the primary source of air pollutant emissions, was assumed to be natural gas for all sites except NTS, which would use liquefied petroleum gas. The effect that NIF operations would have on air pollutant emissions would depend on the candidate site's level of emissions before NIF operations (table I.3.6.1–1). No difference in air quality impacts would exist between the Conceptual Design and Enhanced options.

For all candidate sites, noise impacts would be minor. During construction, localized impacts would be greater for those areas with lower ambient noise values. A high ambient value at NLVF would counteract the short distance from construction activities, leading to no annoying noise at the nearest public residences. At NTS, the ambient noise level is very low, and the distance to the nearest residence is very far; therefore, no noticeable noise impacts from construction would occur. Site clearing would cause minor noise impacts at the other candidate sites (LLNL, LANL, and SNL). Impacts during construction for either the Conceptual Design or Enhanced options would be very minor at nearby site buildings offsite public residences.

I.3.6.3 *Water Resources*

Operation of NIF would require 152 million liters year (MLY) (40 million gallons per year) of w under either the Conceptual Design or Enhar options. This water need would range from percent of current water use at LANL to 220 pe of current water use at NLVF (table I.3.6.1–1). current water supply and wastewater treat capacities at LLNL are expected to be sufficie meet the requirements of NIF. Planned u upgrades would be required at LANL to meet and wastewater needs. At NTS, a 3.2-km (2. underground water pipeline would be requi provide water to the NIF location, and se treatment and disposal facilities would have constructed. At NLVF, current water supply ca would be adequate to meet the 220-percent in in water demand. For SNL, agreement with K Air Force Base and the city of Albuquerque w required to obtain additional water supply discharge additional wastewater.

I.3.6.4 *Biotic Resources*

The maximum amount of land (and percen uncommitted land) that would be required fo each candidate site is summarized unde Resources in table I.3.6.1–1. These areas can servatively viewed as the maximum am habitat that would be lost or modified for N relative disturbance to wildlife from constru NIF would be related to the quality of hat would be impacted by construction. Quality is related to the type of habitat within wh would be constructed and to the degree of ment within the immediate area of NI candidate site.

The NLVF site has the most disturbed habi is also the most developed among the candi Expected impacts to biota at NLVF would b ble, with no impacts expected to rare, thre endangered species. The vegetative comm LLNL and SNL are more developed than but are still indicative of formerly distur The areas surrounding these two sites have partially developed. Thus, impacts to bio

two candidate sites would be minor. Because habitats at these two sites could be used by rare, threatened, or endangered species (but are not preferred habitats), the potential for negligible impacts to listed species exists at these sites. NIF locations at LANL and NTS would be within higher-quality habitats (forested and desert habitats, respectively) than occur at the other candidate sites. Also, these two sites do not have extensive developments in the immediate area. Thus, impacts to biota at these two sites would be considered moderate, with a minor chance of impacts to rare, threatened, or endangered species. There would be no difference in impacts to biotic resources between the Conceptual Design and the Enhanced options.

I.3.6.5 *Cultural and Paleontological Resources*

No impacts would be expected to archaeological sites, historic structures, important paleontological remains, or Native American cultural resources at any of the candidate sites. However, a field survey is in progress at NTS to determine if prehistoric or historic archaeological sites occur in the area proposed for NIF. If any significant sites are found, mitigation measures would be developed in consultation with the Nevada State Historic Preservation Officer.

I.3.6.6 *Socioeconomics*

Data on the peak number of jobs, in-migrating population, number of housing units required, increase in local jurisdiction (revenues and expenditures), and number of daily vehicle trips associated with the construction of NIF at the candidate sites are provided in table I.3.6.1–1. Traffic congestion increases would be expected at LLNL, LANL, NLVF, and SNL.

Slight disproportionate effects could occur to minority populations at LANL and NLVF. No other disproportionate affects to minority and/or low-income populations due to NIF construction and operation would be expected. The construction and operation of NIF is not projected to cause major adverse environmental or human health impacts at four of the five candidate sites. Consequently, no environmental justice issues would be likely at those four sites. However, a cancer fatality is projected within the impact zone for the NLVF site under accident conditions (table I.3.6.1–1). The minority population within the impact zone and close to NLVF site is disproportionately large compared with the population of Nevada as a whole. Thus, there would be a potential environmental justice issue for the NLVF site should NIF be constructed and operated there.

I.3.6.7 *Radiation and Hazardous Chemicals*

NIF would be considered a low-hazard, radiological facility. Such a facility uses radionuclides (for nonreactor purposes) and has other hazards (such as chemicals needed at the facility). Being low-hazard implies that there are minor on site and negligible offsite consequences. Potential radiological impacts from normal NIF operations to the general public surrounding all candidate sites would be inconsequential. Estimated radiation doses vary among sites. The greatest calculated radiation dose for the entire operational life of NIF is 18 person-rem to the general public. No cancer fatalities would be expected to occur. Radiological impacts from the Conceptual Design Option would be about one-third of those from the Enhanced Option.

Under postulated accident conditions, radiological impacts to the public and workers would be minor. The highest calculated radiation dose is 4,900 person-rem. At most, two cancer fatalities could occur if an accidental release occurred. Because of the extremely low accidental release frequency (2×10^{-8}/yr), the risk of radiation-caused cancer fatalities from the postulated accident at any site is essentially zero. Radiological impacts from the postulated accident under the Conceptual Design Option would be about one-half of those under the Enhanced Option.

During transportation of the targets, there would be essentially no radiological impacts to the public. The risk of fatality due to physical trauma from transportation accidents would also be negligible. Impacts would be similar among all target manufacturing sources to target use site pairs because the risks would be dominated by truck transportation from the sites to the nearest airports. The larger variable distance between airports would not contribute significantly to the risk because of lower accident probabilities associated with flying compared with driving.

A wide range of nonradiological chemical releases were considered from operation of NIF. Four release

TABLE I.3.6.8–1.—*Comparison of Waste Management at the Candidate Sites*

Category	LLNL		LANL		NTS		NLVF		SNL	
	Current Capacity (m^3)	Adequate Current or Planned Capacity for NIF	Current Capacity (m^3)	Adequate Current or Planned Capacity for NIF	Current Capacity (m^3)	Adequate Current or Planned Capacity for NIF	Current Capacity (m^3)	Adequate Current or Planned Capacity for NIF	Current Capacity (m^3)	Adequate Current or Planned Capacity for NIF
Treatment										
Low-Level										
Liquid	3,736 (34.1/treatment episode)	Yes	9,000/yr (45/hr)	Yes	None	Yes	None	Yes[a]	Included in mixed low-level	Yes
Solid	None	Yes[a]	76	Yes	None	Yes	None	Yes[a]	Included in mixed low-level	Yes
Mixed										
Liquid	8,750	Yes	None	Yes	None	Yes	None	Yes[a]	Data not available	Yes
Solid	11,800	Yes	None	Yes	None	Yes	None	Yes[a]	Data not available	Yes
Hazardous										
Liquid	97	Yes	Varies	Variable[b]	None	Yes[a]	None	Yes[a]	Data not available	Yes[a]
Solid	None	Yes[a]	Varies	Variable	None	Yes[a]	None	Yes[a]	Data not available	Yes[a]
Disposal										
Low-Level										
Liquid	None	Yes[a]	None	Yes	None	Yes	None	Yes[a]	None	Yes
Solid	None	Yes[a]	24-28 ha area available	Yes	650,000	Yes	None	Yes[a]	None	Yes
Mixed										
Liquid	None	Yes[a]	None	Yes	None	Yes	None	Yes[a]	None	Yes
Solid	None	Yes[a]	None	Yes	90,626	Yes	None	Yes[a]	None	Yes
Hazardous										
Liquid	None	Yes[a]	None	Yes	None	Yes[a]	None	Yes[a]	None	Yes[a]
Solid	None	Yes[a]	None	Yes	None	Yes[a]	None	Yes[a]	None	Yes[a]

[a] Shipped offsite.

[b] Varies depending on the waste stream.

Source: Andrews and Tobin 1995; Bowers 1995; NTS 1996.

I.4 Affected Environment and Environmental Impacts

I.4.1 Lawrence Livermore National Laboratory

I.4.1.1 *Affected Environment*

The following sections describe the affected environment associated with the construction and operation of the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory (LLNL). Land use, air quality and acoustics, water resources, biotic resources, cultural and paleontological resources, socioeconomics, radiation and hazardous chemicals, and waste management are described.

I.4.1.1.1 Location and Land Use

The LLNL 332-hectare (ha) (821-acre) site is east of the city of Livermore, California; immediately to the south is Sandia National Laboratories (SNL), Livermore (figure I.3.4.1.1–1). Although their primary missions are similar, LLNL and SNL are separate facilities. Also located south of LLNL are agricultural areas devoted to grazing, orchards and vineyards, some low-density residential areas, and a business park to the southwest. A very small amount of low-density residential development lies east of LLNL, and a business park is located to the north. A parcel of open space to the northeast has been rezoned to allow development of a center for heavy industry (LLNL 1994d). A high-density residential area lies west of the site. Figure I.4.1.1.1–1 shows generalized land use at LLNL and vicinity.

The majority of the LLNL site is designated "industrial," and the perimeter areas on the western and northern portions of the site are designated "industrial" or "agricultural." The southwestern and southeastern quadrants of the site are the most crowded. The proposed location for NIF at LLNL is in the northeastern quadrant of the site adjacent to existing inertial confinement fusion (ICF) facilities (figure I.3.4.1.1–2).

Slopes at the LLNL site are nearly level. Soils are loamy textured, shallow to very deep soils occur on older fans and floodplains. The erosion potential is slight to moderate. No prime or unique farmland soils are located at LLNL.

I.4.1.1.2 Air Quality and Acoustics

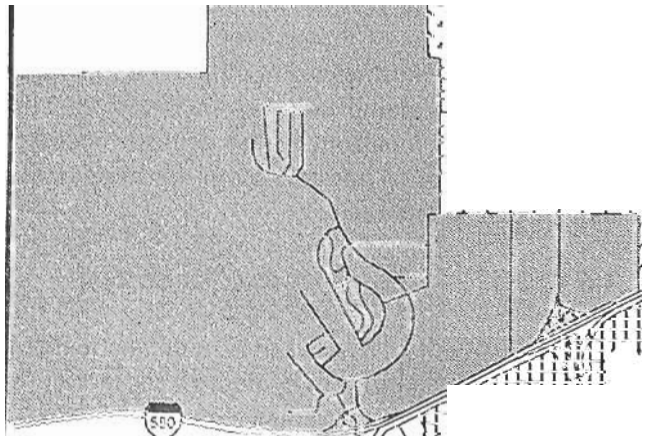
This discussion of existing air quality and acoustics includes a review of the meteorology, climatology, and atmospheric dispersion characteristics near LLNL. No meteorological data were available for the proposed NIF location, so the nearest local and regional monitoring information was used to describe expected site conditions.

I.4.1.1.2.1 *Meteorology and Climatology*

The climate at LLNL and the surrounding region is characterized by mild, rainy winters and warm, dry summers. The annual average temperature at LLNL is 15.0 degrees Celsius (°C) (59.0 degrees Fahrenheit [°F]); average daily temperatures range from 7.9 °C (46.2 °F) in January to 21.0 °C (69.8 °F) in July. The average annual precipitation is 37.8 centimeters (cm) (14.9 inches [in]) (LLNL 1995a). The prevailing winds are from the southwest to west at an annual average wind speed of 3.3 meters per second (m/s) (7.4 miles [mi] per hour [hr] [mph]) (LLNL 1992). The 1994 annual wind rose for LLNL is shown in figure I.4.1.1.2.1–1. During 1994, unstable conditions occurred approximately 29 percent of the year, neutral conditions occurred about 35 percent of the year, and stable conditions occurred the remaining 36 percent (LLNL 1995d). Atmospheric dispersion improves as the wind speed increases and atmospheric conditions become more unstable.

I.4.1.1.2.2 *Ambient Air Quality*

National Ambient Air Quality Standards (NAAQS) exist for the criteria air pollutants ozone, carbon monoxide, nitrogen dioxide, sulfur oxides (measured as sulfur dioxide), particulate matter with a diameter of less than 10 microns (PM_{10}), and lead (40 *Code of Federal Regulations* [CFR] 50). California has established state ambient air quality standards for these pollutants, as well as standards for suspended sulfates, hydrogen sulfide, vinyl chloride (chloroethene), and visibility reducing particles. In addition, the Bay Area Air Quality Management District (BAAQMD) has established a monthly ambient concentration limit for beryllium (LLNL 1994d), which is the same as the National Emission Standard for Hazardous Air Pollutants for beryllium (40 CFR 61.32). Applicable NAAQS and California state and BAAQMD ambient air quality standards are presented in table I.4.1.1.2.2–1.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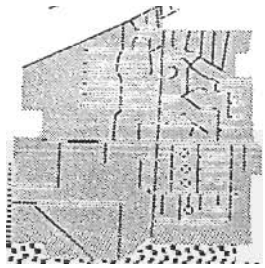


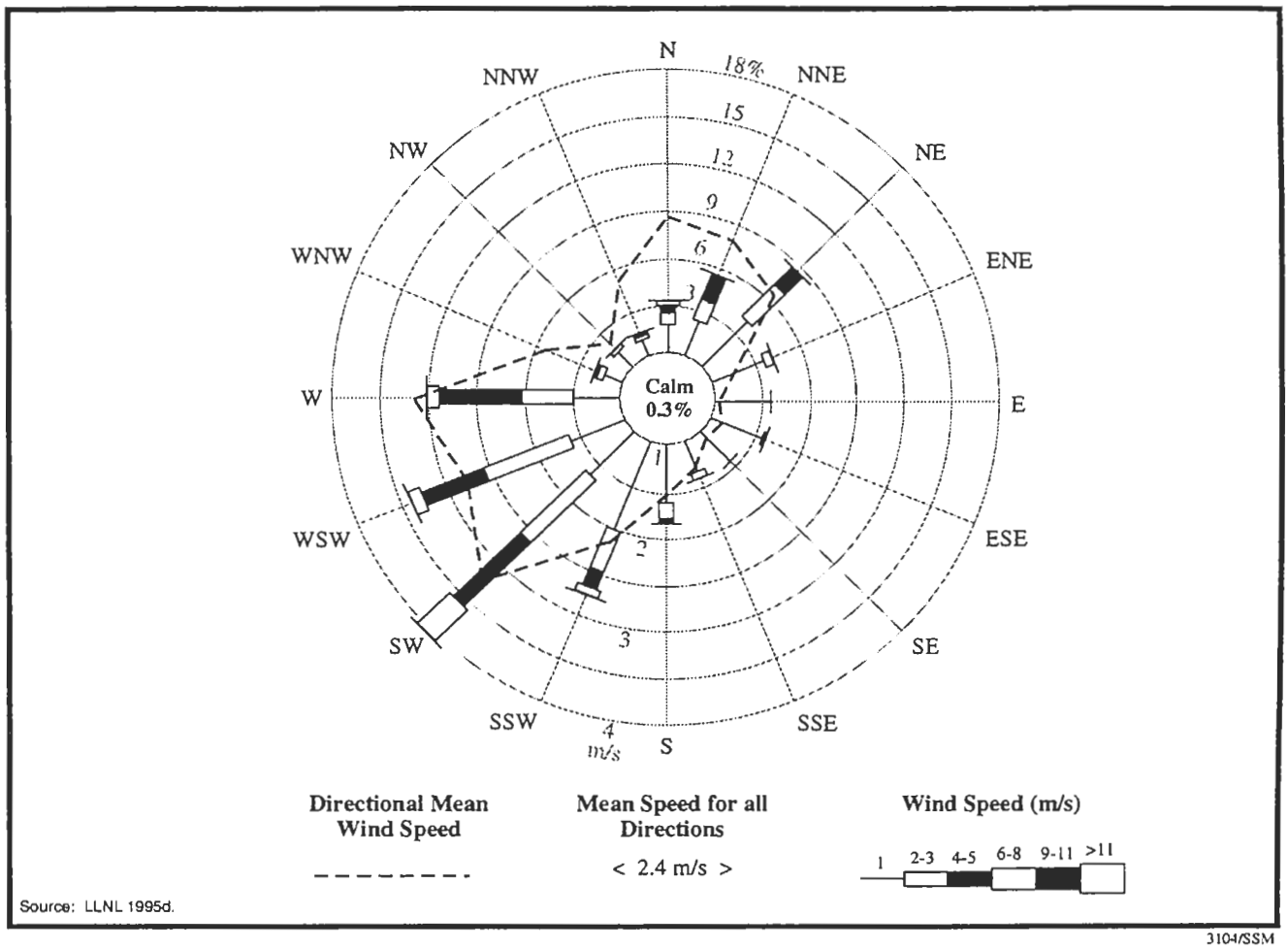


FIGURE I.4.1.1.2.1–1.—*Wind Distribution at Lawrence Livermore National Laboratory, 1994.*

LLNL is located within the San Francisco Bay Area Basin, designated by the Federal Government as the San Francisco Bay Intrastate Air Quality Control Region (AQCR 30). The Bay Area Basin is in attainment for all national ambient air quality standards except carbon monoxide in an urban area that includes the northern tip of Alameda County (40 CFR 81.305). This nonattainment area does not include LLNL. The Bay Area Basin is designated nonattainment for the state ozone and PM_{10} and has an unclassified state designation for hydrogen sulfide and visibility reduction (CARB 1994). (With the exception of one county designated as attainment and four counties and part of a fifth county designated as unclassified, all of California is designated as nonattainment for the state 24-hour PM_{10}.) In general, pollutant emission increases in an area designated nonattainment for a specific pollutant are subject to more stringent permitting requirements than if the area is designated as attainment.

The BAAQMD is responsible for air pollution control from stationary sources and attainment of air quality standards in the San Francisco Bay Area, including Alameda County. The district operates ambient air monitors throughout the San Francisco Bay Area Air Basin to determine compliance with national and state ambient air quality standards. The BAAQMD monitor closest to LLNL is the Livermore Old First Street Station located in downtown Livermore. In addition, LLNL maintains 8 onsite and 11 offsite particulate monitors that measure airborne beryllium concentrations. The most recently published data show violations in calendar year 1993 of the state and national ozone standards and the state 24-hour PM_{10} standard (see table I.4.1.1.2.2–1 and Lazaro et al. 1996).

Federal Prevention of Significant Deterioration (PSD) regulations limit increases in criteria pollutant concentrations resulting from emissions from new

TABLE I.4.1.1.2.2–1.—*Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at Lawrence Livermore National Laboratory*

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	1993 Baseline Concentration[a] ($\mu g/m^3$)
Criteria Pollutant			
Carbon monoxide	8-hour	10,000[b,c]	4,600
	1 hour	23,000[c]	7,000
Lead	Calendar quarter	1.5[b]	0.01
	30-day	1.5[c]	0.01
Nitrogen dioxide	Annual	100[b]	36
	1 hour	470[c]	210
Ozone	1 hour	180[c]	250[d]
Particulate matter 10 microns or smaller	Annual arithmetic mean	50[c]	24.3
	Annual geometric mean	30[c]	20.9
	24-hour	50[c]	84[d]
Sulfur dioxide	Annual	80[b]	ND[e]
	24-hour	105[c]	ND
	3-hour	1,300[b]	ND
	1 hour	655[c]	ND
Mandated by State			
Hydrogen sulfide	1 hour	42	ND
Suspended sulfates	24-hour	25	6.9
Vinyl chloride (chloroethene)	24-hour	26	ND
Visibility-reducing particles	8-hour (10 a.m.-6 p.m. PST)	[f]	ND
Mandated by BAAQMD			
Beryllium	30-day	0.01	0.000137
Other Air Pollutants			
Particulate ammonium-10μm	24-hour	NS[g]	1.50
Particulate chloride-10μm	24-hour	NS	3.61
Particulate nitrate-10μm	24-hour	NS	20.8
Particulate sulfate-10μm	24-hour	NS	4.7
Suspended nitrates	24-hour	NS	22.5
Total suspended particulates	24-hour	NS	93.0

[a] For short-term standards, baseline concentration is highest concentration for year for state standards, second highest for Federal standards.

[b] Federal standard (40 CFR 50).

[c] State standard.

[d] Exceeds most stringent regulation or guideline.

[e] ND - no data available.

[f] In sufficient amount to produce an extinction coefficient of 0.23 per km due to particles when the relative humidity is less than 70 percent.

[g] NS - no data available.

Note: BAAQMD - Bay Area Air Quality Management District.

Source: CARB 1993; Lazaro et al. 1996; LLNL 1994a.

sources above a baseline concentration. The allowable concentration increases (called increments and presented in Lazaro et al. 1996), depend on the PSD classification of the area. Class I areas allow the smallest increases. The area surrounding LLNL contains several PSD Class I areas. The closest such areas are Point Reyes National Wilderness Area, approximately 90 kilometers (km) (55 miles) to the west-northwest; Desolation National Wilderness Area and Mokelumme National Wilderness Areas (160 to 180 km [100 to 110 mi]) to the northeast; and Emigrant National Wilderness Area, Hoover National Wilderness Area, and Yosemite National Park (215 to 230 km [135 to 145 mi]) to the east-northeast and east.

The primary emission sources of criteria pollutants at LLNL are numerous boilers, solvent cleaning operations, stand-by electric generators, and various experimental, testing, and process sources. Emissions estimates for these sources are presented in section I.4.1.2.2.

I.4.1.1.2.3 *Acoustic Conditions*

Major noise emission sources within LLNL include various experimental facilities, equipment, and machines. LLNL is bordered by highways along its entire boundary. In the vicinity of a highway, traffic contributes to ambient noise levels, especially during peak hours. Across the highways bordering the site, the main land uses are light industrial to the north and south, urban residential to the west, agricultural to the southwest, and open rangeland to the east. The acoustic environment along the LLNL boundary is generally assumed to be that of an urban location, with typical average daytime sound levels of 55 to 65 decibel A-weighted (dBA).

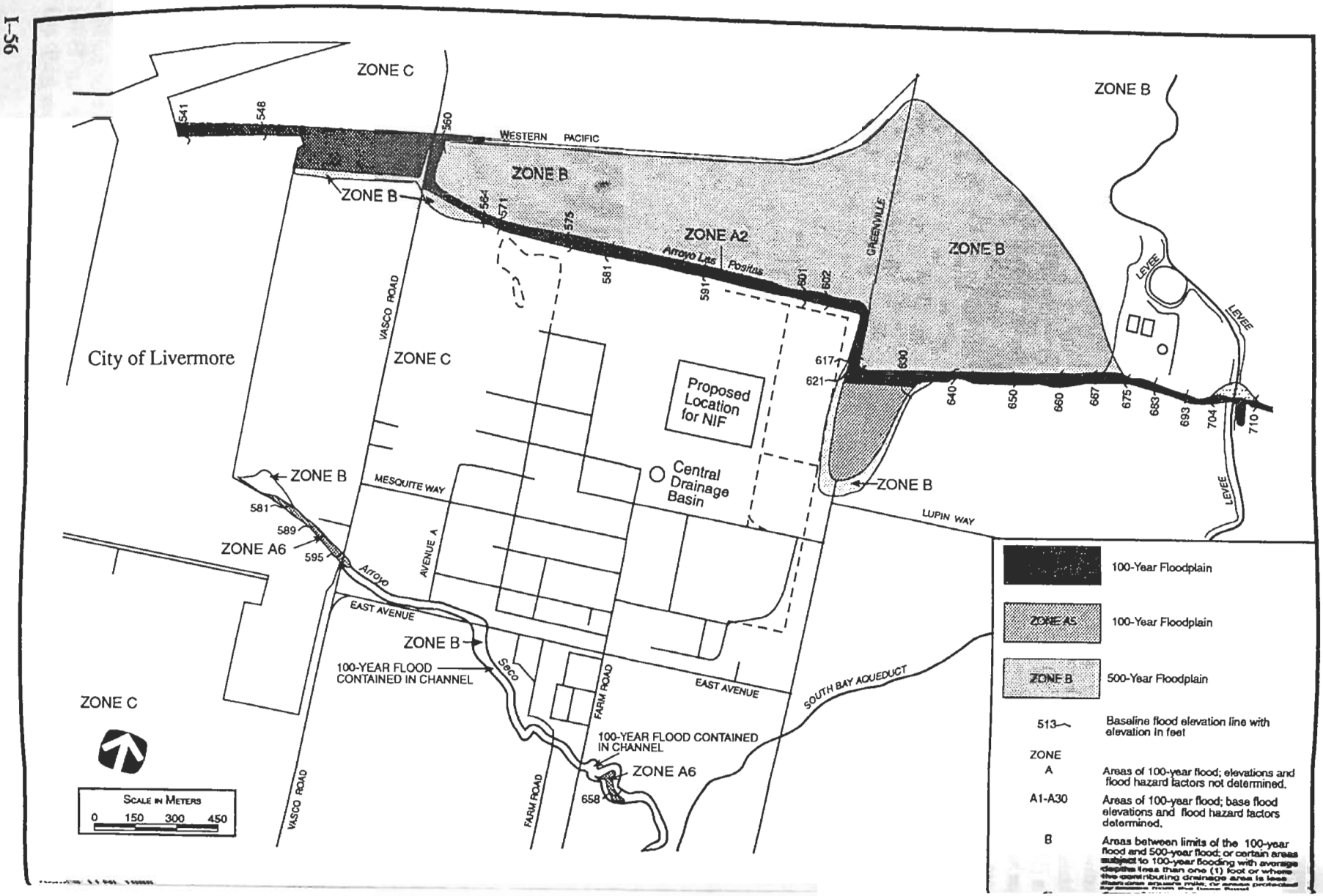
I.4.1.1.3 Water Resources

The LLNL site is in the eastern Livermore Valley. Only intermittent streams flow into the eastern Livermore Valley from the surrounding uplands and low hills. Two intermittent streams flow through the LLNL site: Arroyo Las Positas and Arroyo Seco (figure I.4.1.1.3.–1). The proposed NIF location is in the drainage of Arroyo Las Positas. Arroyo Las Positas drains an area of 13.3 square kilometers (km^2) (5.16 square miles [mi^2]) east of the LLNL site. The channel is not well defined and usually carries only storm runoff. The channel enters the site from the east, is diverted along a ditch around the northern edge of the site, and exits the site at the northwestern corner. Arroyo Seco has a drainage area of 36.3 km^2 (14.0 mi^2) upstream of Sandia National Laboratories, Livermore. The headwaters of the arroyo are in the hills southeast of the LLNL site. The channel is well defined in the LLNL area and is dry for at least six months of the year.

Surface drainage and infiltration at LLNL are generally good, but infiltration decreases locally with increasing clay content in soils (U.S. Department of Energy [DOE] and University of California [UC] 1992). About one-fourth of stormwater runoff within the LLNL site drains into the Central Drainage Basin (figure I.4.1.1.3.–1), which collects runoff from the southeastern quadrant of the LLNL site. During extreme wet weather, the basin can overflow through culverts into storm drains that discharge into Arroyo Las Positas. The remainder of the site drains either directly or indirectly into the two arroyos through storm sewers and ditches (DOE and UC 1992; LLNL 1994d).

Groundwater at the LLNL site occurs in an unconfined zone overlying a series of semiconfined aquifers. The two geologic units containing the most important aquifers are the surface valley-fill deposits and the Livermore Formation. The aquifers in the Livermore Valley are locally recharged by precipitation, irrigation, stream runoff from precipitation, and controlled releases from the South Bay Aqueduct and gravel pits west of the city of Livermore. Groundwater withdrawal from the Livermore Valley is mainly for agricultural use, municipal use, and gravel quarrying. In the vicinity of the LLNL site, agricultural withdrawal is still a major source of groundwater drawdown. Depth to groundwater at the LLNL site varies from about 34 m (110 feet [ft]) in the southeast corner to 9 m (30 ft) in the northwest corner (DOE and UC 1992).

Water used at LLNL (including Sandia National Laboratories, Livermore) is primarily surface water purchased from the city of San Francisco Hetch Hetchy Aqueduct and from the Alameda County Flood and Water Conservation District, Zone 7. A small amount of treated groundwater is used for irrigation and cooling tower makeup. In 1990, 983 million liters (L) (260 million gallons [gal]) and


ZONE C
541
548
560
WESTERN PACIFIC
ZONE B
ZONE B
584
571
575
ZONE A2
Arroyo Las Positas
581
591
601
602
GREENVILLE
ZONE B
ZONE B
LEVEE
LEVEE
City of Livermore
VASCO ROAD
ZONE C
617
621
630
640
650
660
667
675
683
693
704
710
Proposed Location for NIF
Central Drainage Basin
ZONE B
MESQUITE WAY
ZONE B
LUPIN WAY
LEVEE
581
589
ZONE A6
595
AVENUE A
ARROYO
EAST AVENUE
ZONE B
100-YEAR FLOOD CONTAINED IN CHANNEL
SBCO
FARM ROAD
EAST AVENUE
SOUTH BAY AQUEDUCT
ZONE C
100-YEAR FLOOD CONTAINED IN CHANNEL
ZONE A6
658
VASCO ROAD
FARM ROAD
SCALE IN METERS
0 150 300 450
100-Year Floodplain
ZONE A5
100-Year Floodplain
ZONE B
500-Year Floodplain
513
Baseline flood elevation line with elevation in feet
ZONE
A
Areas of 100-year flood; elevations and flood hazard factors not determined.
A1-A30
Areas of 100-year flood; base flood elevations and flood hazard factors determined.
B
Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less

74.1 million L (19.6 million gal) of water were obtained from the two sources, respectively. The water is primarily used for industrial cooling processes, the sanitary system, and irrigation. The LLNL site (excluding Sandia National Laboratories, Livermore) currently uses 970 million liters per year (MLY) (256 million gallons per year [MGY]) annually (LLNL 1995c) and used an average of 990 MLY (262 MGY) from 1986 through 1990 (DOE and UC 1992).

Beginning in 1988, LLNL started implementing water conservation measures such as (1) reducing landscape watering by 35 percent below the projected 1989 level, (2) reducing blowdown from cooling towers to minimal operable levels, (3) limiting use of water for car washes, and (4) eliminating the washing of sidewalks and driveways (DOE and UC 1992).

The city of Livermore Water Reclamation Plant handles sewage from the LLNL site and Sandia National Laboratories, Livermore. The plant currently receives an average of 6.205 MLY (1.643 MGY). The facility is being expanded to treat 11.753 MLY (3.103 MGY) (DOE and UC 1992). LLNL discharges about 402 MLY (110 MGY) of wastewater to the city of Livermore sewer system. This volume includes wastewater from Sandia National Laboratories, Livermore, which is discharged into the LLNL sewer system. LLNL tests and pretreats all wastewater before it leaves the site.

I.4.1.1.4 Biotic Resources

LLNL is within the Southern and Central California Plains and Hills Ecoregion (Omernik 1986). This ecoregion is dominated by annual grasslands. A generalized overview of the habitats and biota that occur at LLNL are provided by DOE and UC (1992). Agricultural, industrial, and residential developments have limited the diversity of wildlife in the area of LLNL. About 259 ha (640 acres) (78 percent) of the 332-ha (821-acre) LLNL site is developed. The developed portions of LLNL are planted with ornamental vegetation and lawns; the undeveloped lands in the security areas (including the proposed NIF and laydown locations) are primarily dominated by nonnative grasses and forbs. Common plant species include ripgut brome, slender oat, star thistle, Russian thistle, turkey mullein, sweet fennel, and Italian ryegrass (DOE and UC 1992). Relatively small areas of other habitats at LLNL hold a special significance, either because of their uniqueness or because of their importance as habitat to biota. These areas are primarily limited to remnant riparian habitats in Arroyo Seco along the southwestern corner of LLNL. These areas contain native tree species such as red willow and California walnut and introduced species such as black locust and almond (DOE and UC 1992). No wildlife refuges or sanctuaries occur at LLNL.

The wildlife of LLNL consists primarily of species adapted to habitats that have been disturbed by humans and that are tolerant of human presence (DOE and UC 1992). Common species at LLNL include the western fence lizard, western meadowlark, American crow, American robin, Anna's hummingbird, white-throated swift, California quail, house sparrow, scrub jay, European starling, house finch, house sparrow, desert cottontail, black-tailed jackrabbit, feral house cat, and California ground squirrel. Raptors that have been observed at LLNL include the red-tailed hawk, Cooper's hawk, sharp-shinned hawk, ferruginous hawk, red-shouldered hawk, black-shouldered kite, American kestrel, burrowing owl, turkey vulture, and golden eagle. Red and gray foxes, coyotes, and raccoons are also known to exist throughout LLNL (DOE and UC 1992).

Wetlands at LLNL are limited to three small areas totaling 0.15 ha (0.36 acre) located at, and downstream from, culverts (DOE and UC 1992). Saltgrass and sedge dominate the two wetlands that exist along Arroyo Las Positas; the other wetland is dominated by cattails, with saltgrass and sedge also existing. Other plant species existing in these wetlands include willow, curly dock, ryegrass, and Hooker's evening primrose. These wetlands are located 300 m (1,000 ft) and more from the proposed NIF construction area.

Aquatic habitats are limited to intermittent drainages (in the two arroyos that cross the site), ditches, and a 1.6-ha (4-acre) water retention basin at LLNL. The water retention basin, located southwest of the proposed NIF location near the center of LLNL, is the only water body that contains fish (mosquito fish). It also could provide habitat suitable for waterfowl, tricolored blackbirds, sensitive amphibians, and sensitive aquatic invertebrates. Runoff from this

basin could eventually increase riparian habitat within Arroyo Las Positas (DOE and UC 1992). Kingfishers and pied-billed grebes have been observed at the basin (LLNL 1994d).

A list of rare, threatened, and endangered Federal and state species that could exist at LLNL is provided in Lazaro et al. (1996). Most of the listed species would be more likely to exist in the less disturbed habitats of LLNL, although several of the species could forage or inhabit the grassland habitat identified for NIF and/or laydown locations (such as western burrowing owls). During detailed surveys conducted in 1991, no sensitive species were encountered at LLNL (DOE and UC 1992). During the summer of 1994, a nesting pair of white-tailed kites, a state-protected species, was noted in a stand of eucalyptus trees near the East Gate (LLNL 1994a). No designated critical habitats for federally listed species exist at LLNL.

I.4.1.1.5 Cultural and Paleontological Resources

No prehistoric or historic archaeological sites or historic structures exist on the proposed locations for NIF at LLNL. The uppermost 0.6 to 1.2 m (2 to 4 ft) of sediment at the proposed site is composed of redeposited fill that would not contain any undisturbed archaeological remains. Results of an intensive pedestrian survey (employing 15 m [50 ft] transects) conducted in July 1990 noted the disturbed character of the surficial sediment and absence of archaeological remains (Bennett 1994). The fill unit overlies alluvium of Pleistocene age that was deposited at least 15,000 years ago (Dresen and Weiss 1985) and thus antedates the earliest documented human settlement in the region (therefore, has little or no probability of containing archaeological remains). Paleontological remains (which would represent late Quaternary fauna) have not been recovered from the alluvium (Dresen and Weiss 1985). Consultation is in progress with Native American groups to identify any important cultural resources on LLNL.

I.4.1.1.6 Socioeconomics

Socioeconomic characteristics discussed here include the regional economy, population and housing, public finance and public service infrastructure, and local transportation. Regional economic statistics are based on a regional economic study area that encompasses 22 counties around LL defined by the U.S. Bureau of Economic A (BEA). The economic study area is a broad la product market-based region linked by trade economic sectors within the region. Statist population and housing, public finance, and service infrastructure are based on the re influence (ROI), a three-county area (Al Contra Costa, and San Joaquin counties) in nearly 93 percent of all LLNL employees Lazaro et al. (1996) lists counties included economic study region and the counties incl the ROI. Assumptions, assessment methodo and supporting data for each technical area presented in Lazaro et al. (1996).

I.4.1.1.6.1 *Regional Economy*

The regional economic study area for LLNL inc the San Francisco-Oakland-San Jose Consol Metropolitan Statistical Area, consisting following Primary Metropolitan Statistical A Oakland, San Francisco, San Jose, Santa Cruz Rosa-Petaluma, and Vallejo-Fairfield-Napa. Be 1988 and 1995, employment in the economic area was projected to increase from 4,555,8 5,117,400. BEA projects a compounded an annual rate of growth of 1.2 percent from 19 2003 (527,124 jobs) (BEA 1990). The unem ment rate in the area is expected to decrease fro percent in 1995 to 4.4 percent in 2010 (Assoc of Bay Area Governments 1993).

In 1995, LLNL employed approximately 8 people, accounting for 0.2 percent of employ the regional economic study area. The distribu LLNL employees by place of residence in the R presented in Lazaro et al. (1996).

I.4.1.1.6.2 *Population and Housing*

The ROI has experienced significant popu growth between 1980 and 1990, with an av annual increase of about 2 percent, bringing the total to about 2.5 million. By the year 2000, pop tion in the ROI is expected to grow to approxi 2.9 million (U.S. Department of Commerce BEA 1990).

Between 1980 and 1990, the number of housing in the ROI increased approximately 19 percent

832,559 to 986,553 (see table I.4.1.1.6.2–1). The number of housing units in Alameda County increased from 444,607 units in 1980 to 504,109 units in 1990 (13.4 percent). Housing units in Contra Costa County increased from 251,917 units in 1980 to 316,170 units in 1990 (25.5 percent). Housing units in San Joaquin County increased from 136,001 units in 1980 to more than 166,274 units in 1990 (22.3 percent). The number of housing units in the ROI is expected to increase about 16 percent over the period 1990 to 2000. The rental vacancy rate in the ROI is approximately 5 percent (U.S. Department of Commerce 1994; Urban Land Institute [ULI] 1995).

The residential building permit volume within the ROI remained strong between the mid- to late-1980s; however, with the national and local recession and a slowing of new household formation, permit volume in the region dropped between 1990 and 1993. The market rebounded somewhat in 1994. The largest percent of new construction within the ROI since 1989 has been within Contra Costa County, where most NIF employees would reside (ULI 1995).

Contra Costa County has historically been the Bay Area's strongest market for residential development, followed by Alameda County. Most new construction has been within southern Alameda County and eastern Contra Costa County, a trend that is likely to continue. Substantial new construction is also planned within central Contra Costa County east of San Roman and north of Dublin (ULI 1995).

The rental apartment market, which experienced some overbuilding in the 1980s, has improved in the 1990s. Production has declined sharply since 1989, reflecting a market adjustment to overbuilding and changes in the Federal tax code. Because of the public construction volume during the 1980s and the subsequent slow economy, rental rate increases since 1985 have generally been lower than the rate of inflation. With high land and construction costs, rental rates do not justify new construction. Despite the lack of new construction, vacancy rates remained about 5 percent in 1993 and 1994. Vacancy rates have not declined because of the doubling up that has occurred in the depressed economy and the large number of renters who have taken advantage of favorable prices and interest rates to purchase homes.

The counties within the ROI are far more receptive to residential development than the San Francisco area on the western side of the bay. The ROI is likely to continue to experience strong residential development activity. Substantial inventories of suitable land remain, particularly in the southern portion of Alameda County and the eastern portion of Contra Costa County near LLNL (ULI 1995).

I.4.1.1.6.3 *Public Finance and Public Services Infrastructure*

Public financial characteristics of the local jurisdictions in the ROI that are most likely to be affected by construction and operation of NIF at LLNL are summarized in this section. The data reflect total revenues and expenditures of each jurisdiction's general fund, special revenue funds, and (as applicable) debt service, capital project, and expenditure trust funds. Major revenue and expenditure categories and revenues less expenditures for counties and cities are presented in table I.4.1.1.6.3–1. Table I.4.1.1.6.3–2 summarizes public service levels for community services, health care, and education.

I.4.1.1.6.4 *Local Transportation*

Vehicular access to LLNL is primarily from Interstate 580 by the Vasco Road and Greenville Road interchanges. LLNL can be entered through security gates along Vasco Road, East Avenue, and Greenville Road. Specific access points include Westgate Drive, Mesquite Way, Southgate Drive, Avenue J, and East Gate Drive (DOE and UC 1992). Table I.4.1.1.6.4–1 lists the site access roads at LLNL, the average daily traffic volumes for each route, and the estimated levels of service at key local intersections.

Traffic concerns in the ROI have reinforced attempts to restrict residential development. However, these restrictions have pushed residential development to the urban fringes, worsening traffic congestion. Among the solutions being instituted for the region's transportation problems are numerous improvements now under way or planned for the region's public transit systems. Several extensions of the Bay Area Rapid Transit (BART) system are currently under construction, including a new line of Dublin and Pleasanton and an extension of the Concord line to Pittsburgh (ULI 1995).

TABLE I.4.1.1.6.2–1.—*Population and Housing Data for the Lawrence Livermore National Laboratory Area*

Category	1980	1990	1996	1997	1998	1999	2000	2001	2002	2003
Estimated ROI population	2,109,052	2,538,312	2,767,679	2,795,646	2,823,903	2,852,453	2,881,300	2,905,074	2,929,049	2,953,227
Estimated total housing units	832,559	986,553	1,078,949	1,094,349	1,109,748	1,125,148	1,140,547	1,155,946	171,346	1,186,745
Estimated vacant owner units	23,722	28,541	31,750	32,075	32,579	33,048	33,589	34,094	34,598	35,103
Estimated vacant renter units	16,585	19,238	21,357	21,731	22,088	22,444	22,800	23,156	23,513	23,869
Estimated total vacant units in ROI	40,307	47,779	52,945	53,806	54,667	55,528	56,389	57,250	58,111	58,972

Source: Historical data from U.S. Department of Commerce 1994; projections by Halliburton-NUS 1995.

TABLE I.4.1.1.6.3–1.—*Public Finance—Lawrence Livermore National Laboratory Area*

Revenues and Expenditures[a]	Alameda County	City of Livermore	City of Pleasanton	Contra Costa County	San Joaquin County	City of Manteca	City of Tracy
Local sources (percent)	43	90	94	35	26	86	86
State sources (percent)	36	10	6	65	74	14	14
Federal sources (percent)	21	0	0	0	0	0	0
Total revenues (dollars)	988,275,000	28,841,041	33,901,086	598,723,000	381,106,067	12,086,164	14,375,044
General government (percent)	6	19	21	12	6	10	14
Public safety, health, and community services (percent)	93	75	79	87	94	88	84
Debt service (percent)	0	6	0	1	0	2	0
Other (percent)	1	1	0	1	0	0	2
Total expenditures (dollars)	1,037,595,000	29,572,914	31,449,570	609,924,000	373,471,380	11,283,214	14,697,326
End-of-year fund balance (dollars)	120,596,000	13,129,925	10,803,206	27,014,000	13,607,115	3,327,880	2,243,365

[a] If reporting body did not distinguish between state and Federal revenue sources, the total for all intergovernmental revenue was combined and reported under the "State sources" heading.
Source: Alameda County 1994; Contra Costa County 1994; San Joaquin County 1994; city of Livermore 1994; city of Pleasanton 1994; city of Tracy 1994; city of Manteca 1994.

TABLE I.4.1.1.6.3–2.—*Public Services—Lawrence Livermore National Laboratory Area*

Part I: Education

County/School District	Enrollment	Pupil-Teacher Ratio	Per Pupil Expenditure ($)
Alameda County	188,076	28.4:1[a]	4,538
Contra Costa County	132,951	22.9:1[a]	4,192
San Joaquin County	119,115	NA	4,347

Part II: Level of Service per 1,000 Population

County/Jurisdiction	Police Protection	Fire Protection	General Government	Physicians
Alameda County	0.5	0.1	7.9	2.7
City of Livermore	1.0	0.8	5.5	NA
City of Pleasanton	1.2	0.8	6.6	NA
Contra Costa County	0.6	0.4[b]	7.7	2.6
San Joaquin County	0.3	NA[c]	12.8	1.6
City of Manteca	1.0	0.6	5.9	NA
City of Tracy	1.1	0.6	5.1	NA

[a] Pupil-teacher ratio is for grades 1–8.

[b] Contra Costa Fire Protection District is the largest fire protection district in Contra Costa County; however, other districts also provide service throughout the county.

[c] General Government number includes firefighters. Fire services in San Joaquin County are provided by approximately 27 fire protection districts, including city fire departments.

Note: NA - not applicable.

Source: Contra Costa County 1994; Alameda County 1994; Contra Costa County School Districts 1994; American Medical Association 1994; Federal Bureau of Investigation 1993; San Joaquin County Schools 1995a; San Joaquin County Schools 1995b; city of Pleasanton Personnel Department 1995; city of Manteca Personnel Department 1995; city of Manteca Fire Department 1995; Contra Costa Fire Protection Department 1995; Alameda County Fire Department 1995.

Freeway improvements are also under way in the region, including replacement of Cypress Freeway, improvements to major interchanges in Walnut Creek, and construction of a high-occupancy vehicle ramp from Interstate 80 to the Bay Bridge. There are numerous ongoing seismic retrofit projects (California Department of Transportation 1995). With general political resistance to infill housing development, most affordable housing is being produced in remote locations within the region and beyond in Solano and San Joaquin counties. These areas are poorly served by public transportation and are located along increasingly congested traffic arteries, such as Interstate 205. With the focus of new housing development likely to continue in these areas, traffic congestion is projected to worsen (ULI 1995).

LLNL is served by several public transportation providers. San Joaquin County provides bus access to LLNL from the San Joaquin Valley, Wheels Transit Service serves LLNL from the Tri-Valley region, and BART provides express buses during peak commuting hours (ULI 1995).

Major railroads in the ROI are the Atchison, Topeka, and Santa Fe Railroad, the Southern Pacific Transportation Company, and the Union Pacific Railroad. The Union Pacific passes within 1.6 km (1 mi) of LLNL; however, there is no direct rail access to LLNL.

The ROI is served by several airports, in Oakland International, San Jose Intern Stockton Metropolitan, and San Francisco I tional Airport. The Livermore Municipal serves local air traffic.

I.4.1.1.6.5 *Environmental Justice*

Environmental justice concerns the potential and adverse environmental or human health to disproportionately affect minority or low populations. For this assessment, enviro justice is evaluated for impacts within the site defined as an 80 km (50 mi) radius around and within the local area. Lazaro et al. presents the demographic analysis of minor low-income population distributions on a re and local basis.

In the LLNL site region in 1990, 7 percent of ulation was low income and 41 percent was m These values are lower percentages of bot income and minority persons than the Californ averages (12 percent low income and 43 p minority). However, within that area, census closer to LLNL tend to have a higher propor minority population but a lower proportion o income population than do census tracts farth the site.

TABLE I.4.1.1.6.4–1.—*Baseline Traffic on Lawrence Livermore National Laboratory Access Roads*

Route	From	To	Estimated 1995 AADT	Estimated 19 LOS
Patterson Pass Road	Vasco Road	Greenville Road	1,040	A
East Avenue	Vasco Road	Greenville Road	11,250	A
East Avenue	Buena Vista Avenue	Vasco Road	13,800	A
East Avenue	Hillcrest Avenue	Buena Vista Avenue	18,700	A
Telsa Road	Vasco Road	Greenville Road	2,600	A
Telsa Road	Buena Vista Avenue	Vasco Road	6,400	A
First Avenue	N. Mines Road	Las Positas Road	28,300	B
Vasco Road	Brisa Street	Patterson Pass Road	18,300	A
Vasco Road	Westgate Drive	Mesquite Way	13,500	B
Vasco Road	East Avenue	Telsa Road	4,150	A
Greenville Road	Patterson Pass Road	Lupin Way	5,200	A

Note: AADT - average annual daily trips; LOS - level of service.
Source: DOE and UC 1992.

I.4.1.1.7 Radiation and Hazardous Chemicals

I.4.1.1.7.1 *Radiation Environment*

Many of the activities that take place at LLNL involve handling radioactive materials and operating radiation-producing equipment. A detailed discussion of the radiation environment, including background, radiological releases, and doses to members of the public is presented in the publication *Environmental Report 1993* (LLNL 1994d). The concentrations of radioactivity in various environmental media (air, water, soil) in the site region are also presented in that report.

Calculated radiological doses were used to estimate the potential health impacts to the public and onsite workers at LLNL from any releases of radioactivity. The annual doses to an individual, the surrounding population (within 80 km [50 mi]), and workers are summarized in table I.4.1.1.7.1–1; corresponding health risks are also presented in the table. These values are in addition to those from natural background, consumer products, and medical sources, which total about 365 millirems (mrem) per year. Background radiation doses are unrelated to LLNL operations. Regulatory limits that specify the maximum effective dose equivalent to individual members of the public and occupational workers are also presented in table I.4.1.1.7.1–1. The doses to the public presented in table I.4.1.1.7.1–1 are within regulatory limits (DOE 1990) and are small compared to background radiation. The onsite worker doses are also within regulatory limits.

I.4.1.1.7.2 *Hazardous Chemical Environment*

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous particulates or vapors that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, soil through contact or via the food pathway). Exposure pathways to LLNL workers during normal operation may include inhaling the workplace atmosphere, drinking LLNL potable water, and possibly other contact with hazardous materials associated with work assignments. The maximum daily quantities of hazardous materials stored in 1992 are listed in table I.4.1.1.7.2–1. The potential for health impacts varies from facility to facility and from worker to worker, and depends on the operations performed, as well as the materials handled. However, workers are protected from hazards specific to the workplace through (1) appropriate training, (2) engineering controls, (3) work practices, (4) administrative controls, (5) monitoring, and (6) protective equipment. LLNL workers are also protected by adherence to Occupational Safety and Health Administration (OSHA) and U.S. Environmental Protection Agency (EPA) standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded.

TABLE I.4.1.1.7.2–1.—*Maximum Daily Quantities of National Ignition Facility-Related Hazardous Materials Stored at Lawrence Livermore National Laboratory*

Hazardous Material	Quantity
Acetone	3,577 kg
Alumina	3,345 kg
Ammonium hydroxide	2.23 kg
Copper	55.8 kg
Ethyl alcohol	13,244 L
Hafnium oxide	1,115 kg
Mercury	1,238 kg
Sodium hydroxide	9,455 kg
Tetraethyl orthosilicate	1,904 kg

Note: kg - kilograms; L - liters.
Source: DOE and UC 1992.

I.4.1.1.8 Waste Management

LLNL currently operates four waste management facilities. The Area 514 and Area 612 facilities contain treatment and storage units for hazardous and mixed wastes. The Building 693 facility is currently a container storage unit for mixed hazardous waste, *Toxic Substances Control Act* (TSCA)-regulated waste (such as polychlorinated biphenyls), and radioactive waste. The Building 233 container storage unit is currently used to store mixed waste, low-level waste (LLW), and transuranic (TRU) waste.

TABLE I.4.1.1.7.1–1.—*Annual Radiation Doses to the General Public and Onsite Workers from Normal Operations at Lawrence Livermore National Laboratory*

Receptor	Atmospheric Releases		Liquid Releases		Total		
	Regulatory Limit[a]	Calculated	Regulatory Limit[a]	Calculated[b]	Regulatory Limit[a]	Calculated	Risk[c]
Individual Dose							
Average exposed individual[d] (mrem)	10	1.3×10^{-4}	4	0.0	100	1.3×10^{-4}	6.5×10^{-11}
Maximally exposed individual (mrem)	10	6.5×10^{-2}	4	0.0	100	6.5×10^{-2}	3.3×10^{-7}
Population Dose[e]							
Population within 80 kilometers (person-rem)	[f]	7.6×10^{-1}	[f]	0.0	[f]	7.6×10^{-1}	3.8×10^{-4}
Worker Dose[g]							
Average worker (mrem)	NA	NA	NA	NA	5,000	2.1	8.4×10^{-7}
Maximally exposed worker (mrem)	NA	NA	NA	NA	5,000	1,300	5.2×10^{-4}
Total worker[h] (person-rem)	NA	NA	NA	NA	None	18.3	7.3×10^{-3}

[a] The regulatory limits for individuals are given in DOE Order 5400.5. The 10 mrem/yr limit from airborne emissions is required by the *Clean Air Act*. The 4 mrem/yr limit is required by the *Safe Drinking Water Act*, and the total dose of 100 mrem/yr is the limit from all pathways combined. The occupational limit for workers is 5,000 mrem/yr (10 CFR 835).

[b] The calculated dose values listed in this column conservatively include all water pathways, not just the drinking water pathway.

[c] Based on latent fatal cancer risk factors of 5×10^{-7}/mrem for individuals, 5×10^{-4} /person-rem for population, and 4×10^{-7}/mrem for workers (ICRP 1991).

[d] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.

[e] Estimated for a population of approximately 6 million.

[f] No regulatory limit exists for population doses; however, a 100 person-rem value for the population is found in proposed 58 FR 16268 (10 CFR 834).

[g] Worker doses were estimated on the basis of readings from monitoring devices called thermoluminescent dosimeters.

[h] The number of badged workers in 1994 was approximately 8,700.

Note: NA - not applicable.

Source: LLNL 1994d.

TABLE I.4.1.1.8–1.—*Current Waste Management at Lawrence Livermore National Laboratory*

Category	1994 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity[a] (m^3)	Disposal Method	Disposal Capacity (m^3)
Low-Level							
Liquid	181	Neutralization, filtration, solidification, precipitation, oxidation, flocculation, blending	3,736 (34.1/ treatment episode)	Hazardous Waste Management Division Facilities	627	Treated wastewater discharged to city of Livermore sanitary sewer if within approved limits	None
Solid	307	Shredding, drum crushing, compaction	NA	Hazardous Waste Management Division Facilities	2,297	Shipped to Nevada Test Site	NA
Mixed Low-Level							
Liquid	51	Neutralization, filtration, solidification, precipitation, oxidation, flocculation, blending	8,750	Hazardous Waste Management Division Facilities	627	Treated wastewater discharged to city of Livermore sanitary sewer if within approved limits	NA
Solid	20	Shredding, drum crushing, compaction	11,800	Hazardous Waste Management Division Facilities	2,297	None	None
Hazardous							
Liquid	342	Shipped to offsite RCRA-permitted treatment, storage, and disposal facility, except for silver recovery	97	Hazardous Waste Management Division Facilities	76.9	Shipped to offsite RCRA-permitted treatment, storage, and disposal facility	NA
Solid	237	Shipped to offsite RCRA-permitted treatment, storage, and disposal facility, except for silver recovery	NA	Hazardous Waste Management Division Facilities	98	Shipped to offsite RCRA-permitted treatment, storage, and disposal facility	NA
Nonhazardous (Sanitary)							
Liquid	456,000	None	NA	Retention tanks	829 (spill control capacity 882,622 L)	Discharged to city of Livermore sanitary sewer system	NA
Solid[b]	6,425 t	None	NA	Hazardous Waste Management Division	NA	Offsite landfill	NA

I.4.1.1.8.4 *Nonhazardous Waste*

Solid nonhazardous wastes generated by LLNL consist of paper, plastics, glass, organic, and other wastes. LLNL does not have onsite solid waste disposal facilities. Solid wastes are collected in dumpsters and similar containers in such a manner as to ensure that they do not contain hazardous or radioactive wastes and transported to the Vasco Road Landfill for disposal.

If industrial wastewater generated by LLNL operations exceeds permissible discharge limits and is treatable by permitted LLNL waste treatment units, the water is processed to meet the release criteria and then monitored as it is discharged to ensure that permissible discharge limits are not exceeded. These wastes enter the city of Livermore's sewer system and are then processed at the city's Water Reclamation Plant. The treated wastewater is piped to San Francisco Bay for discharge, except for a small volume that is used for summer irrigation of the municipal golf course adjacent to the Livermore Water Reclamation Plant. Sludge from the treatment plant is disposed of in offsite landfills.

LLNL has an onsite sewage diversion and retention system that is capable of containing approximately 757 cubic meters (m^3) (26,700 cubic feet [ft^3]) of potentially contaminated sewage until it can be analyzed and appropriate handling methods implemented. If the liquids cannot be processed for discharge, they are packaged for treatment or disposal at an offsite facility. Treatment residues, or solids generated from the treatment process, are also packaged for treatment or disposal at an offsite facility.

I.4.1.2 *Environmental Impacts*

The following sections describe the potential environmental impacts for land use and visual resources, air quality and noise, water resources, ecological resources, cultural and paleontological resources, and socioeconomics from constructing and operating NIF at LLNL. In addition, impacts associated with radiation, hazardous chemicals, and waste management are described.

I.4.1.2.1 Land Use and Visual Resources

I.4.1.2.1.1 *Land Use*

Impacts to land use at LLNL from construction and operation of NIF would be limited to the clearing of land, minor and temporary disruptions to contiguous land parcels, and a slight increase in vehicular traffic. No significant impacts to onsite or offsite land uses are anticipated from the project. The proposed location for the two buildings requiring construction for NIF would occupy a large parcel of relatively flat, vacant land in the northeastern corner of LLNL (figure I.3.4.1.1–2). The proposed location is in a section of LLNL where similar types of research and experimentation already occur. Therefore, no conversion of existing land use would result. The NIF buildings would require the clearing of an estimated 8 ha (20 acres) of land for structures, walkways, building access, and buffer space. Such acreage would account for approximately 11 percent of the land currently available for development inside the LLNL site boundaries (Gawronski 1995). An additional 2.0 ha (4.9 acres) would be cleared for a construction laydown area (figure I.3.4.1.1–2). This area would be restored after NIF construction is completed. No impacts to land use (including zoning) on land outside of LLNL or in nearby communities would be expected.

With appropriate erosion and sediment control measures, soil impacts during construction of NIF would be short term and minor. Seismic risks would be taken into account during construction and operation of NIF.

I.4.1.2.1.2 *Visual Resources*

With the exception of minor, temporary impacts (fugitive dust, equipment exhaust, etc.) associated with construction activities, no impacts to the visual character of LLNL or to surrounding visual resources would be expected. The Laser and Target Area and the Optics Assembly buildings would be constructed in a sector of LLNL that has similar structures. The plot that would contain the two new facilities consists of grassland and a few trees that are visually uniform and not distinct or unique. Because so much of LLNL is developed, views into the installation from surrounding points would not be altered by the two new buildings.

I.4.1.2.2 Air Quality and Acoustics

I.4.1.2.2.1 *Air Quality*

The potential air quality impacts resulting from construction and operation of NIF are discussed separately because the air pollutant emissions generated during construction would not occur during NIF operations.

Construction Emissions. Estimated construction emissions, including site-clearing emissions and emissions associated with facility construction, are listed in table I.4.1.2.2.1–1. The construction emission estimates are based on characteristics of the proposed LLNL location and on construction vehicle exhaust and fugitive emissions. Site clearing would occur the first year, followed by facility construction during the next four years (LLNL 1995b).

TABLE I.4.1.2.2.1–1.—*Estimated National Ignition Facility Construction Emissions for the Lawrence Livermore National Laboratory Location*

Pollutant	Total Emissions (t/yr)[a]
Particulate matter 10 microns or smaller	14.51[b]
Volatile organic compounds	0.44
Carbon monoxide	1.23
Nitrogen dioxide	3.76
Sulfur dioxide	0.43
Lead	Negligible

[a] Metric tons (1,000 kg) per year.

[b] Includes 4.17 t/yr (4.60 ton/yr) of fugitive emissions for site clearing, using water spray control that occurs during a 30-day period in the first year and 10 t/yr (11.02 ton/yr) of facility construction emissions that occur for 11 months during the first year of construction.

Source: Lazaro et al. 1996.

The site-clearing phase of construction, which would continue for about one month, would produce the greatest amount of fugitive dust (particulate matter of 10 microns or less [PM_{10}]) emissions. The Industrial Source Complex, Short-Term Model, Version 2 (ISCST2, Version 93109 [EPA 1992a-b]) was used to determine the impact of site-clearing activities on ambient air quality. The Industrial Source Complex dispersion model is the EPA's preferred regulatory modeling tool for most applications in simp (EPA 1995a). The ISCST2 Model wa because the general area from NIF location receptors of concern is relatively flat and is ized as simple terrain. The data selected for air quality were 1994 surface meteorolog from the LLNL site (LLNL 1995d). The surf speeds and directions are summarized in a wind rose (see figure I.4.1.1.2.1–1). In ad constant mixing height of 600 m (1,970 ft) w throughout the year (LLNL 1995d). D emission inventories associated with site clea facility construction; meteorological data u air quality model, assumptions, and mod parameters are presented in Lazaro et al. (19

The national and state 24-hour PM_{10} stand 150 and 50 micrograms (μg)/m^3, respectiv 24-hour average PM_{10} background concentr 84 $\mu g/m^3$ is already above the State Ambi Quality Standard (SAAQS) of 50 $\mu g/m^3$ (s I.4.1.1.2.2–1). Accordingly, site clearing sh conducted so as to minimize further impa ambient air quality. With a conventional spraying dust control system (that is, 50-p control for excavation and 60-percent con traffic on unpaved roads), maximum 24-hour PM_{10} concentrations of 104 $\mu g/m^3$ over back are predicted at the site boundary (about [1,150 ft] east of the proposed NIF loca Operation with additional dust control measu involve continuous water spraying and/or a chemical dust suppressant, would reduce PM_{10} emissions from excavation by 75 percent and emissions from traffic on unpaved roa 90 percent. These measures would bring ma 24-hour average PM_{10} concentrations do 46 $\mu g/m^3$ over the background concentr Including background concentration, max 24-hour concentrations would still be higher t SAAQS for PM_{10}. The ambient air quality i associated with site clearing would be limited area just outside the site boundary, which the public is expected to occupy infrequen addition, site clearing at LLNL would be expe last for only a month, so ambient air quality i associated with site clearing would be localiz porary.

Modeling efforts showed that over a year, th highest 24-hour PM_{10} concentration lev

descending order would be 62, 50, 43, 43, 43, and 36 $\mu g/m^3$ above the background concentration. These levels were predicted for an area near the eastern boundary, which is the closest to the NIF location. In addition, annual average PM_{10} concentrations were estimated for the entire one-year construction period, which consists of one month for site clearing, followed by facility construction. The estimated highest annual arithmetic mean PM_{10} concentration level of 5 $\mu g/m^3$ above the background concentration is well below the state standard of 30 $\mu g/m^3$ in terms of geometric mean. (Note that the arithmetic mean is greater than or equal to the geometric mean.) As a consequence, long-term ambient air quality impacts associated with NIF construction would be minor. However, short-term ambient air quality impacts resulting from site clearing could be moderate, although local and temporary in extent. Additional regulatory information is provided in section I.5.2.1.

Emissions During Operations. Air pollutant emissions from operation of NIF at LLNL are expected to occur primarily from fuel combustion and solvent cleaning of the debris shields. Emissions of solvent volatile organic compounds (VOCs) (ethanol) from debris shield cleaning are estimated at about 0.50 metric tons per year (t/yr) (0.55 ton/yr) (LLNL 1995b). Other potential air pollutant emission sources not considered significant are target destruction under either the Conceptual Design or Enhanced options, emissions from vehicles used for freight shipments and employee commuting, and emissions from welding operations at the Fabrication Facility.

As indicated in table I.4.1.2.2.1–2, estimated air pollutant emissions due to NIF operation are well below 1 t/yr (1.1 ton/yr), except for nitrogen dioxide, which is below 2 t/yr (2.2 ton/yr). Estimated air pollutant emissions from NIF operations are less than 10 percent of LLNL 1994 emissions, except for carbon monoxide, which is approximately 11 percent of 1994 emissions. Existing ambient concentrations for these pollutants (see section I.4.1.1.2.2, table-I.4.1.2.2.1–1) are well below the ambient air quality standards except for PM_{10} and ozone. The increase of 0.16 t/yr (0.18 ton/yr) PM_{10} is less than 5 percent of LLNL 1994 emissions and is not expected to cause a measurable increase in the 24-hour and annual average ambient concentrations. VOC emissions related to NIF operations are estimated to increase by less than 5 percent for the existing emissions at LLNL. Estimated NIF VOC operating emissions at LLNL are 0.56 t/yr (0.61 tons/yr). Total 1995 VOC emissions for the BAAQMD are 269,248 t/yr (296,173 tons/yr) and from fuel combustion are 6,654 t/yr (7,319 tons/yr). Therefore, NIF contribution of VOCs to production of ozone would be almost insignificant (Mangat 1995). On the basis of this information, it can be concluded that NIF operations would have no adverse impact on air quality and would not contribute to a violation of the ambient air quality standards.

The NIF annual energy requirements based on heat and hot water demand for the Laser and Target Area Building and all necessary support facility buildings are listed in table I.4.1.2.2.1–3. All candidate sites would require construction of the Laser and Target

TABLE I.4.1.2.2.1–2.—*Annual Emission Increases with National Ignition Facility Operation at Lawrence Livermore National Laboratory*

Pollutant	1994 Emissions[a] (t/yr)	Projected NIF Emissions (t/yr)[a]	1994 Emissions Plus NIF (t/yr)	NIF Percent of 1994 Emissions
Particulate matter 10 microns or smaller	3.36	0.16	3.52	8.8
Volatile organic compound	13.10	0.56	13.66	4.3
Carbon monoxide	3.99	0.43	4.42	11
Nitrogen dioxide	23.50	1.79	25.29	7.61
Sulfur dioxide	0.37	0.03	0.40	9
Lead	<0.01	Negligible	<0.01	Negligible

[a] Emissions based on site-estimated natural gas external combustion, diesel internal combustion, and volatile organic compound solvent cleaning (0.5 t/yr [0.55 ton/yr]) and emission factors (EPA 1995c; Lazaro et al. 1996).

Source: EPA 1993; Zahn 1995.

Area Building. None of the candidate sites would require construction of the full complement of support facilities that are represented by the annual support facilities energy demand in table I.4.1.2.2.1–3. Therefore, NIF annual energy demand and resulting air pollutant emissions differ among sites based on the area of new buildings required. The ratio of the sum of new support building construction area to the sum of the area for all NIF required support buildings was used to adjust support building energy demand for each candidate site (see table I.3.4–1 for a listing of new buildings required by NIF for each candidate site).

Table I.4.1.2.2.1–2 lists the estimated LLNL annual air pollutant emissions on the basis of the anticipated NIF annual energy requirements provided in table I.4.1.2.2.1–3, adjusted to recognize that at LLNL only one new support building (area of 1,858 square meters [m^2] [20,000 square feet {ft^2}]) would be required out of the total complement of support buildings (area of 26,722 m^2 [287,643 ft^2]) indicated in table I.3.4–1. Published emission factors (EPA 1995b) were used to estimate the emissions. Emissions of VOCs from solvent cleaning are included. For comparative purposes, table I.4.1.2.2.1–2 includes the LLNL 1994 site-wide emissions. More detailed information on emission estimates is provided in Lazaro et al. (1996).

The BAAQMD may require that NIF external combustion facilities (boilers) be equipped with the best available control technology (BACT) for criteria and organic pollutants (Regulation 2, Rule-301) (BAAQMD 1995). BACT will be determined by the permitting process. EPA New Source Performance Standards would limit boiler nitrogen oxide pollutant emissions according to the boiler-rated input. Gas-fired boilers with rated heat input than 105,600 megajoules per hour (MJ/hr million British thermal units per hour [Btu/h not over 264,000 MJ/hr (250 million Btu/h limited to New Source Performance Sta nitrogen oxide emissions ranging from 43 nanograms per joule (ng/J) (depending on release rate, which is a function of the furnace [40 CFR 60.44b]). There are no New Source mance Standard emission limits for gas-fired with a rated heat input at or less than 105,60 (40 CFR 60.40c).

VOC emissions, primarily ethanol (see Lazar 1996), from solvent cleaning of debris shield treatment/refurbishment of optics and laser nents would require no controls but might emission offsets from the Small Facility Ba Account (Regulation 2, Rule 2-302). The Facility Banking Account was establish BAAQMD to provide emission offsets for s pollutant emission facilities such as NIF. Ad regulatory information is presented in section

I.4.1.2.2.2 *Acoustics*

During the site-clearing phase of construction at the LLNL site, noise from construction eq would cause an increase of 14 decibels (dB) (fr dBA to 69 dBA) in the average outdoor d sound level at the location of the maximally ex individual 800 m (2,600 ft) east-northeast of t target chamber room location on the eastern Greenville Road. The Composite Noise L

TABLE I.4.1.2.2.1–3.—*Estimated Annual Energy Requirements for the National Ignition Fac*

Facility	Use	Fuel Type	Annual Energy Consumption
NIF Laser and Target Area Building	Heating, ventilation, and air conditioning	Natural gas	2.11×10^7 MJ
	Domestic hot water	Natural gas	3.11×10^5 MJ
	Stand-by power	Diesel	320 L
NIF Support Facilities[a]	Heating, ventilation, and air conditioning and hot water	Natural gas	1.95×10^7 MJ
	Stand-by power	Diesel	5,500 L

[a] Represents energy consumption for all required NIF support facilities. See table I.3.4–1 for a list of NIF support facilities.
Note: MJ - megajoule(s); L - liter(s).
Source: LLNL 1995b; White 1995e.

to be developed in accordance with California Department of Transportation specification Section 7–1.0G and LLNL's General Construction Activity Stormwater Permit. The proposed bridge spanning Arroyo Las Positas to the staging area (option I) would be constructed so that its structure and supports would not increase the risk of a 100-year flood breaching the banks of the arroyo. The proposed NIF location has minimal flooding potential because it is outside the 500-year floodplain of Arroyo Las Positas although the staging area (option I) would be within the 500-year floodplain (figure I.4.1.1.3.–1). The staging area (option I) would not be used to store highly volatile, toxic, or water reactive materials. Therefore, locating the staging area in the 500-year floodplain would pose no environmental risk.

However, the proposed NIF location is within the 2000-year floodplain for Arroyo Los Positas. Nevertheless, severe flooding at NIF due to overflow of the arroyo would be relatively slow to develop. This would allow the opportunity to secure radioactive and hazardous material inventories and move them to a safe location. A severe flood could result in facility and equipment damage, but the likelihood of such an event would be small over the 30-year operational lifetime of NIF.

Potential effects of NIF on groundwater would be minor to negligible. No groundwater would be used for NIF, and no wastewater would be discharged to aquifers. Groundwater recharge at the LLNL site might be slightly reduced because of additional paved surface areas. Potential impacts of stormwater runoff on groundwater quality are expected to be negligible because NIF would be operated under the Industrial Activity Stormwater Pollution Prevention Plan.

I.4.1.2.4 Biotic Resources

I.4.1.2.4.1 *Terrestrial Resources*

The NIF location at LLNL would occupy a 8.1-ha (20.0-acre) parcel of grassland. The 2.0 ha (4.9 acres) areas designated as optional sites for the temporary staging area contain grassland (option I) or maintained lawns (options II and III) (figure I.3.4.1.1–2). Vegetation within these areas would be eliminated by construction and spoils disp resulting in a minor loss of habitat. This loss w be considered a slight adverse impact. Constr could also affect nearby vegetation through the osition of dust and other particulates from soil d bance and from the operation of vehicles and machinery. This deposition could inhibit photo thesis and, if chronic, result in a limited amou plant mortality. In addition, soil compaction ca by heavy machinery could destroy the plant indirectly damage roots of plants from adjacent by reducing soil aeration and altering soil struc However, impacts from dust and compaction w be temporary, localized, and limited to com species that are found in disturbed areas. The q of the vegetative community at the proposed location is marginal, and since construction w occur in an area of previous disturbance, pote impacts are considered negligible.

Impacts to wildlife from NIF construction wo include (1) loss and alteration of habitat and (2) turbance of individual animals by noise and hu activity. Suitable alternative habitats, and ea pathways to those habitats, exist for displaced i viduals. However, these animals could face stro competitive pressures, potentially resulting in loss of individual animals. It is unlikely that struction activities would be a threat to the com survival of any local wildlife populations.

The areas occupied by NIF buildings, equipm access roads, and parking lots would be unavail to wildlife for the life of the project. The constru laydown area would be unavailable to wildlife d the construction period. It would be restore existing conditions following construction. Vege tion should be reestablished within a few grow seasons. Some portions of the NIF site, particu those around the main buildings, would be la scaped with lawns and scattered bushes and tr Such habitat currently exists around other LL facilities and is of limited use to many wild species. Nevertheless, species adapted to subu areas would readily inhabit or utilize these areas

Few impacts would occur to terrestrial biota du operation of NIF. Increased traffic and local dis bances could lead to increased losses of road-ki individuals of some species, but this impact is considered significant.

I.4.1.2.4.2 *Wetlands and Aquatic Resources*

It is DOE policy (10 CFR 1022) to avoid impacts to wetlands to the maximum extent practicable, in compliance with Section 404 of the *Clean Water Act* and Executive Order 11990 (*Protection of Wetlands*). Because the proposed NIF location is nearly 300 m (1,000 ft) from the nearest wetland, the construction and operation of NIF would not be expected to affect wetlands at LLNL. The location of the temporary access bridge across Arroyo Las Positas for the option I staging area would be about 100 m (328 ft) east of the nearest wetland, and, thus, would not impact wetland habitat. The option I staging area would be the closest alternate laydown area to the wetland. It would be at least 23 m (75 ft) from the nearest wetland. Temporary barriers would be used to prevent inadvertent impacts to the wetland.

The potential for adverse impacts to aquatic resources would be extremely low because no waterbodies are located in the immediate vicinity of the construction area. Generally, impacts to surface waters from construction activities occur as a result of (1) habitat destruction or modification from construction activities within the waterbody or (2) increases in turbidity, sedimentation, or chemical contamination from runoff. Overall, construction impacts to aquatic resources at LLNL would not be considered significant because (1) critical habitats (such as spawning or rearing areas) for important species (recreational, commercial, or listed species) do not occur at the proposed NIF location and therefore would not be affected and (2) increased sedimentation, habitat removal or modification, or potential spills (such as of fuel) would be localized, short term, and mitigable. The increase in impervious land surface associated with NIF could increase runoff, which could accelerate erosion of unstable soils and add to the contaminant load entering nearby waterbodies. However, a stormwater pollution prevention plan would be implemented to control such events (section I.4.1.2.3). Landscaping around new NIF buildings would also minimize surface erosion and site runoff.

I.4.1.2.4.3 *Rare, Threatened, and Endangered Species*

No deleterious impacts to listed species would be expected from construction or operation of NIF. NIF would be located on previously disturbed grassland habitat that is surrounded primarily by developed laboratory facilities. Thus, NIF location does not provide suitable habitat for the listed species that could exist at LLNL. White-tailed kites have nested near the East Gate of LLNL. Mitigative measures that would be taken so that NIF construction traffic would not affect this species (that is, rerouting traffic during nesting) are discussed in section I.4.7. However, construction of the option I staging area and its access road could impact the western burrowing owls by reducing potential foraging habitat or disrupting resident individuals. Nevertheless, loss of foraging area is not expected to adversely affect this species, and burrows of this species would be avoided during construction.

I.4.1.2.5 Cultural and Paleontological Resources

Construction and operation of NIF would have no effects on archaeological sites or historic structures listed on or eligible for the *National Register of Historic Places* (NRHP) or important paleontological remains because these resources are absent in the affected area. Consultation is in progress to determine whether the proposed project could affect Native American cultural resources.

I.4.1.2.6 Socioeconomics

Locating NIF at LLNL would have a minor impact on socioeconomic conditions in the economic study region and in the ROI described in section I.4.1.1.6. This is because LLNL is located in a diverse regional economy with extensive inter- and intraregional, national, and global economic interactions and linkages. Also, because the NIF partnership would include representatives from government, industry, and the academic sectors throughout the United States, procurement and investment would be dispersed over a number of different regions, damping the concentration of economic effects of the program.

The following sections describe the effects of constructing and operating NIF on the host region's economy and employment, and on population and housing, public finances, public services, and local transportation in the ROI.

TABLE I.4.1.2.6.1–1.—*Potential Socioeconomic Impacts in the Lawrence Livermore National Laboratory Area*

Parameters	NIF Alternative Change Over Reference Baseline		Reference Baseline	
	Peak Construction 1998[a]	Operations 2003[b]	1996 to 2002[a]	2003[b]
Regional Employment				
Direct jobs	470	330		
Indirect jobs	2,400	560		
Total jobs	2,870	890	70,000 additional jobs projected annually	50,000 additional jobs projected
Regional Aggregate Earnings[c]				
Direct earnings	27.07	13.81		
Indirect earnings	62.08	16.47		
Total earnings	89.15	30.28		
Regional Population Migration				
ROI in-migrating population	1,600	360	29,000 additional people annually	24,200 additional people
Regional Housing Demand				
Number of housing units in the ROI	580	130	55,000 vacant housing units (annual average)	59,000 vacant housing units
Local Transportation				
Number of trips generated at site per day	902	630		
Public Finance				
Percent change over 1995 fund balance (Alameda County)	-0.03	-0.02	NA[d]	NA
Public Services (LOS)				
Change in service demand (Alameda County)				
Police	0	0	762[d]	832
Fire	0	0	92[d]	100
General	7	2	11,230[d]	12,264
Physicians	3	1	3,923[d]	4,285
Teachers	5	1	7,001[d]	7,646

[a] Construction period would be 1996 to 2002, with peak construction projected to occur in 1998.
[b] Operating period would be 2003 to 2033, with impacts throughout the period projected to remain stable.
[c] Regional earnings are in millions of constant 1994 dollars.
[d] Projected 1998 fund balance for Public Finance, and projected 1998 level of service (LOS) for Public Services.
Source: Model results.

one additional teacher and one additional doctor over the baseline conditions to maintain their level of service (table I.4.1.2.6.1–1).

I.4.1.2.6.5 *Local Transportation*

In 1995, LLNL employed about 8,300 persons. Direct employment generated by the NIF project at LLNL for the life cycle of the project (1996 to 2033) would range from a maximum of 470 new jobs in 1998 to a minimum of 80 new jobs in 2001. The 470 new jobs at LLNL have the potential to generate up to 902 new vehicle trips per day (table I.4.1.2.6.1–1). These additional trips could increase congestion on roads around LLNL, particularly East Avenue (table I.4.1.2.6.5–1).

Indirect jobs could affect traffic flow within the LLNL region, depending on where those jobs were located. However, if the new indirect jobs were sufficiently dispersed, the road network in the San Francisco metropolitan area would likely handle new trips generated by indirect jobs associated with NIF.

I.4.1.2.6.6 *Environmental Justice*

Minorities, but not low-income persons, are clustered disproportionately in the local vicinity of the LLNL site (section I.4.1.1.6.5). Thus, the local area impacts from the construction and operation of NIF could disproportionately affect minorities. However, none of the local area environmental or health impacts from the construction and operation of NIF would be highly adverse or significant. Therefore, no environmental justice issues for local area impacts have been identified for this site.

For the population in the region within 80 km (50 mi) of LLNL, both minorities and low-income populations are in lower proportion to other populations than in California as a whole (section I.4.1.1.6.5). Thus, no environmental justice issues for regional impacts are identified for this site.

I.4.1.2.7 Radiation and Hazardous Chemicals

This section describes potential radiological and hazardous chemical impacts that could result from normal operations and postulated accidents of NIF at LLNL. Methods, data, and assumptions used in estimating these impacts are presented in Lazaro et al. (1996).

I.4.1.2.7.1 *Normal Operations*

The general public living in areas surroundi LLNL site and workers at LLNL may be exp small quantities of radionuclides releas radiation emitted from routine NIF oper however, the expected level of radioactive and radiation emissions would be well within tory limits. No impacts from hazardous ch should occur because only minute quanti hazardous VOCs are expected to be emitted routine NIF operations. Impacts from routin portation of tritium targets would also expected, because there would be no detectab of radiation outside the packages carrying l energy beta-emitting tritium targets.

Table I.4.1.2.7.1–1 summarizes the potential of radiation exposures from the Conceptual and the Enhanced options of NIF operations a

TABLE I.4.1.2.7.1–1.—*Potential Radiolo Impacts from Normal Operations of National Ignition Facility at Lawre Livermore National Laboratory*

Receptor	Conceptual Design Option	Enh Op
Maximally Exposed Individual		
Dose (mrem/yr)	0.04	(
Percent of natural background	0.01	0
30-year fatal cancer probability	$6x10^{-7}$	2x
Population Within 80 Km		
Dose (person-rem/yr)	0.07	(
Percent of natural background	$3x10^{-6}$	8x
30-year fatal cancers	0	
Workers Onsite		
Dose (person-rem/yr)		
Non-NIF workers	0.06	(
NIF workers	10	
30-year fatal cancers	0	

Source: Model results.

Impacts to the Public. For the Enhanced Op estimated radiation dose from all NIF sou

TABLE I.4.1.2.6.5–1.—*Future Traffic Impacts from National Ignition Facility Project on Lawrence Livermore National Laboratory Access Roads*

Route	From	To	Estimated 1995 AADT	Estimated Background and Peak Project Year AADT (1998)	Estimated Percent Change in AADT Between 1995 and Peak Construction Year (%)	Estimated 1995 LOS	Estimated Background and Peak Construction Year LOS (1998)
Patterson Pass Road	Vasco Road	Greenville Road	1,040	1,145	10	A	A
East Avenue	Vasco Road	Greenville Road	11,250	11,520	2	A	B
East Avenue	Buena Vista Avenue	Vasco Road	13,800	14,080	2	A	A
East Avenue	Hilcrest Avenue	Buena Vista Avenue	18,700	19,000	2	A	A
Telsa Road	Vasco Road	Greenville Road	2,600	2,700	4	A	A
Telsa Road	Buena Vista Avenue	Vasco Road	6,400	6,590	3	A	A
First Avenue	N. Mines Road	Las Positas Road	28,300	28,850	2	B	B
Vasco Road	Brisa Street	Patterson Pass Road	18,300	18,900	3	A	A
Vasco Road	West Gate Drive	Misquitte Way	13,500	14,200	5	B	B
Vasco Road	East Avenue	Telsa Road	4,150	4,400	6	A	A
Greenville Road	Patterson Pass Road	Lupin Way	5,200	5,370	3	A	A

Note: AADT - annual average daily trips; LOS - level of service.
Source: DOE and UC 1992.

imp
faci
des

TABLE I.4.1.2.7.2–2.—*Potential Radiological Risks and Consequences of Transporting Tritium Targets from Manufacturing Facilities to Lawrence Livermore National Laboratory*

Manufacturing Facility	Conceptual Design Option	Enhanced Option
General Atomics		
Dose risk (person-rem/yr)	9.0×10^{-7}	7.1×10^{-6}
Fatality risk (cancer fatalities/yr)	5×10^{-10}	4×10^{-9}
Nonradiological accident[a] (fatalities/yr)	6×10^{-4}	1×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	1×10^{-3}	2×10^{-3}
Los Alamos		
Dose risk (person-rem/yr)	2.2×10^{-6}	1.8×10^{-5}
Fatality risk (cancer fatalities/yr)	1×10^{-9}	9×10^{-9}
Nonradiological accident[c] (fatalities/yr)	2×10^{-3}	4×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	4×10^{-4}	9×10^{-4}
Savannah River		
Dose risk (person-rem/yr)	1.8×10^{-6}	1.4×10^{-5}
Fatality risk (cancer fatalities/yr)	9×10^{-10}	7×10^{-9}
Nonradiological accident[c] (fatalities/yr)	6×10^{-4}	1×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	4×10^{-4}	9×10^{-4}
University of Rochester		
Dose risk (person-rem/yr)	1.9×10^{-6}	1.5×10^{-5}
Fatality risk (cancer fatalities/yr)	9×10^{-10}	7×10^{-9}
Nonradiological accident[c] (fatalities/yr)	3×10^{-4}	8×10^{-4}
Nonradiological vehicular emissions (fatalities/yr)	4×10^{-4}	9×10^{-4}
Maximum Consequence Accident Population[b,c]		
Dose (person-rem)	0.33	3.3
Fatal cancers	2×10^{-4}	2×10^{-3}
Maximally Exposed Individual[b,d]		
Dose (rem)	1.2×10^{-4}	1.2×10^{-3}
Fatal cancer probability	6×10^{-8}	6×10^{-7}

[a] Collective population fatalities were calculated for 145 shipments (Conceptual Design Option) and 335 shipments (Enhanced Option). For example, a reported value of 4×10^{-3} fatalities suggests that no fatalities are expected for the proposed action. However, one single fatality out of the entire affected population might be expected over the course of 250 years if the same number of shipments were to continue for that length of time.

[b] The most severe accidents assume that 100 percent of the target tritium is released in an oxide form during an accident. Accident consequences results were determined using RISKIND computer program which is described in Yuan et al. 1993. Stable weather conditions (Pasquill stability class F) with a wind speed of 1 m/s (2.2 mph) were assumed.

[c] The maximum consequences would result from an accident occurring in an urban environment. The population was assumed to extend at a uniform density of 3,861 persons/km^2 (10,000 person/mi^2) to a radius of 80 km (50 mi) from the accident site. The population exposure pathways for urban environments include inhalation and resuspended inhalation. Urban environments were not assumed to produce food for local use or export, hence no ingestion dose was included.

[d] The maximally exposed individual was assumed to be at the location of maximum exposure. The location of the maximally exposed individual was assumed to be 380 m (1,247 ft) from the accident under stable weather conditions. Individual exposure pathways include acute inhalation during passage of the plume. No ingestion dose was considered.

Note: The transportation risk assessment assumed 100 percent of the tritium targets are manufactured and transported to NIF from each site. In practice, tritium targets would be produced and transported from more than one manufacturer. The transportation risk assessment was performed for offsite transportation only. Transportation risks from onsite tritium targets were assumed to be negligible compared with risks from offsite transportation.

Source: Model results.

- A hydrogen fluoride release from the optics treatment area

The nearest public facility to the release points for accidents 1 and 2 is the veterinary hospital to the east. The nearest public facility to the release points for accidents 3 and 4 is the industrial park to the north.

A modeling study was conducted for each of the four release scenarios. More details, including predicted concentrations, are provided in Lazaro et al. (1996). The modeling study applied a dispersion model to each of the releases and used a health criterion representative of acute impacts from an exposure that might happen once in a lifetime. The health criterion (Emergency Response Planning Guidelines-2 [ERPG-2] level) was the concentration below which, if exposure occurred for an hour, would still allow the exposed individual to avoid irreversible health effects by taking emergency action. The results of the modeling yield the following conclusions:

- The threat zone from each of the four accidents would not extend to the boundary with the public under either typical or extreme meteorological conditions

- Nearby buildings and personnel outside would be at risk if any of the four accidents occurred. The assumption was made that the release would not be inhibited by walls of the NIF Laser and Target Area Building, and the wind would take the plume away from the building. The distances beyond which concentrations would fall below the ERPG-2 level for each of the accidents are as follows:

  - Mercury scenario—237 m (778 ft) for both the Conceptual Design and Enhanced options
  - Alumina/silica scenario—171 m (561 ft) for Conceptual Design Option and 231 m (758 ft) for Enhanced Option
  - Carbonyl fluoride scenario—99 m (325 ft) for both the Conceptual Design and Enhanced options
  - Hydrogen fluoride scenario—101 m (331 ft) for both the Conceptual Design and Enhanced options

The personnel in nearby buildings would likely be protected because the release (typically lasting 15 minutes) would pass by the buildings with little infiltration. Personnel in the Laser and Target Area Building and those outside in the immediate vicinity might be affected.

I.4.1.2.8 Waste Management Impacts

This section evaluates potential effects of wastes that would be generated by NIF on current waste management practices at LLNL during construction, normal operation, and the decommissioning of NIF at LLNL.

I.4.1.2.8.1 *Waste Generation and Management During Construction and Operation*

The estimated amounts and types of wastes that would be generated during construction of NIF are listed in table I.4.1.2.8.1–1. Most construction wastes would be nonhazardous and would be handled under conventional construction regulations. Adequate capacity exists at LLNL to handle these wastes. Any hazardous wastes would be handled accordingly, as discussed below.

TABLE I.4.1.2.8.1–1.—*Estimated Amounts and Types of Wastes Generated During Construction of the National Ignition Facility at Lawrence Livermore National Laboratory*

Waste Type	Amount Generated (m^3)
Nonhazardous (sanitary liquid)	14,000
Nonhazardous (sanitary solid)	500
Other nonhazardous (liquid)	900
Other nonhazardous (solid)	900

Source: LLNL 1994b.

Table I.4.1.2.8.1–2 lists the quantities of wastes generated by category for both the Conceptual Design and Enhanced options (Andrews and Tobin 1995). The following discussions describe the proposed disposition of the wastes (using current practices) shown in that table. During operation, various low-level, mixed, hazardous, and nonhazardous wastes would be handled at NIF. Treatment or storage of NIF waste stream would not affect current treatment and/or storage capacities. The quantities of these waste streams at LLNL are presented in tables I.4.1.2.8.1–2 and I.4.1.2.8.1–3. Waste handling

TABLE I.4.1.2.8.1–2.—*National Ignition Facility Waste Estimates for Low-Level, Mixed, and Hazardous Wastes for Both the Conceptual Design and the Enhanced Options (Per Year of National Ignition Facility Operation)*

			Low-Level		Mixed		Hazardous			
							LTAB		OAA	
	Source of Waste	Cleaned[a] (m^3)	Solid (m^3)	Liquid (m^3)	Solid (m^3)	Liquid (m^3)	Solid (m^3)	Liquid (m^3)	Solid (m^3)	Liquid (m^3)
1.	Vacuum pump oil					0.20				
	Chamber pump down					***0.20***				
2.	Molecular sieves		0.37							
	Tritium processing system		***0.98***							
3.	Personal protective equipment and wipes	1.88	0.18	0.60	0.34	0.40				
	General cleaning	***4.88***	***0.46***	***1.56***	***0.88***	***1.04***				
4.	Pre- and HEPA filters		0.02							
	Chamber Ventilation		***0.02***							
	Target chamber decontamination									
	Chamber hardware decontamination									
5.	Hardware from chamber	0.06	0.25							
	Diagnostics target positioner	***0.06***	***0.25***							
6.	Debris shield	0.24 ea				1.40				
		0.63 ea				***3.74***				
7.	Capacitors, oil filled						7.5		0.5	
							7.5		***0.5***	
8.	General chemicals							0.50		1.80
								0.50		***4.10***
	Conceptual design total/yr		0.82	0.60	0.34	2.00	7.5	0.50	0.5	1.80
	Enhanced total/yr		***1.71***	***1.56***	***0.88***	***4.98***	***7.5***	***0.50***	***0.5***	***4.10***

[a] Articles cleaned by wiping, carbon dioxide blasting, and other decontamination methods. These materials would be handled as solid low-level radioactive wastes.

Note: Numbers in bold italics refer to waste estimates for the Enhanced Option; LATB - Laser and Target Area Building; OAB - Optics Assembly Building; HEPA - high-efficiency particulate air.

Source: Andrews and Tobin 1995; Bowers 1995.

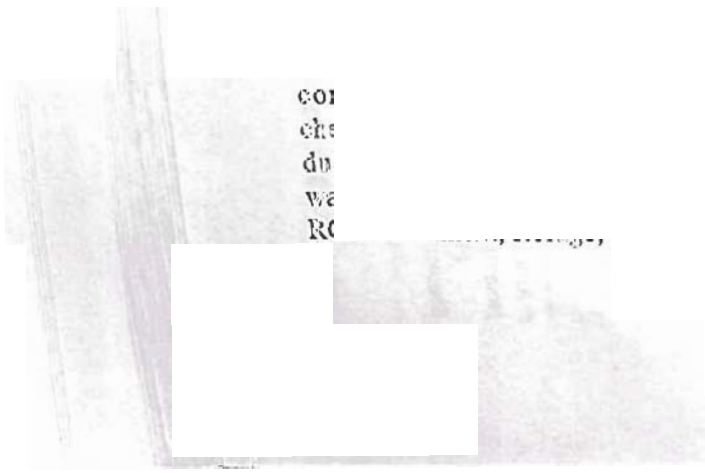
TABLE I.4.1.2.8.1–3.—*National Ignition Facility Waste Estimates for the Conceptual Design and the Enhanced Options After Implementation of Waste Minimization Techniques*

Source of Waste	Cleaned[a] (m^3)	Low-Level Solid (m^3)	Low-Level Liquid (m^3)	Mixed Solid (m^3)	Mixed Liquid (m^3)	Hazardous LTAB Solid (m^3)	Hazardous LTAB Liquid (m^3)	Hazardous OAA Solid (m^3)	Hazardous OAA Liquid (m^3)
1. Vacuum pump oil					0				
Chamber pump down					***0***				
2. Molecular sieves		0.04							
Tritium processing system		***0.09***							
3. Personal protective equipment and wipes	1.88	0.18	0.30	0.25	0.30				
General cleaning	***4.88***	***0.46***	***0.78***	***0.65***	***0.78***				
4. Pre and HEPA filters		0.02							
Chamber Ventilation		***0.02***							
Target chamber decontamination									
Chamber hardware decontamination									
5. Hardware from chamber	0.06	0.12							
Diagnostics target positioner	***0.06***	***0.12***							
6. Debris shield	0.24 ea				0				
	0.63 ea				***0***				
7. Capacitors, oil filled						1.38		0.5	
						1.38		***0.5***	
8. General chemicals							0.5		0.18
							0.5		***0.41***
Conceptual design total/yr		0.36	0.30	0.25	0.30	1.38	0.5	0.5	0.18
Enhanced total/yr		***0.69***	***0.78***	***0.65***	***0.78***	***1.38***	***0.5***	***0.5***	***0.41***

[a] Articles cleaned by wiping, carbon dioxide blasting, and other decontamination methods. These materials would be handled as solid low-level radioactive wastes.

Note: Numbers in bold italics refer to waste estimates for the Enhanced Option; LATB - Laser and Target Area Building; OAB - Optics Assembly Building; HEPA - high-efficiency particulate air.

Source: Andrews and Tobin 1995; Bowers 1995.



Cleaning of the debris shields with carbon dioxide pellets could remove the anti-reflective coating and activated particulate matter. If successful, this procedure could significantly reduce or even eliminate the production of radioactive sodium hydroxide, which is currently listed as liquid mixed waste.

A large fraction of the general chemical waste from the Optics Assembly Area would involve the anti-reflective coating solution. One method for reducing this waste would be to distill the ethanol from the waste solution and reuse it as a cleaner.

Capacitors in the Laser and Target Area Building would be the predominant source of hazardous waste. This source could be reduced by purchasing advanced capacitor units with a longer service life. This decision, however, would depend on the development and cost of such capacitors.

In addition to reducing or eliminating the liquid LLW from debris shield cleaning, carbon dioxide cleaning might also further reduce solid LLW. Far fewer wipes would be needed for general decontamination purposes if a "general decontamination carbon dioxide station" were developed and functional. Other liquid LLW streams, as well as solid mixed and liquid mixed streams, might also be reduced with such a system because carbon dioxide could possibly remove activated particulates, as well as tritium contamination, and eliminate the need for solvents.

Existing Waste Management Capabilities at LLNL. Comparison of the waste volumes that would be generated by NIF (see table I.4.1.2.8.1–2) with current waste handling at LLNL provides an indication of the capability of the existing facilities at LLNL to accommodate the various waste management tasks associated with NIF.

For reference, table I.4.1.1.8–1 shows the current waste management capacity at LLNL. Table I.4.1.2.8.1–4 summarizes, in broad categories, the total yearly NIF waste generation estimates for the Conceptual Design and Enhanced options. Table I.4.1.2.8.1–4 is a condensed version of the earlier detailed flows given in table I.4.1.2.8.1–2.

Table I.4.1.2.8.1–4 shows the potential impact of NIF on waste storage at LLNL. Existing storage capacity (except for hazardous waste) appears to be adequate to handle NIF waste for a number of years. Table I.4.1.2.8.1–5 compares the NIF waste generation rate to the annual handling/treatment capacity at LLNL. This table indicates that NIF waste could generally be treated by current LLNL facilities without a large adverse impact.

In summary, the information presented in tables I.4.1.2.8.1–4 and I.4.1.2.8.1–5 indicates that the added NIF wastes would not represent a significant impact on the existing waste storage capacity nor on the waste treatment capacity at LLNL, since the management of NIF wastes at LLNL would not represent a significant extension of current practices or capabilities. The added impact of NIF wastes on the environment would be minimal and would fall within present regulatory requirements.

I.4.1.2.8.2 *Waste Management at Lawrence Livermore National Laboratory During National Ignition Facility Decommissioning*

The decontamination and decommissioning (D&D) activities for NIF would not add a significant burden to operations at LLNL. This type of activity is common throughout the DOE complex, and LLNL has experienced staff capable of carrying out these types of activities. The procedures proposed by LLNL for decommissioning NIF after its projected 30 years of operation are summarized below (Tobin and Latkowski 1995). The major activated/contaminated components would be located in the target area, so this facility would pose the most complex operation.

Decommissioning of NIF Laser. All assemblies and equipment would be removed from the laser bays, pulse power bays, master oscillator room, and control room. The support systems, piping, and wiring in the laser bays would also be removed. Minimum disassembly would be done on laser components. Glass would be stored in the simplest, least costly manner. Detached assemblies or subassemblies would fall into three categories: those immediately transferable to other DOE projects, those of possible use in the future, and those not likely to be reused. The items in the first category would be reassigned; the items in the second category would be packaged and stored; and the items in the third category would be disposed of through salvage. Several components, namely ignitrons and capacitors, would be handled as wastes. As shown in table I.4.1.2.8.2–1 the volume of the resulting waste would total about 313 m^3 (409 yd^3).

TABLE I.4.1.2.8.1–4.—*Impact of Estimated National Ignition Facility-Generated Waste on W Storage at Lawrence Livermore National Laboratory*

Category	NIF-Generated Waste/Year (m^3)		Years to Fill Storage with NIF Flow Alone[a]		Is Existin Planned S Capaci Adequa
	Solid	Liquid	Solid	Liquid	
Low-Level[b]					
Conceptual design total	2.98	0.60	2,000	500	Yes
Enhanced total	7.25	1.56	800	200	Yes
Mixed					
Conceptual design total	0.34	2.0	7,000	300	Yes
Enhanced total	0.88	4.98	2,600	100	Yes
Hazardous[c]					
Conceptual design total	8.0	2.3	12,250	30	Yes, Margi (liquid
Enhanced total	8.0	4.6	12,250	20	Yes, Margi (liquid

[a] In order to translate the solid waste mass into an expression of volume and to calculate the values shown for the number of y fill storage capacity with NIF flow alone, the following values for the densities of the materials were assumed: molecular s density of diatomaceous earth (0.22 g/cm^3); personal protective equipment and wipes: density of paper (0.4 g/cm^3); pre-a efficiency particulate air filters: density of charcoal (1.8 g/cm^3); paper capacitors: density of paper (0.4 g/cm^3); hardware fr chamber: density of 50 percent aluminum and 50 percent stainless steel (5.3 g/cm^3).

[b] The total amount of the low-level waste was found by adding the values in the column "Cleaned" of table I.4.1.2.8.1–2 to the "Low-Level" of the same table. The density of the debris shield was assumed to be the density of iron (7.87 g/cm^3). The of low-level liquid waste was assumed equal to 1.0 g/cm^3. The amount of the "cleaned" personal protection equipment a wipes/general cleaning was added to the solid low-level radioactive waste.

[c] The values for the hazardous waste are the sum of the Laser and Target Area Building and Target Area Building and Optics As Area values.

Source: Calculated from table I.4.1.1.8–1 and Tobin 1995.

TABLE I.4.1.2.8.2–1.—*Estimated Quantities of Waste from Laser Decommissioning*

Item	Volume (m^3)	Mass (t)
500 ignitron switches - required recycle, Hg, 0.44 L, 6 kg each; EPA 40 CFR 268.42	1.0	3.0
4400 Capacitors - low hazard waste; castor oil on dielectric paper, 140 kg, 0.07 m^3 each	312	616
Total	313	619

Note: Hg - mercury.
Source: Tobin and Latkowski 1995.

Decommissioning of NIF Target Area. Two issues dominate the complexity or ease with which structures in the target area would be decommissioned at the end of NIF operation: (1) the extent of tritium contamination and (2) the contact dose due to long-lived activation products induced in large stru such as the target chamber, space frame/s support frames, and concrete.

Semipermanent facility features that co materials of concern for neutron activation, s cable runs and diagnostics, would be main during NIF operations in such a way that conta rates would allow their reuse in other facilitie condition would be achieved through a combi of periodic change-out, radioactive decay tim shielding. If proven successful, the carbon d system proposed for waste minimization wo adapted to meet NIF decontamination nee proposed, frequent cleaning of equipment an chamber surfaces exposed to tritium and act debris would significantly reduce (if not vi eliminate) the need for major end-of-life deco nation. NIF operations would be designed t minimize the quantity and extent of contami and to reduce the hazard level of wastes. NIF d

TABLE I.4.1.2.8.2–2.—*National Ignition Facility Target Area Low-Level Radioactive Waste Quantities from Decommissioning*

Item	Volume (m^3)	Mass (t)
Vacuum system	34	54
Tritium system	16	36
Diagnostics manipulators	12	3.6
Target positioner	2 (4)	1 (2)
Chamber shielding	282 (567)	310 (620)
Chamber plates	6.3	8.5
Laser light absorbers	1.3 (2.0)	1.9 (3.0)
Chamber support structures	3,058	3,364
Target area beam transport	220 (330)	111 (161)
Final optics hardware	754 (1,204)	545 (815)
Total	4,386 (5,233)	4,425 (5,057)

Note: Values shown assume a 30-year life with 385-megajoule yields. Values in parentheses assume 1,200-megajoule annual yields.

Source: Tobin and Latkowski 1995.

Handling of these components would require ex application of as low as reasonably achievable p tices. Estimated dose rates encountered during de missioning for these components are shown in I.4.1.2.8.2–3. Assuming careful planning handling of the disassembly, it is estimated th occupational exposure involved would be on the of background rates (table I.4.1.2.8.2–4). The o tions required would be unique, but would be w the capability of LLNL personnel, consid LLNL's prior experience with decommissioning facilities and LLW handling.

TABLE I.4.1.2.8.2–3.—*Estimated Contact Dose Rates of Key National Ignition Facility Compo*

Component	30-day Dose Rate (mrem/hr) (385 MJ/1,200 MJ)	3-year Dose Rate (mrem/hr) (385 MJ/1,200 MJ)
Final transport mirror mounts/motors	0.006/0.019	0.004/0.012
Final optics hardware	<3.1/9.7	<0.29/0.9
Diagnostics manipulators	3.4/10.6	0.31/0.97
Target positioner	0.08/0.25	0.007/0.022
Target chamber plates	0.17/0.53	0.015/0.047
Unconverted laser light absorbers	0.005/0.016	0.0013/0.004
Borated "shotcrete" chamber shielding	0.2/0.62	0.052/0.16
Chamber support concrete rods	0.12/0.37 (w/1 at% B)[a]	0.004/0.012 (w/1 at% B)
Vacuum system	28.7/89.5 (if steel) 7.04/2.2 (if aluminum)	3.14/9.8 (if steel) 1.32/4.1 (if aluminum
Mirror support structure	0.003/0.009	0.001/0.003
Chamber shell	0.84/2.6	0.074/0.23
Concrete walls		
Direct shine areas	0.14/0.44 (w/1 at % B)	0.014/0.044 (w/1 at % B)
Behind shielding	0.02/0.062 (w/1 at % B)	0.001/0.003 (w/1 at % B)
Concrete chamber pedestal	0.12/0.37 (w/1 at % B)	0.004/0.012 (w/1 at % B)

[a] w/l at% B - with 1 atom % boron.

Note: Values shown assume 30-year life with 385-megajoule yields and 1,200-megajoule annual yields.

Source: Tobin and Latkowski 1995.

TABLE I.4.1.2.8.2–4.—*Estimated Decommissioning Effort and Occupational Exposure for the National Ignition Facility Target Area for 385- and 1,200-Megajoule Annual Yields*

Component	Description	Effort (Person months)	Dose Rates (μrem/hr)	Dose (mrem)	Dose per worker (mrem, average)
Target Area Beam Transport					-
Support structures	80 t	22.1	1 (3)	3.9 (12.1)	-
Tubes	14 t	4	0 (0)	0 (0)	-
Mirrors/motors	388 (582) ea	18 (27)	4 (12)	12.7 (57)	-
Final Optics Assemblies					-
Optics	768 ea	13.2	0 (0)	0 (0)	-
Hardware	48 (72) ea	14.1 (21.6)	290 (900)	735 (3,421)	-
Target Diagnostic Systems					-
Diagnostics	12 ea	3.6	310 (970)	196 (612)	-
Support systems and TIM	12 ea	1.2	310 (970)	65 (204)	-
Vacuum	1 ea	1.2	310 (970)	65 (204)	-
Target positioner	1 ea	0.4	7 (22)	0.5 (1.5)	-
Target Chamber					-
Spherical shell	87 t	50	74 (230)	651 (2,030)	-
Plates	325 ea	18.3	15 (47)	48 (151)	-
Laser light absorbers	192 (288) ea	14.4 (21.6)	1.3 (4)	3.3 (15)	-
Shielding	283 (567) t	5.7 (11.4)	52 (160)	52 (326)	-
Concrete Supports	3,364 t	67.3	4 (12)	47 (148)	-
Vacuum System	3 ea	2.4	1,320 (410)	558 (1,738)	-
Totals	-	235.9	-	2,437 (8,920)	122 (446)

Source: Tobin and Latkowski 1995.

I.4.2 Los Alamos National Laboratory

I.4.2.1 *Affected Environment*

The following sections describe the affected environment associated with the construction and operation of NIF at Los Alamos National Laboratory (LANL). Land use, air quality and acoustics, water resources, biotic resources, cultural and paleontological resources, socioeconomics, radiation and hazardous chemicals, and waste management are described.

I.4.2.1.1 Location and Land Use

The 11,300-ha (28,000-acre) LANL site is situated on Pajarito Plateau, which consists of a series of finger-like mesas separated by deep east-to-west oriented canyons cut by intermittent streams. Mesa tops range in elevation from approximately 2,400 m (7,800 ft) mean sea level (MSL) on the flanks of the Jemez Mountains to the west to about 1,900 m (6,200 ft) MSL at their eastern termination above the Rio Grande Valley to the east (LANL 1994).

The land surrounding LANL is largely undeveloped, with large tracts of land north, west, and south of the site being held by the Santa Fe National Forest, Bureau of Land Management, Bandelier National Monument, and Los Alamos County. San Ildefonso Pueblo borders LANL to the east (LANL 1994) (figure I.4.2.1.1–1).

Most LANL developments are confined to mesa tops, and most functions are concentrated in eight development areas, each of which is composed of various technical areas (TAs). Most of the land at LANL is very difficult to develop given the significant physical constraints. For example, over half the area consists of slopes that exceed 20 percent (LANL 1990a). Most land provides isolation for security and safety and is held in reserve for future use (LANL 1994).

The proposed NIF location at LANL is within TA-58 (figure I.3.4.2.1–2), which is part of the "Core Area and Two-Mile Mesa North" development area of LANL. The temporary construction laydown area would be located within the location designated for NIF. This development area houses approximately 57 percent of the LANL population and encompasses about 4 percent of the total LANL area. TA-58 is an undeveloped TA west of TA-3, the central hub of administration and support activities. TA-
acterized by gradual to moderate forest
Several dirt and gravel roads cross the a
surveys of the proposed TA-58 greer
indicate that there are no solid waste m
unit locations at the site (ICF Kaiser
1994). Current access to TA-58 is provi
existing canyon crossing from TA-3.

The topography of LANL affords specta
of the surrounding landscape of forested
deep canyons, and the Rio Grande V
mountain scenery, unusual geology, and
ical heritage create a diverse visual envir
scenery contrasts greatly with the functi
trial facilities of LANL. A majority
parking lots, security gates, and service
yards are visible to employees and vi
public roads (DOE 1995c).

LANL is underlain by soil types varyin
from clay and clay loam to gravel. Bec
topographic relief of the Pajarito Pla
outcrops occur on greater than 50 percer
area. Soils on the mesas in the TA-58 ar
widely in thickness and are typically thin
edges of the mesas, where bedrock is oft
The walls of the canyons often consist
outcrops and patches of shallow undeve
Soils near the center of the mesa are more
deeper and more stable, indicating less
soils near the edges of the mesa (LANL
soils at LANL are acceptable for standa
tion techniques, and none have been
prime farmland or soil of statewide im
New Mexico.

I.4.2.1.2 Air Quality and Acoustics

This discussion of existing air quality a
includes a review of meteorology and
and ambient air quality characteristics n

I.4.2.1.2.1 *Meteorology and Climato*

LANL and the surrounding region have
temperate mountain climate. The ann
temperature at LANL is 8.8 °C (47.8
daily temperatures range from -2.0 °C
January to 20.0 °C (68.0 °F) in July.
annual precipitation at LANL is 47.5
(Bowen 1992). Prevailing winds at LA

the south during the day and from the west-northwest at night. The annual average wind speed is 2.8 m/s (6.3 mph) (Bowen 1989). The 1994 annual wind rose for LANL is shown in figure I.4.2.1.2.1–1. From 1990 to 1994, unstable atmospheric conditions occurred approximately 33 percent of the time, neutral conditions occurred about 36 percent of the time, and stable conditions occurred the remaining 31 percent of the time (Kreiner 1995). Atmospheric dispersion improves as the wind speed increases and as atmospheric conditions become more unstable.

I.4.2.1.2.2 *Ambient Air Quality*

The State of New Mexico is responsible for air pollution control and attainment of air quality standards in Los Alamos County. In addition to NAAQS for criteria pollutants, LANL is subject to ambient air quality standards adopted by New Mex Applicable NAAQS and New Mexico state ambien quality standards are presented in table I.4.2.1.2.

LANL is located within the Upper Rio Grande Va Intrastate AQCR 157. None of the areas within LA and its surrounding counties are designated as no tainment areas for any of the NAAQS (40 C 81.332). The nearest nonattainment area, for ca monoxide and total suspended particulates, is in S nalillo County, about 65 km (40 mi) south. In gen pollutant emission increases in an area desig nonattainment for a specific pollutant are subje more stringent permitting requirements than if area is designated attainment.

The New Mexico Environment Department ma closest to LANL is adjacent to the Bandelier Na

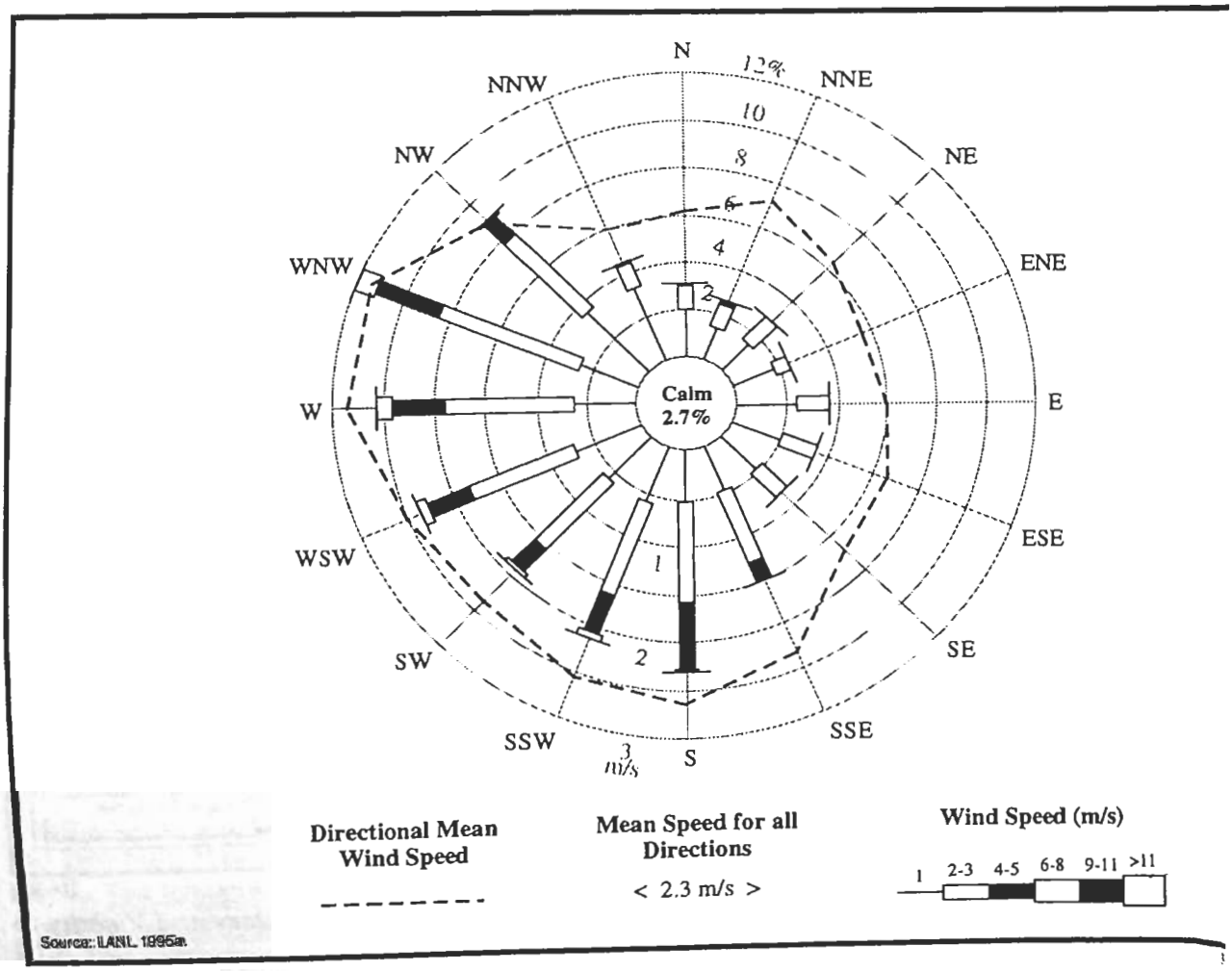


FIGURE I.4.2.1.2.1–1.—*Wind Distribution at Los Alamos National Laboratory, 1994*

Monument at the southern LANL site boundary, approximately 8 km (5 mi) south-southeast of the proposed NIF location. In addition, LANL maintains eight onsite and nine offsite particulate monitors that measure airborne beryllium concentrations. The most recently published monitoring data show no violations of the NAAQS (see table I.4.2.1.2.2–1).

One Prevention of Significant Deterioration (PSD) Class I Area, the Bandelier National Monument's Wilderness Area, borders LANL to the south. To date, LANL has not been subject to PSD requirements (LANL 1990b; LANL 1994).

The primary emission sources of criteria pollutants at LANL are the steam plants, powerplant, beryllium operations, asphalt plant, burning of explosive wastes, and experimental detonation of conventional explosives (LANL 1994). Other emission sources include fugitive particulates from waste-burial activities, industrial processes, vehicles, and construction activities. Emission estimates for these sources are presented in section I.4.2.2.2.

Table I.4.2.1.2.2–1 presents the baseline ambient air concentrations for criteria pollutants for 1992 to 1993. The baseline concentrations are in compliance with applicable regulations and guidelines.

I.4.2.1.2.3 *Acoustic Conditions*

Major noise emission sources within LANL include various industrial facilities, equipment, and machines. At the site boundary, away from most of the industrial facilities at LANL, noise emitted from the site is barely distinguishable from background noise levels. However, some noise from detonation of explosives can be heard at residences adjacent to the site.

Background noise levels of 31 to 35 dBA have been measured near the Bandelier National Monument entrance and State Route 4 (Vigil 1995) and 38 to 51 dBA at White Rock (Burns 1995). The higher background noise levels at White Rock result from a greater amount of traffic (DOE 1995c).

Peak noise sources at LANL include explosive experiments at several TAs. An onsite peak noise level of 140 to 148 dBA has been measured 230 m (750 ft) from a 9-kg (20-lb) trinitrotoluene (TNT) test. Offsite peak noise levels measured from a 70-kg (150-lb) TNT test were 71 dBA at the site boundary and 60 to 70 dBA at permanent residences (DOE 1995c).

The acoustic environment along the LANL boundary is typical of a rural location, with residual noise levels of 35 to 50 dBA (EPA 1974). Near highways, traffic contributes to ambient noise levels, especially during peak hours, resulting in significantly higher noise levels than at remote locations.

The State of New Mexico has not established specific numerical environmental noise standards applicable to LANL. The Los Alamos County Code, Chapter 8.28.060(d), prohibits propagated noise levels in residential areas above 65 dBA between 7:00 a.m. and 9:00 p.m. and above 53 dBA at other times. Noise between 65 and 75 dBA for more than 10 minutes in a given hour is allowed between 7:00 a.m. and 9:00 p.m. Permits can be requested for temporary activities that exceed these standards (DOE 1995c).

I.4.2.1.3 Water Resources

Proposed new facilities for NIF would be located at the mesa top between Twomile Canyon and one of its tributaries (figure I.3.4.2.1–2). Streamflow in Twomile Canyon and its tributaries is ephemeral. Most runoff results from summer thunderstorms, and occasionally from intermittent springs (LANL 1993).

Groundwater in the LANL area occurs in three modes: (1) water in shallow alluvium in canyons, (2) perched groundwater, and (3) the main aquifer of the Los Alamos area. The main aquifer is the only aquifer in the area capable of serving as a municipal water supply. The main aquifer is separated from the alluvial and perched groundwater by about 110 to 190 m (350 to 620 ft) of tuff and volcanic sediments with low moisture content (LANL 1994).

The water supply for LANL comes from three DOE-owned well fields. Some surface water is used for boiler makeup and lawn watering, but this source accounts for only about 1 percent of the total water use. Average annual production for the entire system is about 5,600 MLY (1,480 MGY), of which about one third (1,900 MLY [502 MGY]) is used at

TABLE I.4.2.1.2.2–1.—*Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at Los Alamos National Laboratory*

Pollutant	Averaging Time	Most Stringent Regulation or Guideline (mg/m^3)	Baseline Concentration[a] (mg/m^3)
Criteria Pollutant			
Carbon monoxide	8 hours	7,689[b]	115
	1 hour	11,578[b]	630
Lead	Calendar quarter	1.5[c]	ND[d]
Nitrogen dioxide	Annual	73[b]	3.8[e]
	24 hours	145[b]	ND[d]
Ozone	1 hour	235[c]	139[e]
Particulate matter 10 microns or smaller	Annual	50[c]	8[e]
	24 hours	150[c]	21[e]
Sulfur dioxide	Annual	40[b]	1.3[f]
	24 hours	202[b]	ND[d]
	3 hours	1,300[c]	ND[d]
	1 hour	NS[g]	23[f]
Mandated by State			
Hydrogen sulfide	1 hour	11[b]	ND[d]
Soiling index	-	0.4[h]	ND[d]
Total reduced sulfur	30 minutes	3[b]	ND[d]
Total suspended particulates	Annual	60[b]	8
	30 days	90[b]	<21
	7 days	110[b]	<21
	24 hours	150[b]	21

[a] For short-term standards, baseline concentration is second highest concentration for year for Federal standards and for 1-hour hydrogen sulfide state standard; highest concentration for other short-term standards.
[b] State standard.
[c] Federal standard (40 CFR 50).
[d] ND - No data available.
[e] 1993 New Mexico Environment Department (NMED) data at Bandelier.
[f] 1992 LANL data at TA-3.
[g] NS - No Federal or state standard exists.
[h] Units of cohs/1,000 linear ft of air.
Source: LANL 1994; Lazaro et al. 1996; NMEIB 1995; NMEIB 1996.

LANL. The annual consumption, without the proposed NIF, is expected to increase to 2,300 MLY(608 MGY) in the year 2005. Most water consumption is for industrial use (LANL 1990a; Purtymun et al. 1994; Richardson 1995c).

Most recent water quality monitoring data available for drinking water at LANL indicate that all parameters regulated under the *Safe Drinking Water Act* were in compliance with the maximum contaminant levels established by the regulation (LANL 1994).

I.4.2.1.4 Biotic Resources

LANL is located at the transition between the zona/New Mexico Plateau and Southern Roc ecoregions (Omernik 1986). The predominant ha in the western portion of LANL (including proposed NIF area) is the ponderosa pine commu (2,100 to 2,300 m [6,900 to 7,500 ft] eleva range). This community is dominated by ponde pine, with Douglas fir, Gambel oak, mountain m and little bluestem also being common. The pin juniper community (1,900 to 2,100 m [6,20 6,900 ft] elevation range) also occurs in the area

habitat consists of stands of pinyon pine and one-seeded juniper, as well as grasses such as blue grama and galleta (DOE 1995c). NIF site is located west of a developed area of LANL (figure I.3.4.2.1–2).

Reptiles common to the LANL area include the collared lizard, eastern fence lizard, and whiptail lizard (DOE 1995c). Bird species that nest in the northwestern portion of LANL include the American robin, black-headed grosbeak, chipping sparrow, common raven, Hammond's flycatcher, lesser goldfinch, Steller's jay, white-breasted nuthatch, and western tanager (Travis 1992). LANL has traditionally been a wintering area for elk and mule deer. However, these two species have recently been using LANL on a year-round basis (DOE 1995c). This use has prompted concerns about increases in vehicular accidents with elk and deer at LANL (Kirk 1995, as cited in DOE 1995c). A herd of elk is resident at Two-Mile Mesa, and signs of black bear have been observed in Operational Unit 1111 (which includes TA-58). Raccoons, coyotes, porcupines, and skunks frequent the area (LANL 1993). Smaller mammal species include the Mexican woodrat, deer mouse, Abert's squirrel, and Nuttall's cottontail.

Wetlands at LANL are limited to the canyons, where riverine intermittent wetlands exist in most of the canyons and palustrine emergent and/or scrub-shrub wetlands exist in sections of Pueblo, Los Alamos, Sandia, Pajarito, and Ancho canyons. No wetlands exist in the immediate area proposed for NIF.

Aquatic habitats on LANL are primarily limited to springs and intermittent streams that flow through the 14 major canyons that pass throughout LANL. Releases of treated industrial and sanitary wastewaters allow portions of the intermittent streams in Los Alamos, Sandia, and Mortandad canyons to maintain more permanent flows. No aquatic habitats exist on the immediate NIF location area.

A list of the Federal and state rare, threatened, and endangered species that could exist at LANL is provided in Lazaro et al. (1996). Habitats that could attract several of the species (for example, Mexican spotted owl, northern goshawk, loggerhead shrike, gray vireo, and spotted bat) are present within Operational Unit 1111 (within which the proposed NIF location occurs) (LANL 1993). However, no designated critical habitats for Federal-listed species exist at LANL.

I.4.2.1.5 Cultural and Paleontological Resources

More than 1,300 prehistoric sites have been recorded on LANL; however, no archaeological sites or historic structures are recorded for the proposed NIF location in TA-58. Preliminary assessment of the proposed NIF location indicates that it is unlikely to contain archaeological remains; a field survey will be conducted to verify this assessment (ICF Kaiser Engineers and LANL 1994). Paleontological remains are unlikely to exist on the proposed NIF location because the Pajarito Plateau, composed of Pleistocene volcanic tuffs and the Bandelier Formation, does not contain fossiliferous deposits. No Native American cultural resources have been identified in the proposed NIF location by the six potentially affected tribes.

I.4.2.1.6 Socioeconomics

Socioeconomic characteristics described for LANL include regional economy, population and housing, public finance and public service infrastructure, and local transportation. Regional economic statistics are based on a regional economic study area that encompasses seven counties around LANL as defined by the Bureau of Economic Analysis. The economic study area is a broad labor and product market-based region linked by trade among economic sectors within the region. Statistics for population and housing, public finance, and public service infrastructure are based on the ROI, a three-county area in which more than 90 percent of all LANL employees reside. The ROI includes the counties of Los Alamos (with 48.3 percent of LANL employees), Rio Arriba (20.8 percent), and Santa Fe (19.0 percent). Counties included in the economic study region and counties included in the ROI are listed in Lazaro et al. (1996). Assumptions, assessment methodologies, and supporting data for each TA are also presented in Lazaro et al. (1996).

I.4.2.1.6.3 *Public Finance and Public Services Infrastructure*

Public financial characteristics of the local jurisdictions in the ROI that would most likely be affected by construction and operation of NIF at LANL are summarized in this section. The data reflect total revenues and expenditures of each jurisdiction's general fund; special revenue funds; and, as applicable, debt service, capital project, and expenditure trust funds. Major revenue and expenditure categories and total revenues less expenditures for counties and cities are presented in table I.4.2.1.6.3–1. Table I.4.2.1.6.3–2 summarizes levels of service for education, community services, and health care.

TABLE I.4.2.1.6.3–1.—*Public Finance—Los Alamos National Laboratory Area*

Revenues and Expenditures[a]	Los Alamos County	Rio Arriba County	Santa Fe County	Santa Fe City	Espanola
Local sources (percent)	56	80	88	82	11
State sources (percent)	44	20	12	17	89
Federal sources (percent)	0	0	0	0	0
Total revenues (dollars)	19,825,220	10,662,842	29,528,335	16,175,431	6,679,263
General government (percent)	26	36	25	44	24
Public safety, health and community services (percent)	74	59	65	51	57
Debt service (percent)	0	4	9	5	7
Other (percent)	0	1	1	0	12
Total expenditures (dollars)	16,085,523	9,280,844	27,221,324	6,454,442	7,015,513
End-of-year fund balance (dollars)	7,190,875	5,570,366	17,676,743	61,911,387	2,851,826

[a] If reporting body did not distinguish between state and Federal revenue sources, the total for all intergovernmental revenue was combined and reported under the "State sources" heading.

Source: City of Espanola 1995; city of Santa Fe 1995; Los Alamos County 1995; Rio Arriba County 1995; Santa Fe County 1995.

TABLE I.4.2.1.6.3–2.—*Public Services—Los Alamos National Laboratory Area*

Part I: Education

County/School District	Enrollment	Pupil-Teacher Ratio	Per Pupil Expenditure[a] ($)
Los Alamos County	3,472	15.0:1	6,231
Rio Arriba County	6,807	18.0:1	4,375
Santa Fe County	14,152	18.8:1	3,415

[a] Expenditure per pupil was based on total operating expenditures for each school district and used 40-day membership attendance numbers for the number of students.

2.6
0.8
3.2
NA

NMSR 50

Santa Fe Municipal Airport and Los Alamos Airport serve local air traffic (DOE 1993a; DOT 1992).

I.4.2.1.6.5 *Environmental Justice*

Environmental justice concerns the potential for high and adverse environmental or human health impacts to disproportionately affect minority or low-income populations. In this project-specific analysis (PSA), environmental justice is evaluated for impacts within the site region, defined as an 80-km (50-mi) radius around the site, and for the local area. Lazaro et al. (1996) presents the demographic analysis of minority and low-income population distributions on a regional and local basis.

In the LANL site region in 1990, 14 percent of the population was low income and 52 percent was minority. This value represents a lower percentage of the population that is low income, but a slightly higher percent that is minority, than the New Mexico state averages (21 percent low income and 49 percent minority). Within that area, census tracts closer to the LANL site tend not to have significantly higher or lower proportions of minority or low-income populations than tracts farther from the site.

I.4.2.1.7 Radiation and Hazardous Chemicals

I.4.2.1.7.1 *Radiation Environment*

LANL's radiological activities include testing of weapons for the Nation's nuclear arsenal, space nuclear systems, controlled thermonuclear fusion, and nuclear safeguards. A detailed discussion of the radiation environment, including background, radiological releases, and doses to members of the public is presented in *Environmental Surveillance at Los Alamos During 1992* (LANL 1994). The concentrations of radioactivity in various environmental media (air, water, soil) in the site region are also presented in that report.

Calculated radiological doses were used to estimate the potential health impacts to the public and onsite workers at LANL from any releases of radioactivity. The annual doses to individuals, the surrounding population (within 80 km [50 mi]), and workers are summarized in table I.4.2.1.7.1–1; corresponding health risks are also presented in the table. These values are in addition to those from natural background, consumer products, and medical sources, which total about 405 mrem. Background radiation doses are unrelated to LANL operations. Regulatory limits that specify the maximum effective dose equivalent to individual members of the public and occupational workers are also presented in table I.4.2.1.7.1–1.

The doses to the public presented in table I.4.2.1.7.1–1 are within regulatory limits (DOE 1990) and are small in comparison with background radiation. The onsite worker doses are all within regulatory limits, with the exception of the maximally exposed worker dose received by one worker.

I.4.2.1.7.2 *Hazardous Chemical Environment*

The background chemical environment important to human health has been discussed in section I.4.1.1.7.2. The inventories of hazardous materials stored at LANL are presented in table I.4.2.1.7.2–1. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. LANL workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded.

I.4.2.1.8 Waste Management

The current waste management practices at LANL are outlined in table I.4.2.1.8–1. Wastes managed at LANL from research activities include spent nuclear fuel, TRU, low-level, mixed, hazardous, and nonhazardous wastes.

I.4.2.1.8.1 *Low-Level Waste*

Both liquid and solid LLW are generated and managed at LANL. Liquid LLW is generated from many areas throughout the site. LANL has two onsite liquid LLW treatment facilities, one of which uses ion-exchange technology. A new Radioactive Liquid Waste Treatment Facility is planned for LANL. Con-

TABLE I.4.2.1.7.1–1.—*Annual Radiation Doses to the General Public and Onsite Workers from Normal Operations at Los Alamos National Laboratory*

	Atmospheric Releases		Liquid Releases		Total		
Receptor	Regulatory Limit[a]	Calculated	Regulatory Limit[a]	Calculated[b]	Regulatory Limit[a]	Calculated	Risk[c]
Individual Dose							
Average exposed individual[d] (mrem)	10	$6.3x10^{-3}$	4	0[e]	100	$6.3x10^{-3}$	$3.2x10^{-9}$
Maximally exposed individual (mrem)	10	7.9	4	0.8	100	8.7	$4.4x10^{-6}$
Population Dose							
Population within 80 km (person-rem)	[f]	1.4	[f]	0[g]	[f]	1.4	$7.0x10^{-4}$
Worker Dose[h]							
Average worker (mrem)	NA	NA	NA	NA	5,000	34	$1.4x10^{-3}$
Maximally exposed worker (mrem)	NA	NA	NA	NA	5,000	7,000[i]	$2.8x10^{-3}$
Total workers[j] (person-rem)	NA	NA	NA	NA	None	194	$7.7x10^{-2}$

[a] The regulatory limits for individuals are given in DOE Order 5400.5. The 10 mrem/yr limit from airborne emissions is requir by the *Clean Air Act*, the 4 mrem/yr limit is required by the *Safe Drinking Water Act*, and the total dose of 100 mrem/yr is th limit from all pathways combined. The occupational limit for workers is 5,000 mrem (10 CFR 835).

[b] The calculated dose values given in the column under Liquid Releases conservatively includes all water pathways, not just th drinking water pathway.

[c] Based on a risk factor of $5x10^{-7}$/mrem for individuals, $5x10^{-4}$/person-rem for population, and $4x10^{-7}$/mrem for workers (ICR 1991).

[d] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.

[e] Estimated for a population of approximately 224,000.

[f] No regulatory limits exist for population doses; however, a 100 person-rem value for the population is found in proposed 1 CFR834 (58 FR 16268).

[g] Although the maximally exposed individual receives a dose, no population groups are exposed to any liquid pathways.

[h] Worker doses were estimated on the basis of readings from monitoring devices called thermoluminescent dosimeters.

[i] Only one worker exceeded the worker dose regulatory limit.

[j] The number of badged workers in 1992 was approximately 5,700.

Note: NA - not applicable.

Source: LANL 1994.

TABLE I.4.2.1.7.2–1.—*Maximum Daily Quantities of National Ignition Facility-Related Hazardous Materials Stored at Los Alamos National Laboratory*

Hazardous Material	Quantity
Acetone	22,300 L
Alumina	123,957 kg
Copper	18,067 kg
Ethanol	>22,300 L
Hydrofluoric acid	4,268 L
Lead	12,555 kg
Mercury	1,545 kg
Sodium hydroxide	>223,000 kg

Source: Richardson 1995a.

struction is expected to be complete in the year LANL also has an evaporation lagoon for the dis of tritium-contaminated aqueous wastes at T The primary user of this facility is the Los Al Meson Physics Facility.

Solid LLW is generated from many areas throu LANL and is disposed of onsite at TA-54, Ar Solid LLW waste, such as paper, plastic, glass and rags, is separated into compactivel and nor pactivel materials by the waste generators. A (200-ton) compactor currently in the perm stage will be used in the future to compact waste before it is placed in the landfill. Noncom ible LLW items, such as large equipment and

TABLE I.4.2.1.8–1.—*Current Waste Management at Los Alamos National Laboratory*

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity[a] (m^3)	Disposal Method	Disposal Capacity (m^3)
Low-Level							
Liquid	21,400	Chemical treatment and ion-exchange; solidification; volume reduction (vial crusher)	9,000 (45 m^3/hr)	Chemical and ion-exchange plant TA-50 chemical plant TA-21	663	Treated effluent is discharged to the environment. Residual sludge is solidified and disposed of at TA-54 Area G as a solid LLW	See solid LLW
Solid	2,500	Compaction	76	TA-54 in area G	Variable[b]	In-situ compaction. Currently solid LLW goes to TA-54, Area G for burial	24 to 28 ha
Mixed Low-Level							
Liquid	0	Neutralization, precipitation, oxidation, thermal treatment, deactivation, and solidification; volume reduction; liquid scintillation cocktail vials	None	RCRA-permitted bldgs. (not built yet); interim status container storage areas	583	Incinerator at Diversified Scientific Services, Incorporated in Kingston, TN	NA
Solid	44.9	None	None	TA-54, Area L, or Area G	1,864	None-NTS is planned when permitted, and planned Mixed Waste Disposal Facility	NA
Hazardous							
Liquid	273	Thermal treatment; treatment tanks-neutralize, precipitate and evaporate	Varies depending on the waste stream	Thermal treatment: TA-14, -15, -16, -36 and -39. Storage: TA-5 storage and treatment TA-54, area L	502	Offsite	NA
Solid	668.56[a]	Thermal treatment; flashpad	Varies depending on the waste stream	See above	See above	See above	See above
Nonhazardous (Sanitary)							
Liquid	692,827[c]	Filter, settle, stripping	1,060,063	NA	NA	Permitted discharge sanitary tile fields	2,271,240 l/day
Solid	8,180 t	None	None	NA	NA	Onsite county landfill and landfill Area J, TA-54	NA

[a] Consists of 84.079 t (92.68 tons) *Resource Conservation and Recovery Act* regulated, 460.368 t (507.46 tons) state regulated, and 124.11 t (136.81 tons) *Toxic Substances Control Act* regulated.

[b] Solid LLW is stored temporarily to optimize disposal operations.

[c] 1991 data.

Note: NA - not applicable.

Source: Andrews and Tobin 1995; Bowers 1995.

combustion units (boilers) if the boilers were subject to New Source Performance Standards (New Mexico Environment Improvement Board/Air Quality Control Regulations 702) (NMEIB/AQCR 702) (NMEIB 1994). Gas-fired boilers with rated heat input greater than 105,600 MJ/hr (100 million British thermal units [Btu/hr]), but not over 264,000 MJ/hr (250 million Btu/hr), are limited to New Source Performance Standards nitrogen oxide emissions ranging from 43 to 86 ng/J (depending on the heat release rate, which is a function of the furnace volume [40 CFR 60.44b]). There are no New Source Performance Standards emission limits for gas-fired boilers with a rated heat input at or less than 105,600 MJ/hr (40 CFR 60.40c).

Emissions of VOC at the stated annual rate of about 0.5 t/yr (0.55 ton/yr) would not have a significant impact on local air quality and would not require any additional controls (NMEIB/AQCR 702, Part 2). Additional regulatory information is presented in section I.5.2.1.

I.4.2.2.2.2 *Acoustics*

During the clearing phase of construction for NIF at the LANL site, noise from construction equipment would increase the average outdoor sound level by 6 dB at the location of the nearest public residence. That point corresponds to the location of the maximally exposed individual 1,670 m (5,480 ft) north-northeast of the proposed NIF location. The average outdoor sound level at this location would be expected to increase from 40 to 46 dBA when the clearing equipment was operating. The CNR rank, adjusted for the estimated preexisting background level and for temporal and conceptual characteristics of the sound, would be expected to be "C." Noise with CNR ranks of "A" through "D" is generally considered to be acceptable, with "A" being the least annoying. At a rank of "C," sporadic complaints from the public are expected. However, the possibility of complaints might be lessened if it were explained to the public beforehand that the noise would occur over a period of only about two weeks, and only during daylight hours.

The average outdoor daytime sound level at the nearest laboratory building at LANL would be expected to increase by 14 dB, from 40 dBA to 54 dBA. The adjusted CNR rank for the resulting sound is "D." This sound level would occur outside the laboratory buildings. Unless windows and doors were open, the increase in sound level would not be expected to interfere with any activities that were not sensitive to sound at the level of normal speech.

The average daytime sound level at the nearest Los Alamos townsite residential area, about 1.6 km (1 mi) northwest of the construction site, would be expected to increase by 4 dB, from 45 to 49 dBA. The adjusted CNR rank for the increased level is "B."

These estimates are based on the assumptions given in Lazaro et al. (1996). It is possible that actual noise levels might be either slightly higher or lower than these estimates.

I.4.2.2.3 Water Resources

Construction of NIF at LANL would be expected to have minor to negligible effects on water quality. Utility upgrades under LANL's long-range utilities development plan are expected to meet future projected water requirements and wastewater treatment needs, including those for NIF.

During construction, about 2.95 MLY (0.80 MGY) of water would be required for NIF (LLNL 1995b). NIF operations would require about 152 MLY (40 MGY) of raw water. About 18 MLY (4.7 MGY) of that total would be for domestic use (table I.4.2.2.3–1).

TABLE I.4.2.2.3–1.—*Water and Wastewater Utility Capacity at Los Alamos National Laboratory*

Utility System	Current Usage[a,b]	NIF Requirement[c]	Projected Usage, Including NIF[a]	Current Capacity[a]
Water supply (MLY)	5,519	152	5,671	6,800
Wastewater treatment (MLY)	693	18	711	829

[a] LANL 1990a; LANL 1995b; Richardson 1995c.
[b] DOE 1993b.
[c] LLNL 1995a.

Sanitary wastewater generated by operation of NIF is estimated to total about 18 MLY (4.7 MGY). Consolidation of LANL's existing sewer system was completed in 1992, bringing all treatment systems into compliance with Federal and state regulations. Wastewater treatment capacity in the new consolidated facility is sufficient to meet NIF requirements.

Because the canyons south and north of the NIF location are more than 20 m (65 ft) deep, the 100-year floodplain is contained within the canyons (Dunham 1995). No floodplain map for the 500-year flood is available, but because of the depth of the canyons, flooding of the NIF location from the 500-year flood is unlikely.

I.4.2.2.4 Biotic Resources

I.4.2.2.4.1 *Terrestrial Resources*

NIF (including the temporary construction laydown area) would be constructed within a mix of ponderosa pine and pinyon pine-juniper habitats and would eliminate up to 4.0 ha (9.9 acres) of these habitats. The general types of impacts that could result from NIF construction at LANL would be similar to those discussed for LLNL (e.g., destruction or displacement of wildlife within construction areas) (section I.4.1.2.4). However, the ponderosa pine and pinyon-juniper habitats that would be affected at LANL are of a higher quality than is the disturbed grassland at LLNL. Construction of NIF at LANL would extend the influence of an urbanized/industrial area into more natural habitat and increase fragmentation of the wooded habitat. Operation of NIF is not expected to have significant adverse impacts on terrestrial resources. Fencing around NIF may have a localized affect on the movement of the elk herd and localized disturbance of wildlife could occur from the increased level of human activity.

I.4.2.2.4.2 *Wetlands and Aquatic Resources*

The proposed NIF location at LANL does not contain, nor is it located near, wetlands or surface water resources. Therefore, construction and operation of NIF at LANL would not be expected to adversely affect such resources.

I.4.2.2.4.3 *Rare, Threatened, and Endange Species*

No significant adverse impacts to rare, threate endangered species from construction or oper NIF at LANL would be expected. Several of th species that exist at LANL could exist in t proposed for NIF (section I.4.2.1.4.3). Constru NIF facilities could result in a minor loss of that could be utilized by some species (e.g Mexican jumping mouse, northern goshaw vireo, southwestern willow flycatcher, spotted occult little brown bat). However, no habita nated as critical would be affected. Lights ass with the NIF project could affect the availab prey base for the Mexican spotted owl (Risber

I.4.2.2.5 Cultural and Paleontological Resources

Construction and operation of the proposed LANL would have no effect on archaeological historic structures listed on or eligible for because these resources are absent in the a area. The proposed NIF would have no ef important paleontological remains or American cultural resources.

I.4.2.2.6 Socioeconomics

Locating NIF at LANL would have a minor in socioeconomic conditions in the economi region and in the ROI described in section I Because NIF partnership includes represe from government, industry, and the academi throughout the United States, procurem investment required for NIF would be disper a number of different regions, damping the co tion of economic effects of the program in th area.

The following sections describe the effects structing and operating NIF on the host economy and employment, and on popu housing, public finances and services, and loc portation in the ROI.

I.4.2.2.6.1 *Regional Economic Impacts*

Slight changes in employment and economic levels in the economic study region would oc

local spending of employee wages, procurement of goods and services (including construction materials), and other local investments associated with constructing and operating NIF. In addition to creating new jobs (direct) at the site, indirect job opportunities, such as community-support services, would also be created in the economic study region as a result of NIF construction and operation. The total new jobs created (direct and indirect) would contribute slightly to unemployment reduction, income increases, and economic output in the regional economy during construction and operation of NIF (table I.4.2.2.6.1–1). Constructing NIF at LANL would result in a peak of approximately 270 direct jobs in 1998. This construction-related procurement would indirectly create nearly 860 jobs in the economic study area. Employment for operation would begin phasing in as construction neared completion. Direct employment related to operations is projected at 330, with nearly 270 indirect jobs created throughout the economic study region. As a result of construction and operation of NIF, the baseline compounded average annual growth rate from 1995 to 2003 would increase by 0.03 percentage points.

Peak earnings associated with the 270 direct jobs created in 1998 are projected at approximately 15.3 million dollars. Construction-related procurement would indirectly create more than 16 million dollars in regional earnings. Direct earnings related to operations are projected to reach nearly 14 million dollars, with 5.5 million dollars in indirect earnings added to the regional economy.

I.4.2.2.6.2 *Population and Housing*

Construction. Population in-migration resulting from the NIF construction phase demands would begin in 1996 and peak in 1998, with a projected cumulative total of 2,200 people moving into the ROI (table I.4.2.2.6.1–1) over the three-year period. This population increase would result in demand for an additional 800 housing units in the ROI. Baseline projections of the LANL ROI housing market from 1996 (NIF construction start date) through 1998 indicate that nearly 8,800 housing units would be available. The introduction of 2,200 new workers and their families could affect the housing market in the ROI. Additional housing demand could absorb approximately 800 homes or 9 percent of the 8,800 vacant housing units in the LANL region. Such a high demand for housing could stimulate new housing starts and affect housing costs in the region. However, most of this housing demand would be temporary and would primarily affect the renter segment of the ROI housing market.

Operations. Population in-migration resulting from the NIF operation phase demands could result in an additional 610 people moving into the ROI. While this demand for housing would be longer term relative to construction, no perceptible strain on the market is expected, assuming that the general conditions associated with the housing market continue.

I.4.2.2.6.3 *Public Finance*

Construction. Given the population and economic growth associated with NIF during the construction phase, fiscal balances (revenues and expenditures) are expected to increase for all jurisdictions within the ROI. Short-term public impacts would peak during 1998 and would then decline as construction neared completion in 2002. Since the largest percentage of socioeconomic impacts are expected to occur in Los Alamos County (assuming current residential patterns), that county would experience the largest fiscal impact in the ROI (table I.4.2.2.6.1–1).

Operations. The increase in population and economic growth as a result of NIF operations would increase fiscal balances for all counties within the ROI, with greatest impact in Los Alamos County. Fiscal impacts would remain relatively stable throughout the operational period.

I.4.2.2.6.4 *Public Services*

By 1998, the county of Los Alamos would need to hire 13 additional teachers and two additional doctors to maintain its current level of service. By 2003, when operations would start, the county would need only four additional teachers over the baseline conditions to maintain the current level of service.

I.4.2.2.6.5 *Local Transportation*

In 1995, LANL employed approximately 6,200 persons (DOE 1993a). Direct employment generated by NIF at LANL for the life cycle of the project (1996 to 2033) would range from a minimum of 28 new jobs in 1996 to a maximum of 270 new jobs in 1998.

TABLE I.4.2.2.6.1–1.—*Potential Socioeconomic Impacts in the Los Alamos National Laboratory Area*

Parameters	NIF Alternative Change Over Reference Baseline		Reference Baseline	
	Peak Construction 1998[a]	Operations 2003[b]	1996 to 2002[a]	2003[b]
Regional Employment				
Direct jobs	270	330		
Indirect jobs	860	270		
Total jobs	1,130	600	1,760 additional jobs projected annually	2,250 additional jobs projected
Regional Aggregate Earnings[c]				
Direct earnings	15.29	13.81		
Indirect earnings	16.27	5.48		
Total earnings	31.56	19.29		
Regional Population Migration				
ROI in-migrating population	2,200	610	1,700 additional people annually	1,360 additional people
Regional Housing Demand				
Number of housing units in the ROI	800	220	9,080 vacant housing units (annual average)	10,080 vacant housing units
Local Transportation				
Number of trips generated at site per day	518	630		
Public Finance				
Percent change over 1995 fund balance	4.40	0.71	NA[d]	NA
Public Services (LOS)				
Change in service demand (Los Alamos County)				
Police	2	1	48[d]	50
Fire	5	2	130[d]	136
General	28	8	566[d]	585
Physicians	2	0	55[d]	56
Teachers	13	4	260[d]	268

[a] Construction period would be 1996 to 2002, with peak construction projected to occur in 1998.
[b] Operating period would be 2003 to 2033, with impacts throughout the period projected to remain stable.
[c] Regional earnings are in millions of constant 1994 dollars.
[d] Projected 1998 fund balance for Public Finance, and projected 1998 level of service (LOS) for Public Services.
Note: LOS - level of service.
Source: Model results.

The peak number of direct jobs created by NIF at LANL would be approximately 270 in 1998. These direct jobs could generate up to 518 new daily trips on LANL access roads (table I.4.2.2.6.5–1). Depending on where the new workforce resided, congestion on NMSR 4 from NMSR 126 to NMSR 501 could increase in Los Alamos County. The level of service on NMSRs 501 and 502 near LANL are currently approaching congested levels during peak periods; new trips generated from NIF construction and operation could aggravate congestion on these roads (table I.4.2.2.6.5–1).

A peak of approximately 860 indirect jobs in 1998 could impact traffic flow within the region, depending on where these jobs were located. If all indirect employment was concentrated in either Los Alamos or Santa Fe, increased congestion could occur on that city's roads. However, if indirect jobs were dispersed throughout the region, the regional road system would likely be able to handle the additional trips generated from the operation of NIF.

I.4.2.2.6.6 *Environmental Justice*

For the population in the region within 80 km (50 mi) of LANL, minorities are in a higher proportion and low-income populations are in lower proportion to other populations than in New Mexico as a whole (section I.4.2.1.6.5). Socioeconomic impacts within this region would be beneficial. Health impacts from radiological doses in this region would not be expected to result in any cancer fatalities. Because these two impacts would not be highly adverse, no environmental justice issues for regional impacts have been identified.

Neither minority nor low-income populations are clustered disproportionately in the local vicinity of the LANL site (section I.4.2.1.6.5). Thus, the local area impacts from construction and operation of NIF would not disproportionately affect either minority or low-income populations at this site. Consequently, no environmental justice issues related to local area impacts from the construction and operation of NIF have been identified.

I.4.2.2.7 Radiation and Hazardous Chemicals

This section describes potential radiological and hazardous chemical impacts resulting from normal operations and postulated accidents at NIF at LANL. Methods, data, and assumptions used in estimating impacts are presented in Lazaro et al. (1996).

I.4.2.2.7.1 *Normal Operations*

The general public surrounding the LANL site and workers at LANL may be exposed to small quantities of radionuclides released and radiation emitted from routine NIF operations; however, these levels of radioactive releases and radiation emissions would be expected to be well within regulatory limits. No impacts from hazardous chemicals should occur, because only minute quantities of hazardous VOCs would be expected to be emitted during routine NIF operations. Impacts from routine transportation of tritium targets would also not be expected, because there would be no detectable levels of radiation outside the packages carrying the low-energy beta-emitting tritium targets.

Table I.4.2.2.7.1–1 summarizes the potential impacts of radiation exposures resulting from the Conceptual Design and the Enhanced options of NIF operations at LANL.

TABLE I.4.2.2.7.1–1.—*Potential Radiological Impacts from Normal Operations of the National Ignition Facility at Los Alamos National Laboratory*

Receptor	Conceptual Design Option	Enhanced Option
Maximally Exposed Individual		
Dose (mrem/yr)	0.003	0.009
Percent of natural background	7×10^{-4}	0.002
30-year fatal cancer probability	4×10^{-8}	1×10^{-7}
Population Within 80 Km		
Dose (person-rem/yr)	0.02	0.06
Percent of natural background	2×10^{-5}	6×10^{-5}
30-year fatal cancers	0	0
Workers Onsite		
Dose (person-rem/yr)		
Non-NIF workers	0.02	0.05
NIF workers	10	10
30-year fatal cancers	0	0

Source: Model results.

TABLE I.4.2.2.6.5–1.—*Future Traffic Impacts from National Ignition Facility Project on Los Alamos National Laboratory Access Roads*

Route	From	To	Estimated 1995 AADT	Estimated Background and Peak Project Year AADT (1998)	Estimated Percent Change in AADT Between 1995 and Peak Construction Year (%)	Estimated 1995 LOS	Estimated Background and Peak Construction Year LOS (1998)
NMSR 4	NMSR 126	NMSR 501 N at Los Alamos W Gate	723	750	4	A	A
NMSR 4	NMSR 501 N at Los Alamos W Gate	NMSR 502	3,103	3,125	1	B	B
NMSR 501	NMSR 502 at Los Alamos	NMSR 502 at Los Alamos	9,327	9,675	4	D	D
NMSR 502	NMSR 501 at Los Alamos	NMSR 4	8,941	9,272	4	D	D
NMSR 502	NMSR 4	NMSR 30	12,267	12,721	4	D	D

Note: AADT - annual average daily trips; LOS - level of service.
Source: DOE 1993a.

Impacts to the Public. For the Enhanced Option, the estimated radiation dose to a maximally exposed member of the public located about 1.6 km (1 mi) north-northeast of NIF would be 0.01 mrem/yr, which would be much less than the dose limit of 100 mrem/yr resulting from all pathways combined (DOE 1990). The likelihood of the maximally exposed individual contracting a fatal cancer would be 1 in 10 million for the entire operational life of NIF (dose/yr x 30 yr x fatal cancer risk factor of $5x10^{-4}$/rem). The estimated radiation dose to the surrounding public is 0.06 person-rem/yr; no cancer fatalities would be expected to occur in the public for the entire NIF operations at LANL. For the Conceptual Design Option, estimated radiation impacts are about one-third the impacts from the Enhanced Option. No adverse health effects would result.

Impacts to Workers. In addition to potential exposure to radionuclides, the general LANL workers outside NIF could be exposed to direct radiation resulting from high-yield experiments at NIF. For the Enhanced Option, the estimated radiation dose to these non-NIF workers at LANL is 0.05 person-rem/yr. No cancer fatalities would be expected to occur to workers for the entire NIF operations at LANL. For the Conceptual Design Option, estimated radiation impacts are about one-third the impacts from the Baseline Option, posing an extremely low risk of adverse health effects.

Potential radiation exposures inside NIF would be kept as low as reasonably achievable through facility design and administrative controls. The design objective of NIF would be to keep the individual radiation worker dose to less than 500 mrem/yr. On average, it is estimated that a NIF worker would receive a dose of approximately 30 mrem/yr.

I.4.2.2.7.2 *Postulated Accidents*

Radionuclides and hazardous chemicals could be released by accidents postulated at NIF and during the transport of tritium targets. Tables I.4.2.2.7.2–1 and I.4.2.2.7.2–2 summarize potential impacts to the public and workers from postulated facility and transportation accidents. A description of each accident scenario evaluated is provided in Lazaro et al. (1996).

Radiological Impacts

Impacts to the Public. The public could be exposed to radionuclides released from a postulated accident at NIF. The bounding accident assumes an earthquake would occur at the time of a maximum-yield experiment, with an accidental release frequency of $2x10^{-8}$/yr. For the Enhanced Option, the estimated radiation dose to the maximally exposed member of the public is 0.1 rem. The likelihood that the maximally exposed individual would contract a fatal cancer from this exposure is 1 in 16,000. The estimated radiation dose to the surrounding public is 490 person-rem. No cancer fatalities would be expected to occur in the public following such an accident at NIF. For the Conceptual Design Option, estimated radiation impacts are about half the impacts calculated for the Enhanced Option. No adverse health effects would be expected.

TABLE I.4.2.2.7.2–1.—*Potential Radiological Impacts from Postulated Bounding Accident Involving the National Ignition Facility at Los Alamos National Laboratory*

Receptor	Conceptual Design Option	Enhanced Option
Maximally Exposed Individual		
Dose (rem)	0.08	0.1
Fatal cancer probability	$4x10^{-5}$	$7x10^{-5}$
Risk (cancer fatalities/yr)	$8x10^{-13}$	$1x10^{-12}$
Population Within 80 Km		
Dose (person-rem)	290	490
Fatal cancers	0	0
Risk (cancer fatalities/yr)	$3x10^{-9}$	$5x10^{-9}$
Workers Onsite		
Dose (person-rem)	14	23
Fatal cancers	0	0
Risk (cancer fatalities/yr)	$1x10^{-10}$	$2x10^{-10}$

Source: Model results.

Table I.4.2.2.7.2–1 also indicates that the risk of radiation-caused cancer fatalities from the postulated accident at LANL would be essentially zero, considering the extremely low probability of the accident occurring during NIF operations. The risk would be the product of the estimated radiation dose, fatal

Nc

Source

cancer risk factor of $5x10^{-4}$/rem, and accident release frequency of $2x10^{-8}$/yr.

Impacts to Workers. For the Enhanced Option, the estimated radiation dose to all workers at LANL from the postulated accident is 23 person-rem. No cancer fatalities would be expected to occur to workers following the postulated accident. For the Conceptual Design Option, estimated radiation impacts are about half the impacts calculated for the Enhanced Option. No adverse health effects would be expected. The risk of radiation-caused cancer fatalities would essentially be zero, considering the extremely low potential for the postulated accident to occur. LANL has a comprehensive emergency plan, which would be expanded to incorporate NIF to ensure protection of workers in case of an accident or natural disaster.

Transportation Impacts. Radiological impacts associated with the transportation of tritium targets would result from a release of tritium into the environment following a transportation accident. Since tritium is a pure beta emitter with no associated gamma radiation, radiological risks associated with routine (incident-free) transportation operations are considered to be negligible. The potential radiological impacts of transporting tritium targets were calculated for truck and air travel. For this analysis, it was assumed that the tritium targets would be transported by truck from the manufacturing sites to the nearest major airport and then by cargo aircraft to Albuquerque International Airport. After arriving at Albuquerque, the targets would be transferred to a truck for shipment to NIF at LANL.

Table I.4.2.2.7.2–2 presents the risks associated with the transportation of tritium targets from each of the tritium manufacturing facilities to NIF at LANL. Radiological risk from transportation activities is defined as the product of the accident consequence (dose) and the probability of the accident occurring, and was calculated by considering a wide range of accidents, from high-probability, low-consequence events to low-probability, high-consequence events (see Lazarro et al. 1996). Latent cancer fatality risks were obtained by multiplying the dose risk by 0.0005 latent cancer fatalities per person-rem (ICRP 1991). Latent cancer fatality risks range from $1x10^{-9}$ to $1x10^{-8}$ per year for all cases.

Nonradiological impacts associated with the ground transport of tritium targets were calculated under both routine (incident-free) and accident conditions. Nonradiological population risks for routine operations were calculated by multiplying the distance traveled by truck in urban population density zones by a risk factor for latent mortality from pollutant inhalation (Rao et al. 1982). Nonradiological population risks resulting from vehicular accidents were calculated in a similar manner by multiplying the state-specific accident fatality rate by the distance traveled by truck in the state.

The maximally exposed individual and population doses were calculated for a transportation accident involving release of the entire tritium cargo (assumed to be five tritium targets). Radiological impacts from a potential maximum-consequence accident were assessed for a general population located in a zone of urban population density. Maximally exposed individuals are assumed to be exposed unshielded as the plume passed at a distance resulting in the largest dose to the individual. Radiological consequences were assessed using worst-case weather conditions (Pasquill Stability Class F) for both the collective population and the maximally exposed individual. For assessment purposes, it was assumed that the entire tritium cargo was released to the environment in oxide form. The estimated number of latent cancer fatalities from the maximum-severity transportation accident was calculated by multiplying the population committed effective dose equivalent by 0.0005 latent cancer fatalities per person-rem (ICRP 1991). Table I.4.2.2.7.2–2 summarizes the impacts resulting from a maximum-consequence accident during the transport of tritium targets.

Hazardous Chemical Impacts. A number of possible chemical accidents were studied in terms of their potential impacts on workers and the public outside the LANL site boundaries. The range of accidents considered (including an aircraft crash) and the four possible accidents likely to have the greatest impacts were studied in detail (see Lazaro et al. 1996). These four accidents are as follows:

- A mercury release from the ignitron switches
- A combined alumina/silica release from the target chamber

somewhat higher for the Enhanced Option; however, no changes in waste handling would be necessary.

Aqueous LLW would be treated at TA-50 (radioactive Liquid Waste Treatment Facility) if the tritium concentration was low enough in the TA-53 lagoon or would be treated using equipment and techniques developed by LANL's Tritium Systems and Engineering Group (Richardson 1995d). Molecular sieves would be disposed of at TA-54, Area G. Personal protective equipment and cleaned wipes would be reused, as is common practice at other laboratories. Solid LLW would be disposed of at TA-54, Area G. High-efficiency particulate air filters are currently sampled and characterized at LANL by the Chemical Science and Technology Division, which has a program to dispose of high-efficiency particulate air filters at TA-54. Solid LLW material that is discarded is an approved waste for disposal at TA-54.

Solid mixed wastes generated by NIF would be stored at Area G of TA-54 in inspectable arrays until characterization and selection of an appropriate disposal facility (for example, Hazardous Waste Treatment Facility or NTS). The tritiated vacuum pump oil could be stabilized. Liquid mixed waste would be treated onsite or stabilized.

Hazardous Waste. Disposal of capacitors and general chemicals would be handled as outlined in section I.4.2.1.8.3.

Nonhazardous Waste. Nonhazardous wastes generated by NIF would be handled similarly to current procedures at LANL (section I.4.2.1.8.4). The incremental waste generated by NIF would not be expected to significantly affect the volume of wastes that would be disposed of at the Los Alamos County Landfill located on property owned by DOE (Richardson 1995e).

Potential Waste Minimization During Operations. During operations, waste minimization would be handled as described in section I.4.1.2.8 for LLNL.

Existing Waste Management Capabilities at LANL. The estimated waste that would be generated by NIF is listed in table I.4.1.2.8.1–2. Table I.4.2.2.8.1–1 compares the NIF waste generation rate to the annual handling/treatment capacity at LANL. Table I.4.2.2.8.1–2 details the impacts that NIF would have on existing storage capacities at LANL.

I.4.2.2.8.2 *Waste Management at Los Alamos National Laboratory During National Ignition Facility Decommissioning*

LANL proposes that decommissioning NIF after the projected 30 years of operation would follow the procedures for handling the laser, target area, and associated equipment as described in section I.4.1.2.8 for LLNL.

TABLE I.4.2.2.8.1–1.—*Comparison of National Ignition Facility Waste to Annual Treatment Capacity at Los Alamos National Laboratory* [Page 1 of 2]

Category	Ratio of NIF Waste Generation to Annual Treatment Capacity[a]	Treatment Capacity (m^3/yr)	Is Existing or Planned Treatment/Disposal Capacity Adequate
Low-Level			
Liquid			
Conceptual design total	2.8×10^{-2}	9,000 (45 m^3/hr)	Yes
Enhanced total	7.4×10^{-2}	9,000 (45 m^3/hr)	Yes
Solid			
Conceptual design total	1.7×10^{-2}	76	Yes
Enhanced total	3.8×10^{-2}	76	Yes
Mixed			
Liquid			
Conceptual design total	NA[b]	None	Yes
Enhanced total	NA	None	Yes

TABLE I.4.2.2.8.1–1.—*Comparison of National Ignition Facility Waste to Annual Treatment Capa at Los Alamos National Laboratory* [Page 2 of 2]

Category	Ratio of NIF Waste Generation to Annual Treatment Capacity[a]	Treatment Capacity (m^3/yr)	Is Existing or Planne Treatment/Disposal Capacity Adequate
Low-Level			
Liquid			
Solid			
Conceptual design total	NA	None	Yes
Enhanced total	NA	None	Yes
Hazardous			
Liquid			
Conceptual design total	Variable[c]	Variable	Variable
Enhanced total	Variable	Variable	Variable
Solid			
Conceptual design total	Variable	Variable	Variable
Enhanced total	Variable	Variable	Variable

[a] The following values for the densities of the materials were assumed: molecular sieves: density of diatomaceous earth (0.27 g/cm^3); personal protective equipment and wipes: density of paper (0.4 g/cm^3); pre and high-efficiency particulate airfil density of charcoal (1.8 g/cm^3); paper capacitors: density of paper (0.4 g/cm^3); hardware from the chamber: density of 50 pe aluminum and 50 percent stainless steel (5.3 g/cm^3).

[b] NA - not applicable.

[c] Depending on waste stream.

Source: Calculated from tables I.4.1.2.8.1–2 and I.4.2.1.8–1.

TABLE I.4.2.2.8.1–2.—*Impact of Estimated National Ignition Facility-Generated Waste on Wa Storage at Los Alamos National Laboratory*

Category	NIF-Generated Waste/Year (m^3)		Years to Fill Storage with NIF Flow Alone[a]		Is Existing Storage Capacity Adequate	
	Solid[b]	Liquid[b]	Solid	Liquid	Solid	Liquid
Low-Level						
Conceptual design total	2.98	0.60	Variable	600	Variable	Yes
Enhanced total	7.25	1.56	Variable	200	Variable	Yes
Mixed						
Conceptual design total	0.34	2.00	5,500	300	Yes	Yes
Enhanced total	0.88	4.98	2,000	100	Yes	Yes
Hazardous[c]						
Conceptual design total	8.0	2.30	63	200	Yes	Yes
Enhanced total	8.0	4.60	63	100	Yes	Yes

[a] The following values for the densities of the materials were assumed: molecular sieves: density of diatomaceous earth (0.27 g/cm^3); personal protective equipment and wipes: density of paper (0.4 g/cm^3); pre- and high-efficiency particulate a filters: density of charcoal (1.8 g/cm^3); paper capacitors: density of paper (0.4 g/cm^3); hardware from the chamber: density 50 percent aluminum and 50 percent stainless steel (5.3 g/cm^3).

[b] The total amount of the low-level waste was found by adding the values in the column "Cleaned" of table I.4.1.2.8.1–2 to t column "Low-Level" of the same table. The density of the debris shield was assumed to be the density of iron (7.87 g/cm^3). density of the low-level liquid waste was assumed equal to 1.0 g/cm^3. The amount of the "cleaned" personal protective equip and wipes/general cleaning was added to solid low-level radioactive waste.

[c] The values for the hazardous waste were calculated by adding the hazardous waste from the Laser and Target Area Building the Optics Assembly Area.

Source: Calculated from tables I.4.1.2.8.1–2 and I.4.2.1.8–1.

I.4.3 Nevada Test Site

I.4.3.1 *Affected Environment*

The following sections describe the affected environment associated with the construction and operation of NIF at Area 22 of Nevada Test Site (NTS). Land use, air quality and acoustics, water resources, biotic resources, cultural and paleontological resources, socioeconomics, radiation and hazardous chemicals, and waste management are described.

I.4.3.1.1 Location and Land Use

The 350,000-ha (867,000-acre) NTS site is located east of U.S. Route 95 in Nye County, Nevada. All of the land within NTS is owned by the Federal Government and is administered, managed, and controlled by DOE. NTS is also entirely bordered by Federal land—the land to the west, north, and east consists of the Nellis Air Force Range, and Federal land to the south is administered by the Bureau of Land Management. There is no prime farmland at NTS. Offsite agricultural activity occurs on the southern side of U.S. Route 95 and consists of a cattle allotment granted by the Bureau of Land Management (DOE 1995c). Figure I.4.3.1.1–1 shows generalized land uses at NTS and vicinity.

NTS is divided into three major regions consisting of 26 areas. The northern region is the underground nuclear weapons test area. The southwestern region (Area 25) provides support primarily for DOE's proposed high-level waste repository at the Yucca Mountain Project Site. The southeastern region is the nonnuclear explosives test area and the primary administrative and support area of NTS. Mercury Base Camp, in the southeastern region is the main base camp for worker housing and administrative operations for the site (DOE 1995c).

The proposed location for NIF is in Area 22, which is an undeveloped area approximately 3.2 km (2.0 mi) southwest of the Mercury Base Camp (figure I.3.4.3.1–2). New buildings required for NIF would be constructed in Area 22, while most other NIF requirements would be met through conversion of existing facilities located within the Mercury Base Camp. General maintenance would use two existing buildings in Area 6, approximately 52 km (32 mi) from the proposed NIF location. The temporary construction laydown area would be located within the location designated for NIF.

NTS is in the southern Great Basin Region of the Basin and Range Physiographic Province, which is characterized by a series of north-south trending mountain ranges separated by broad alluvial valleys. The higher elevations on NTS are on Pahute Mesa, about 2,205 m (7,235 ft), and Rainer Mesa, about 2,345 m (7,649 ft) above sea level. The lowest elevations are in Frenchman Flat and Jackass Flats, both at approximately 910 m (3,000 ft) above sea level (DOE 1995d).

The visible facilities of NTS are scattered within this setting. Public viewpoints of NTS are located in the Amargosa Valley and Mercury Valley along U.S. Route 95. At the principal view point in the Mercury Valley, the main base camp at Mercury is well defined at night by facility lighting (DOE 1995c).

Limited soil studies have been performed at NTS. Studies in adjacent areas have classified soils into three major types: shallow soils developed in the uplands and mountains; soils on valley fill and nearly level to moderately sloping outwash plains, alluvial fans, and fan aprons; and playas and soils on nearly level flats and basins. Possible erosion hazards range from slight to severe, while the shrink-swell potential ranges from low to high for these soils. The potential for wind erosion and shrink-swell increases into the playas and basins. The soils at NTS are considered acceptable for standard construction techniques. There is no prime farmland at NTS (DOE 1995c).

I.4.3.1.2 Air Quality and Acoustics

This discussion of existing air quality and acoustics includes a review of the meteorology, climatology, and atmospheric dispersion characteristics near NTS.

I.4.3.1.2.1 *Meteorology and Climatology*

The climate at NTS and in the surrounding region is characterized by limited precipitation, low humidity, and large diurnal temperature ranges. The lower elevations are characterized by hot summers and mild winters. As elevation increases on the site, precipitation increases and temperature decreases (DOE 1986). The annual average temperature at Desert Rock, NV, near the proposed NIF location at NTS is

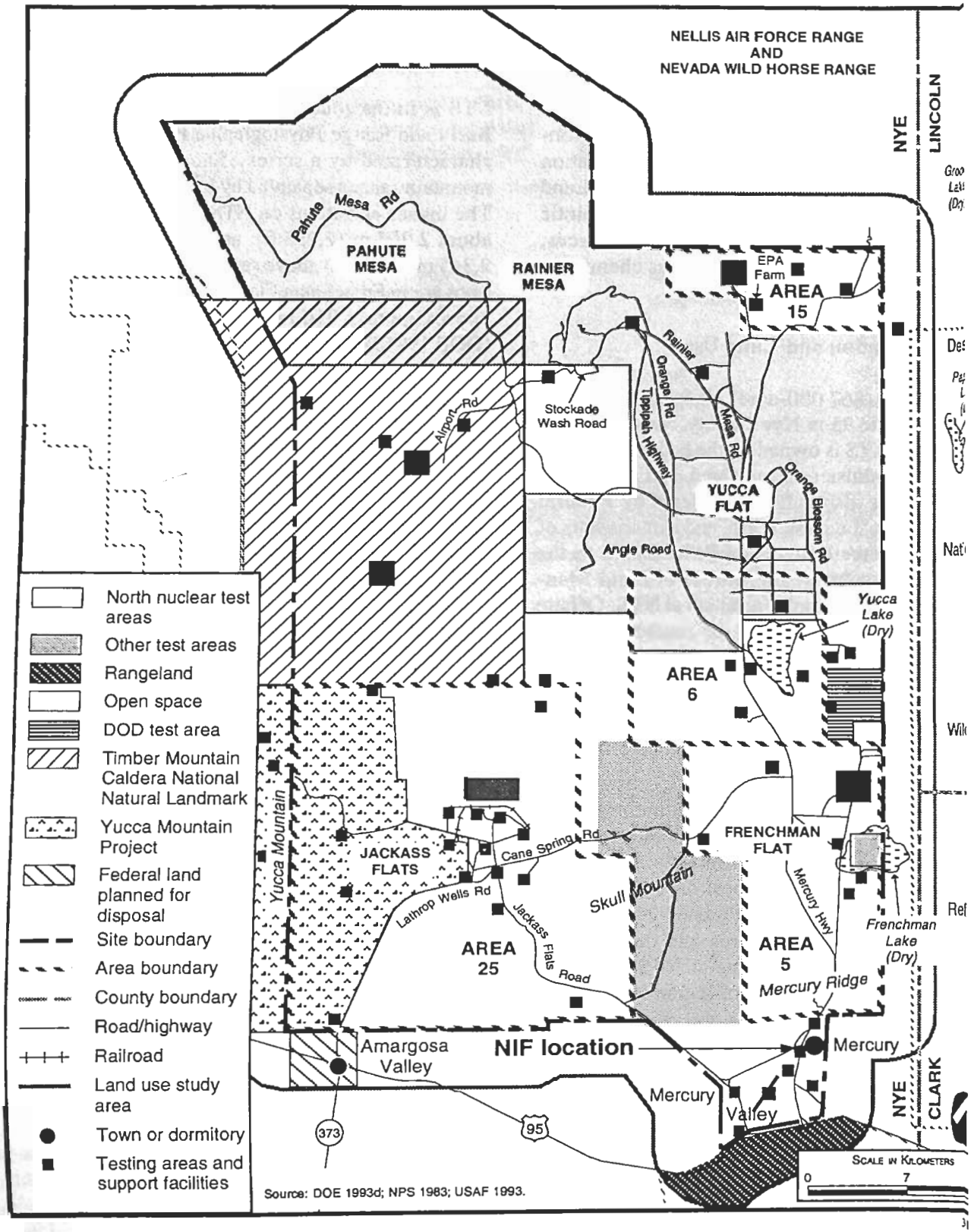


FIGURE I.4.3.1.1–1.—*Generalized Land Use at Nevada Test Site and Vicinity.*

16.5 °C (62 °F); average daily temperatures range from 6.5 °C (44 °F) in January to a maximum of 29.0 °C (84 °F) in July. The average annual precipitation is 17.1 cm (6.72 in). The prevailing winds are from the south-southwest during the day and east-northeast at night at an annual average wind speed of 15 km/hr (kph) (9.2 mph) (White 1995a). The 5-year wind rose for NTS (based on measurements at Desert Rock Air Strip) is shown in figure I.4.3.1.2.1–1. During 1987 to 1991, unstable atmospheric conditions occurred approximately 22 percent of the time, neutral conditions about 38 percent of the time, and stable conditions the remaining 40 percent (EPA 1995b). In general, atmospheric dispersion improves as the wind speed increases and as atmospheric conditions become more unstable.

The limited precipitation and warm temperatures characteristic of the region create an arid climate that limits the growth of ground-covering vegetation, resulting in large areas of exposed soil that are potential sources of windborne particulate matter (dust). Atmospheric particulate matter concentrations are reduced if the exposed soil is wetted or if the particulate matter is "washed out" of the atmosphere by precipitation. However, the area's precipitation and temperature seldom provide these beneficial mechanisms. This condition increases the particulate matter background concentration and increases the likelihood that the area's PM_{10} and total suspended particulates (TSP) ambient air concentrations will approach or exceed regulatory standards.

I.4.3.1.2.2 *Ambient Air Quality*

The State of Nevada is responsible for air pollution control and attainment of air quality standards in Nye County. Federal air quality standards exist for the criteria air pollutants ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, PM_{10}, and lead

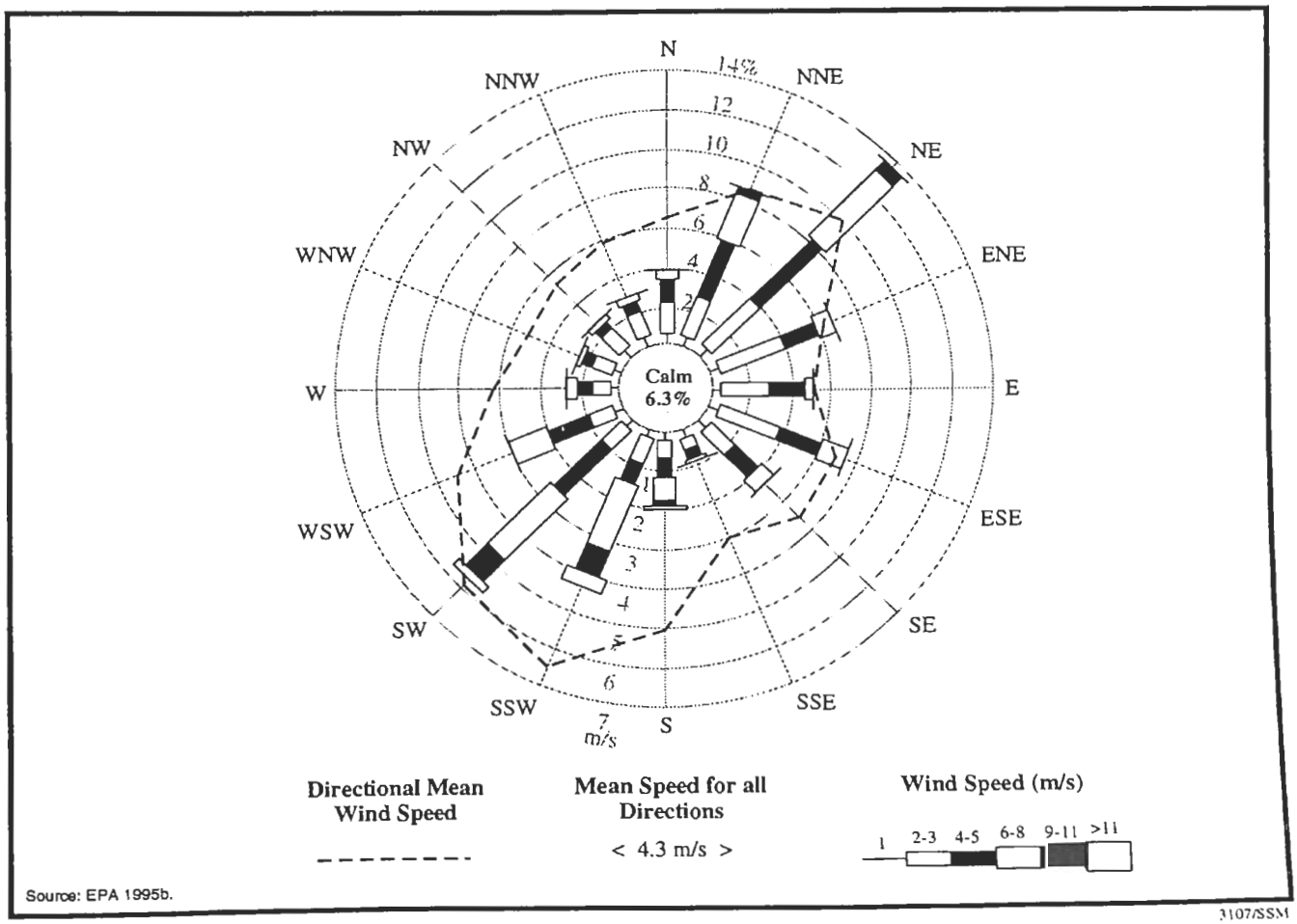


FIGURE I.4.3.1.2.1–1.—*Wind Distribution at Nevada Test Site, 1987-1991.*

(40 CFR 50). Nevada has also established state ambient air quality standards for these pollutants, as well as for hydrogen sulfide and visibility. The state and national ambient air quality standards for criteria pollutants are the same for Nye County (NBAQ 1988-1992). Applicable NAAQS and Nevada State ambient air quality standards are presented in table I.4.3.1.2.2–1.

Nye County, located in the Nevada Interstate AQCR 147, is in attainment or unclassified with regard to the NAAQS (40 CFR 81.329). In general, pollutant emission increases in an area designated nonattainment for a specific pollutant are subject to more stringent permitting requirements than if the area is designated attainment or unclassified.

The monitoring data available for NTS are very limited. Carbon monoxide data were collected for one month at three NTS sites in 1990. Onsite monitoring data have also been collected for PM_{10} and sulfur dioxide. The closest state-operated air monitoring station, located in the North Las Vegas area (AQCR 13) about 105 km (65 mi) southeast of NT is not representative of NTS. Table I.4.3.1.2.2 shows that, except for the 24-hour PM_{10}, baseli concentrations are in compliance with applica national and Nevada ambient air quality standa The PM_{10} is exceeded because of moderate ba ground concentrations attributable to the des terrain and contributions from operations at the s (DOE 1995c).

The area surrounding NIF location at NTS cont two PSD Class I areas: the Grand Canyon Natio Park, approximately 193 km (120 mi) to the ea southeast in Arizona, and Sequoia National Pa approximately 169 km (105 mi) to the west in Ca fornia.

The primary criteria pollutant emission source NTS include particulates from construction, unpa roads, and other ground surface disturbances; vari pollutants from operation of fuel-burning equipm incineration, and open burning; and VOCs from f

TABLE I.4.3.1.2.2–1.—*Comparison of Baseline Ambient Air Concentrations with Most Stringen Applicable Regulations and Guidelines at Nevada Test Site*

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutant			
Carbon monoxide	8 hours	10,000[a,b]	2,300
	1 hour	40,000[a,b]	2,700
Lead	Calendar quarter	1.5[a,b]	ND[c]
Nitrogen dioxide	Annual	100[a,b]	ND
Ozone	1 hour	235[a,b]	ND
Particulate matter	Annual	50	8.4
	24 hours	150[a,b]	172.6[d]
Sulfur dioxide	Annual	80[a,b]	6.9
	24 hours	365[a,b]	117
	3 hours	1,300[a,b]	660.6
Mandated by State			
Hydrogen sulfide	1 hour	112[c]	ND
Visibility	-	[e]	ND

[a] Federal standard (40 CFR 50).
[b] State standard.
[c] ND - No data available.
[d] Exceeds most stringent regulation or guideline.
[e] In sufficient amount to reduce the prevailing visibility to less than 48 km (30 mi) when humidity is less than 70 percent.
Source: NSEC 1995; DOE 1995c.

storage facilities (DOE 1995c). Emission estimates for these sources are listed in section I.4.3.2.2.

I.4.3.1.2.3 *Acoustic Conditions*

Major sources of noise within NTS include various industrial facilities, equipment, and machines, and aircraft operations. No noise survey data for NTS are available. At the site boundary, away from most of the industrial facilities at NTS, noise emitted from the site is barely distinguishable from background noise levels.

The acoustic environment along the NTS boundary can be classified as either uninhabited desert or small rural communities and is assumed to be that of a rural location with residual noise levels of 35 to 50 dBA (EPA 1974). Near highways, traffic contributes to ambient noise levels, especially during peak hours, resulting in significantly higher noise levels than at remote locations. Except for the prohibition of nuisance noise, neither the State of Nevada nor its local governments have established specific numerical environmental noise standards applicable to NTS (DOE 1995c).

I.4.3.1.3 Water Resources

No perennial streams exist in the proposed NIF location at NTS (figure I.3.4.3.1–2). Rainfall quickly evaporates or infiltrates the normally dry soil; flows in stream channels occur only after significant precipitation events. Flowing water in the normally dry channels, if it occurs, also evaporates or seeps into permeable sand and gravel channel beds (DOE 1995d). During extreme storm events, sheet flooding may occur. The 500-year floodplain has not been delineated for the proposed NTS Area 22 location for NIF. Preliminary calculations indicate that the broad, flat plain that includes the proposed NIF location may experience a sheet flow reaching a depth of 0.09 m (0.3 ft) during a 500-year flood event (White 1995f).

Groundwater beneath the eastern portion of NTS, which includes the proposed NIF location, is part of the Ash Meadows groundwater sub-basin. Three primary aquifers are present within this subbasin: the Lower Carbonate (the deepest), the Volcanic, and the Valley-Fill (the shallowest). Other aquifers are present to a limited extent under the area, but their water-yielding potential has not been thoroughly investigated. The Lower Carbonate, the regional aquifer, has a saturated thickness ranging from about 100 to 1,000 m (328 to 3,280 ft). The groundwater in this aquifer flows in a south-southwest direction toward Ash Meadows. The Volcanic and Valley-Fill aquifers range in thickness from 0 to about 600 m (0 to 1,970 ft) and are confined within local drainage basins. The depth to the groundwater table is about 220 m (722 ft) beneath valleys in the southern part of NTS (DOE 1995c-d). NTS water supply system consists of 17 wells, 11 of which are currently active (White 1995b).

I.4.3.1.4 Biotic Resources

NTS occurs within the Southern Basin and Range Ecoregion (Omernik 1986). The site is in a transition area between the Mojave and Great Basin deserts and, thus, contains species characteristic of both deserts. Less than one percent of the 350,000 ha (867,000 acres) of NTS is developed; thus, natural plant communities are found across most of NTS. The areas designated for use for NIF are within the creosote bush community (one of nine major plant communities occurring at NTS). Introduced plants such as red brome, cheatgrass, and Russian thistle are common in some areas (DOE 1995c).

Common wildlife species at NTS include the side-blotched lizard, western shovel-nosed snake, black-throated sparrow, red-tailed hawk, Merriam's kangaroo rat, and Great Basin pocket mouse. Raptors common to NTS include the turkey vulture and rough-legged hawk. Carnivores that exist at NTS include the long-tailed weasel and bobcat, and big-game species include the pronghorn antelope and mule deer. Hunting is not permitted on NTS.

Wetlands are associated with the playas and springs on NTS. However, no potential wetlands exist in the area designated for NIF. Natural aquatic resources at NTS are limited to two playas and a few natural springs. In addition, sewage lagoons and ponds are associated with existing NTS facilities, and man-made water reservoirs are located throughout NTS. The water reservoirs support introduced bluegill, goldfish, and golden shiners. None of the aquatic resources exist in the area designated for NIF.

A list of Federal and state rare, threatened, and endangered species that could potentially exist at NTS is provided in Lazaro et al. (1996). The desert tortoise is the only Federal-listed (threatened) species known to inhabit NTS, and no designated critical habitats for Federal-listed species exist at NTS. Habitats that could attract several of the species (e.g., chuckwalla, desert tortoise, and loggerhead shrike) are present. The distribution of the desert tortoise includes the southern third of NTS, which includes the location designated for NIF (figure I.4.3.1.4–1). Urbanization, roadways, habitat fragmentation, grazing, wildfires, disease, and other perturbations have caused decreases in desert tortoise populations (Bury et al. 1994; Corn 1994). The occurrence of the desert tortoise on NTS is $\leq 17/km^2$ ($44/mi^2$). They occur mostly in the lowland desert community dominated by creosote bush and burro bush (Bury et al. 1994).

I.4.3.1.5 Cultural and Paleontological Resources

An intensive archaeological field survey (employing 15-m [50-ft] transects) was conducted at the proposed NIF location and access road on NTS during August 1995 (Jones 1995). The survey documented an isolated artifact (stone flake) that does not meet eligibility criteria for NRHP and is not considered significant (Hattori 1995). Paleontological remains are unlikely to occur on the proposed NIF location on the basis of its geologic setting, which lacks fossiliferous deposits. No Native American cultural resources have been identified in the proposed NIF location in the course of consultation with potentially affected tribes.

I.4.3.1.6 Socioeconomics

Socioeconomic characteristics summarized here for the NTS area include the regional economy, population and housing, public finance and public service infrastructure, and local transportation. Regional economic statistics are based on a regional economic study area that encompasses 11 counties around NTS as defined by BEA. The economic study area is a broad labor and product market-based region linked by trade among economic sectors within the region. Statistics for population, housing, public finance, and public service infrastructure are based on the ROI, a two-county area in which 97 percent of all NTS employees reside. These counties are Clark Co (containing 82 percent of NTS employees) and N County (15 percent). Lazaro et al. (1996) li counties and cities included in the economic st region and the counties included in the R(Assumptions, assessment methodologies, and s porting data for each TA are also presented in La et al. (1996).

I.4.3.1.6.1 *Regional Economy*

The regional economic study area for NTS inclu the Las Vegas Metropolitan Statistical Area (Cl County). Employment in the economic study re was projected to increase from 412,300 in 198 496,700 in 1995. BEA projects a compoun average annual rate of growth of 1.9 percent fi 1995 to 2003 (79,522 jobs) (BEA 1990).

In 1995, NTS employed about 8,600 persons (D 1995), accounting for 2.0 percent of employme the regional economic study area. The distributio NTS employees by place of residence in the R(presented in Lazaro et al. (1996).

I.4.3.1.6.2 *Population and Housing*

The ROI has experienced significant popula growth between 1980 and 1990, with an ave annual increase of about 4.5 percent, bringing 1990 total to approximately 683,000 persons. P lation growth has been strongest in Clark Count the year 2000, population in the ROI is projecte grow to approximately 860,000 (U.S. Departme Commerce 1994; BEA 1990).

Between 1980 and 1990, the number of housing in the ROI increased from 194,899 to 325,26 increase of 67 percent (see table I.4.3.1.6.2 Housing in Clark County increased from app mately 190,607 units in 1980 to 317,188 uni 1990. Housing in Nye County increased f 4,292 units in 1980 to approximately 8,073 un 1990. Assuming a continuation of current cons tion and economic trends, the number of hou units in the ROI is projected to increase to app mately 455,000 units by the year 2000.

The number of vacant owner units in the RO increased from approximately 11,000 in 19 about 17,000 in 1990. It is estimated that in the

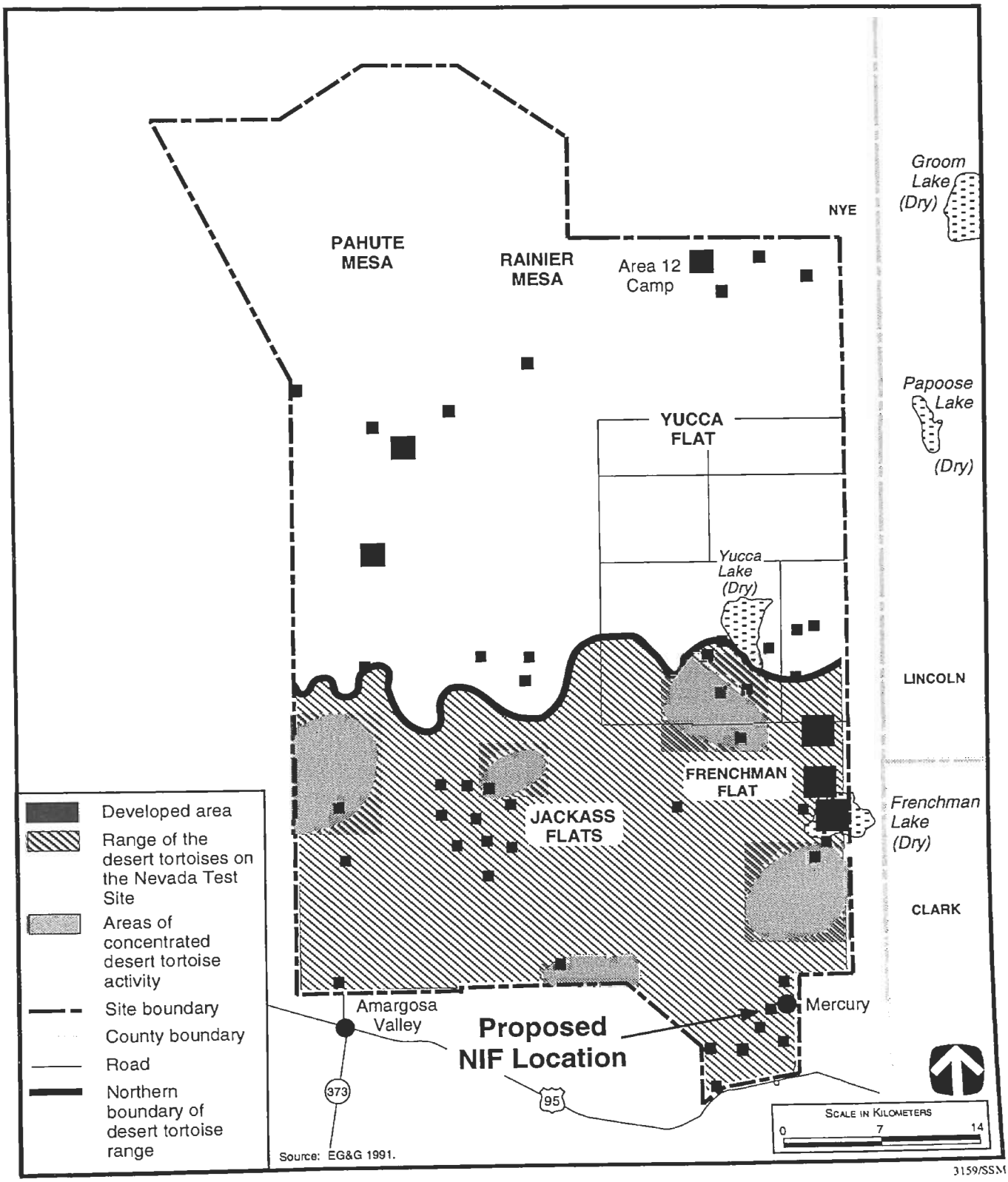


FIGURE I.4.3.1.4–1.—*Distribution of the Desert Tortoise at Nevada Test Site.*

TABLE I.4.3.1.6.2–1.—*Population and Housing Data for the Nevada Test Site Area*

Category	1980	1990	1996	1997	1998	1999	2000	2001	2002	2003
Estimated ROI population	472,135	683,040	798,044	812,625	827,527	842,675	858,100	870,949	883,990	897,227
Estimated total housing units	194,899	325,261	403,478	416,514	429,551	442,587	455,623	468,659	481,695	494,731
Estimated vacant owner units	10,806	16,954	21,319	22,047	22,774	23,502	24,229	24,957	25,684	26,412
Estimated vacant renter units	7,319	15,022	18,968	19,625	20,283	20,940	21,598	22,255	22,913	23,571
Estimated total vacant units in ROI	18,125	31,976	40,287	41,672	43,057	44,442	45,827	47,212	48,597	49,983

Source: Historical data from U.S. Department of Commerce 1994; projections by Halliburton-NUS 1995.

2000 there will be approximately 24,000 vacant owner units if current construction and economic trends continue in the ROI.

In 1980 there were approximately 7,000 vacant rental units in the ROI. The number of vacant rental units increased to about 15,000 in 1990. It is estimated that in the year 2000 there will be approximately 22,000 vacant rental units if current construction and economic trends continue in the ROI.

Between 1993 and 1994, within the Las Vegas Metropolitan Statistical Area, single-family development experienced a sharp increase of about 30 percent in new housing units. Multifamily housing construction increased by 44 percent between 1993 and 1994. The number of new housing units sold increased as well, rising 11 percent over 1993 levels. In spite of the growing supply of houses in the Las Vegas market, new housing prices continue to climb (ULI 1995).

I.4.3.1.6.3 *Public Finance and Public Services Infrastructure*

Public financial characteristics of the local jurisdictions in the ROI that are most likely to be affected by construction and operation of NIF at NTS are summarized in this section. The data reflect total revenues and expenditures of each jurisdiction's general fund, special revenue funds, and, as applicable, debt service, capital project, and expenditure trust funds. Major revenue and expenditure categories and total revenues less expenditures for counties and cities are presented in table I.4.3.1.6.3–1.

Table I.4.3.1.6.3–2 summarizes public service levels for education, community services, and health care.

I.4.3.1.6.4 *Local Transportation*

Vehicular access to NTS is provided by U.S. 95 to
south, with access to the northeast provided by S
Route 373. State Route 160 provides site access fr
the south and east. Road segments providing acc
to NTS experience little traffic congestion outside
the Las Vegas metropolitan area. Although traffic
generally heavier on U.S. 95 than on State Route 3
both roads are projected to remain at level of serv
A (DOE 1995a). Table I.4.3.1.6.4–1 lists the s
access roads at NTS and the average daily tra
volumes for each route. No major road improvem
are scheduled for road segments providing immed
access to NTS (DOE 1995c). Although no pul
transportation system serves NTS, a contract
service for workers is available at a nominal c
(DOE 1995c). The major railroad in the ROI is
Union Pacific Railroad located approximately 80
(50 mi) east of NTS near the city of Las Veg
McCarran International Airport in the city of
Vegas provides jet passenger service from b
national and local carriers.

I.4.3.1.6.5 *Environmental Justice*

Environmental justice concerns the potential for
and adverse environmental or human health imp
to disproportionately affect minority or low-inco
populations. In this PSA, environmental justic
evaluated for impacts within the site region, defi
as the area within an 80-km (50-mi) radius around
site, and for the local area. Lazaro et al. (19
presents the demographic analysis of minority
low-income population distributions on a regio
and local basis.

TABLE I.4.3.1.6.3–1.—*Public Finance—Nevada Test Site Area*

Revenues and Expenditures[a]	Clark County	City of Henderson	City of Las Vegas	City of North Las Vegas	Nye County
Local sources (percent)	63	39	46	44	53
State sources (percent)	37	61	54	56	47
Federal sources (percent)	0	0	0	0	0
Total revenues (dollars)	295,686,362	44,838,156	165,281,174	33,422,607	12,348,383
General government (percent)	22	25	19	15	37
Public safety, health, and community services (percent)	66	75	80	85	63
Debt service (percent)	0	0	0	0	0
Other (percent)	11	0	0	0	0
Total expenditures (dollars)	241,422,802	42,164,384	155,307,893	33,027,839	12,511,908
End-of-year fund balance (dollars)	77,826,604	1,140,575	13,712,536	3,656,142	1,374,364

[a] If reporting body did not distinguish between state and Federal revenue sources, the total for all intergovernmental revenue was combined and reported under "state sources."

Source: City of Henderson 1995; Nye County 1994; city of North Las Vegas 1994; city of Las Vegas 1994.

TABLE I.4.3.1.6.3–2.—*Public Services—Nevada Test Site Area*

Part I: Education

County/School District	Enrollment	Pupil-Teacher Ratio	Per Pupil Expenditure ($)
Clark County School District	145,327	16.6:1[a]	3,478[b]
Nye County School District	4,467	NA	3,662

[a] Pupil-teacher ratio for Clark County includes administrative personnel.

[b] Expenditure per pupil for Clark County is based on total expenditure.

Note: NA - not available.

Part II: Level of Service per 1,000 Population

County/Jurisdiction	Police Protection	Fire Protection	General Government	Physicians
Clark County	1.2	0.5	5.1	1.4
City of Henderson	0.8	0.8	6.4	NA
City of Las Vegas	4.5	1.2	7.0	NA
City of North Las Vegas	2.4	0.8	9.2	NA
Nye County	5.3	NA[a]	19.1	0.4

[a] Fire protection services are provided by cities in the county, and departments are predominantly volunteer.

Source: Clark County School District 1994; city of North Las Vegas 1994; city of Las Vegas 1994; Clark County 1994; Federal Bureau of Investigation 1993; American Medical Association 1994; city of Henderson Fire Department 1995; city of Henderson Personnel Department 1995; city of Las Vegas Human Resources Department 1995; Nye County School District 1995; Nye County Sheriff's Department 1995; Nye County Personnel Department 1995; city of Tonopah Fire Department 1995; Clark County Personnel Department 1995.

TABLE I.4.3.1.6.4–1.—*Baseline Traffic on Nevada Test Site Access Roads*

NTS Access Road	1993 Average Daily Traffic
U.S. 95 (6.1 km north of Mercury Interchange)	2,715
U.S. 95 (In Searchlight, 0.16 km south of SR-164)	6,115
SR 160 (In Pahrump Valley, 61 m south of SR 372 to Ash Meadows)	10,600
SR 160 (Pahrump Valley at Clark/Nye County line)	2,970
SR 160 (145 m south of U.S. 95)	655
U.S. 95/6 (In Tonopah, 0.3 km north of U.S. 6 north of St. Patrick Street)	7,635
SR 160 (In Pahrump Valley, 0.16 km north of SR 372 to Ash Meadows)	6,670

Source: Nevada Department of Transportation 1993.

In the NTS site region in 1990, 10 percent of the population was low income and 14 percent was minority, compared with the Nevada state average of 10 percent low income and 21 percent minority. Within the area, census tracts closer to the NTS site tend not to have significantly higher or lower proportions of minority or low-income populations than tracts farther from the site.

I.4.3.1.7 Radiation and Hazardous Chemicals

I.4.3.1.7.1 *Radiation Environment*

Both aboveground and underground tests of nuclear weapons and test devices have been conducted at NTS. In addition, weapons effects tests have been conducted on military communications, electronics, satellites, sensors, and other materials. In October 1992, underground nuclear testing was halted. The site maintains the capability of resuming testing if directed by the President. A detailed discussion of the radiation environment, including background, radiological releases, and doses to members of the public, is presented in *U.S. Department of Energy Nevada Operations Office Annual Site Environment Report–1993, Volume 1* (DOE 1994a). The concentrations of radioactivity in various environmental media (air, water, soil) in the site region are also presented in that reference.

Calculated radiological doses were used to estim the potential health impacts to the public and onsi workers at NTS from any releases of radioactivi The annual doses to individuals, to the surroundi population (within 80 km [50 mi]), and to worke are summarized in table I.4.3.1.7.1–1; correspon ing health risks are also presented in this table. Thes doses are in addition to those from natural back ground, consumer products, and medical source which total about 378 mrem. Background radiati doses are unrelated to NTS operations. Regulato limits that specify the maximum effective dos equivalent to individual members of the public a occupational workers are also presented i table I.4.3.1.7.1–1. The doses to the public listed the table are within regulatory limits (DOE 199 and are small in comparison to background rad tion. The onsite worker doses are also within regu tory limits.

I.4.3.1.7.2 *Hazardous Chemical Environment*

The background chemical environment importa human health consists of the atmosphere, which contain hazardous chemicals that can be inha drinking water, which may contain hazard chemicals that can be ingested; and other envi mental media with which people may com contact (for example, soil through contact or vi food pathway). Exposure pathways to NTS wo during normal operation may include inhalin workplace atmosphere, drinking NTS potable w and possibly other contact with hazardous mat associated with work assignments. The potenti health impacts varies from facility to facilit from worker to worker, and available informati not sufficient to allow a meaningful estimatio summation of these impacts. However, worke protected from hazards specific to the work through appropriate training, protective equip monitoring, and management controls. NTS wo are also protected by adherence to OSHA and occupational standards that limit atmospheri drinking water concentrations of poten hazardous chemicals. Appropriate monitoring, reflects the frequency and amounts of chemical in NTS operation processes, ensures that standards are not exceeded. The quantities o related hazardous materials purchased for use in 1994 are listed in table I.4.3.1.7.2–1.

TABLE I.4.3.1.7.1–1.—*Annual Radiation Doses to the General Public and Onsite Workers from Normal Operations at Nevada Test Site*

Receptor	Atmospheric Releases		Liquid Releases		Total		
	Regulatory Limit[a]	Calculated	Regulatory Limit[a]	Calculated[b]	Regulatory Limit[a]	Calculated	Risk[c]
Individual Dose							
Average exposed individual[d] (mrem)	10	$5.5x10^{-4}$	4	0.0	100	$5.5x10^{-4}$	$2.8x10^{-10}$
Maximally exposed individual (mrem)	10	$4.8x10^{-3}$	4	0.0	100	$4.8x10^{-3}$	$2.4x10^{-9}$
Population Dose[e]							
Population within 80 km (person-rem)	[f]	$1.2x10^{-2}$	[f]	0.0	[f]	$1.2x10^{-2}$	$6.0x10^{-6}$
Worker Dose[g]							
Average worker (mrem)	NA	NA	NA	NA	5,000	2.6	$1.0x10^{-6}$
Maximally exposed worker (mrem)	NA	NA	NA	NA	5,000	750	$3.0x10^{-4}$
Total workers (person-rem)[h]	NA	NA	NA	NA	None	2	$8.0x10^{-4}$

[a] The regulatory limits for individuals are given in DOE Order 5400.5. The 10 mrem/yr limit from airborne emissions is required by the *Clean Air Act*, the 4 mrem/yr limit is required by the *Safe Drinking Water Act*, and the total dose of 100 mrem/yr is the limit from all pathways combined. The occupational limit for workers is 5,000 mrem (10 CFR 835).

[b] The calculated dose values given in the column under Liquid Releases conservatively includes all water pathways, not just the drinking water pathway.

[c] Based on latent fatal cancer risk factors of $5x10^{-7}$/mrem for individuals, $5x10^{-4}$ /person-rem for population, and $4x10^{-7}$/mrem for workers (ICRP 1991).

[d] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.

[e] Estimated for a population of approximately 21,750 people.

[f] No regulatory limits exist for population doses; however, a 100 person-rem value for the population is found in proposed 58 FR 16268 (10 CFR 834).

[g] Worker doses were estimated on the basis of readings from monitoring devices called thermoluminescent dosimeters.

[h] The number of badged workers in 1992 was approximately 780.

Note: NA - not applicable.

Source: Reynolds Electrical and Engineering Co., Inc. 1994.

TABLE I.4.3.1.7.2–1.—*Maximum Daily Quantities of National Ignition Facility-Related Hazardous Materials Purchased by and Stored at Nevada Test Site*

Hazardous Material	Quantity (kg)
Acetone	394
Ethanol (l)	80
Hydrofluoric acid	273
Sodium hydroxide	856

Source: White 1995c.

I.4.3.1.8 Waste Management

The current waste management practices at NTS are outlined in table I.4.3.1.8–1. Wastes generated by research activities at NTS include TRU wastes, LLW, mixed, hazardous, and nonhazardous wastes.

I.4.3.1.8.1 *Low-Level Waste*

LLW has been generated and disposed of in eight areas at NTS, but currently only Areas 3 and 5 are active for LLW treatment, storage, and disposal.

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TABLE I.4.3.1.8–1.—*Current Waste Management at Nevada Test Site*

Category	1993 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Low-Level							
Liquid	Dependant on restoration activities	Not determined	NA	None	NA	None	None
Solid	178	None	NA	None	NA	Shallow burial	650,000
Mixed Low-Level							
Liquid	Included in solid	None	NA	NA	NA	None	None
Solid	None	None	None	Containers on asphalt pads	1,208	Pit	90,626
Hazardous							
Liquid	248	Contracted offsite	None	RCRA-permitted storage unit	See solid hazardous	Contracted offsite	NA
Solid	Approx 4 (878 kg hazardous) (2,400 kg explosives)	Contracted offsite	None	RCRA-permitted storage unit[a]	61.6	Contracted offsite	NA
Nonhazardous (Sanitary)	11,000	None for solid, septic fields for liquid	As required for liquid	None	None	Landfill (onsite)	Expandable as required; as of November 1994, 459,000 m^3 available
Nonhazardous (Other)	82,800	None for solid, septic fields for liquid	As required for liquid	None	None	Landfill (onsite)	Expandable as required

[a] Explosive waste is treated immediately after generation. Explosives are not stored at the Hazardous Waste Storage Unit.

Note: NA - not applicable.

Source: NTS 1996; White 1995g.

about 3.2 km (2 mi) southwest of the Mercury Base Camp in an isolated part of Nye County (figure I.3.4.3.1–2). An estimated 18 ha (45 acres) of land in Area 22 would be required for buildings, walkways, building access, temporary construction laydown area, and buffer space. However, the required acreage represents a small fraction of total land available on NTS for future development (White 1995d). The project would be located on a large tract of vacant land that has at least an additional 80 ha (200 acres) available for future expansion. No impacts to land use outside of Area 22 would be expected.

With appropriate erosion and sediment control measures, soil impacts during construction of NIF would be short term and minor. Seismic risks would be taken into account during construction and operation of NIF.

I.4.3.2.1.2 *Visual Resources*

Although structures erected for the NIF project would alter the visual landscape of the proposed location, no adverse visual impacts are expected. The proposed NIF location at NTS is remotely located in a part of Nevada that has a population density of less than 1.0 person/km^2 (2.6 persons/mi^2). The area is relatively flat, dominated by desert vegetation, and not visually diverse. NIF structures, particularly the Laser and Target Area Building, would be visible to persons using U.S. Highway 95, but the distance of the site from the highway (about 6.5 km [4 mi]) would lessen its visual domination of the horizon. Other manmade structures, such as the Mercury Base Camp and Desert Rock Air Strip, already exist in the vicinity of the proposed NIF site.

I.4.3.2.2 Air Quality and Acoustics

I.4.3.2.2.1 *Air Quality*

Construction Emissions. Estimated air pollutant emissions from site clearing and facility construction are listed in table I.4.3.2.2.1–1. The construction emission estimates are based on characteristics of the proposed NTS location for NIF and on construction vehicle exhaust and fugitive emissions.

Site clearing would continue for about 2.5 mont followed by facility construction for four ye (LLNL 1995b). Site clearing would produce t greatest amount of fugitive dust PM_{10} emissio The ISCST2, Version 93109 [EPA 1992a-b] w used to determine the impact of site-clearing acti ities on ambient air quality (see se tion I.4.1.2.2.1). The data selected for modeli air quality were surface meteorological data a twice-daily mixing height data from the near Desert Rock National Weather Service Station 1987-91 (EPA 1995b). The surface wind spe and directions are summarized in an annual wi rose (see figure I.4.3.1.2.1–1). Detailed emissi inventories associated with site clearing a facility construction, meteorological data used, quality model assumptions, and model inp parameters are presented in Lazaro et al. (1996

TABLE I.4.3.2.2.1–1.—*Estimated National Ignition Facility Construction Emissions fo the Nevada Test Site Location*

Pollutant	Total Emissions (t/yr)[a]
Particulate matter	31.93[b] (35.20)
Volatile organic compounds	0.44 (0.49)
Carbon monoxide	1.23 (1.36)
Nitrogen dioxide	3.73 (4.11)
Sulfur dioxide	0.43 (0.47)
Lead	Negligible

[a] Metric tons (1,000 kg) per year.

[b] Includes 10.43 t/yr (11.50 ton/yr) of fugitive emissions fo site clearing using water-spray control that would occur during an approximate 73-day period in the first year and 21.14 t/yr (23.30 ton/yr) of facility construction emission that would occur for the remainder of the first year of construction.

Note: See Lazaro et al. (1996) for details.

Source: Lazaro et al. 1996.

Because of the arid conditions typical of the regi the 24-hour average PM_{10} background concen tion representative of NTS site is 173 μg/m^3 (ta I.4.3.1.2.2–1), which is already over the national; state standard of 150 μg/m^3 (see table I.4.3.1.2.2- Therefore, site clearing should be carried out so a minimize additional impacts on ambient air qual With conventional dust control (that is, 50 perc control for excavation and 60 percent control

NTS must comply with the Nevada State Air Pollution Control regulations. Construction activities at NTS would require an operating permit for any surface area disturbance of more than 2.02 ha (5 acres) of land (that is, clearing, excavating, and leveling the land) (Nevada Administrative Code [NAC] Section 445.365). Therefore, a construction permit would be required for NIF. Construction fugitive dust air pollutant emissions must be controlled by using the best practical methods to prevent particulate matter from becoming airborne (NAC Section 445B.365 [NSEC 1995]).

External combustion units (boilers) must have a state air pollution permit before construction (NAC Sections 445B.291, 445B.287). Liquid petroleum gas-fired boilers with rated heat input greater than 105,600 MJ/hr (100 million Btu/hr) but not over 264,000 MJ/hr (250 million Btu/hr) are limited to New Source Performance Standards (NSPS) nitrogen oxide emissions of from 43 to 86 ng/J, depending on the heat release rate, which is a function of the furnace volume (40 CFR 60.44b). There are no NSPS emission limits for liquid petroleum gas-fired boilers with a rated heat input at or less than 105,600 MJ/hr (40 CFR 60.40c).

Emissions of VOC at the stated annual rate of 0.5 t/yr (0.55 ton/yr) would not have a significant impact on local air quality and would not require any additional controls (NAC 445B.395). Additional air quality regulatory information is presented in section 5.2.

I.4.3.2.2.2 *Acoustics*

During the clearing phase of construction of NIF at NTS, there would be no increase in the average outdoor daytime sound level at the nearest private residence, 20 km (12.4 mi) south-southwest of the NIF site. The average outdoor daytime sound leve this point would remain at 28 dBA or less dur hours the clearing equipment was operating. T CNR rank, adjusted for the estimated preexist background level, would not be expected to cha from its normal level.

The residual outdoor daytime sound level at nearest laboratory building (the gate house/secu office) is expected to increase by 12 dB, to 40 d The existing average daytime sound level at this p is estimated to be 28 dBA. The adjusted CNR rank the resulting sound is "C." These estimates are ba on the assumptions given in Lazaro et al. (1996). possible that the actual noise levels might be high lower than those estimated.

I.4.3.2.3 Water Resources

About 2.95 MLY (0.78 MGY) of water woul required for NIF construction (LLNL 1995b). W and wastewater utility requirements for NIF op tions at NTS are shown in table I.4.3.2.3–1. The water supply required for NIF operations would about 152 MLY (40 MGY), of which 18 M (4.7 MGY) would be for domestic use. NTS w supply system has adequate production and sto capacity to meet the needs of NIF. The water wou obtained from six existing wells on NTS. An u ground water pipeline about 3.2-km (2-mi) would have to be constructed to the NIF loca Sewage treatment and disposal facilities would have to be constructed for the project. Adequate area exists for such facilities (White 1995e). foundations for NIF buildings would be abov depth of the 500-year flood and project faci would be designed to withstand any flood. Mat that might cause water pollution would not be s within reach of the 500-year flood.

TABLE I.4.3.2.3–1.—*Water and Wastewater Utility Capacity at Nevada Test Site*

Utility System	Current Usage	NIF Requirement	Projected Usage, Including NIF	Current Capacity
Water supply[a] (MLY)	2,400	152	2,552	14,800
Wastewater treatment (MLY)	0	18	18	0

[a] Represents pumping capacity for all the water supply wells for NTS water services area, which includes NIF location.
Source: White 1995e.

I.4.3.2.4 Biotic Resources

I.4.3.2.4.1 *Terrestrial Resources*

At NTS Area 22, NIF (including the temporary construction laydown area) would be constructed within undeveloped creosote bush habitat, eliminating up to 18.2 ha (45.0 acres) of that habitat. The general types of impacts that could result from NIF construction at NTS would be similar to those discussed for LLNL (section I.4.1.2.4–1). Areas disturbed by construction but not occupied by a building, parking lot, or access road would be of minimal value to wildlife because of the difficulty of reestablishing a vegetative cover in a desert environment (DOE 1995c). Additionally, introduced plants such as red brome, cheatgrass, and Russian thistle readily invade disturbed areas and delay revegetation by native plants.

I.4.3.2.4.2 *Wetlands and Aquatic Resources*

The proposed NIF location at NTS does not contain, nor is it located near, wetlands or surface water resources. Therefore, construction and operation of NIF at NTS would not be expected to adversely affect such resources.

I.4.3.2.4.3 *Rare, Threatened, and Endangered Species*

No habitat designated as critical to threatened or endangered species would be affected by construction of NIF. Construction and operation of NIF (including the 3.2-km [2-mi] underground water supply pipeline) at NTS Area 22 location could pose a threat to individual desert tortoises and their habitat. Vehicular traffic associated with NIF construction and operation would also be a threat to tortoises. The ferruginous hawk would be discouraged from using areas near NIF because of human disturbance, but the loggerhead shrike could use the fence that would surround NIF for perching and hunting sites (DOE 1995c).

I.4.3.2.5 Cultural and Paleontological Resources

Construction and operation of the proposed NIF at Area 22 would have no effect on archaeological sites or historic structures listed on or eligible for the NRHP, or on important paleontological remains or Native American cultural resources.

I.4.3.2.6 Socioeconomics

Locating NIF at NTS would have a minor impact on the economic study region and in the ROI described in section I.4.3.1.6 because the site is in a somewhat diverse regional economy with extensive inter- and intraregional, national, and global economic interactions and linkages. None of the average annual increases in any of the socioeconomic variables would constitute a major difference from the region-specific average annual increases expected without NIF. Also, because the NIF partnership includes representatives of government, industry, and the academic sector throughout the United States, procurement and investment would be dispersed over a number of different regions, thus dampening the concentration of economic effects of the program.

The following sections describe the effects of constructing and operating NIF on the host region's economy and employment, and on population, housing, public finances and services, and local transportation in the ROI.

I.4.3.2.6.1 *Regional Economic Impacts*

Slight changes in employment and economic activity levels in the economic study region would occur from local spending of employee wages, procurement of goods and services including construction materials, and other local investment associated with constructing and operating NIF. In addition to creating new jobs (direct) at the site, indirect job opportunities, such as community support services, would also be created in the economic study region as a result of these new direct jobs. The total new jobs created (direct and indirect) would contribute slightly to unemployment reduction and would increase income and economic output in the regional economy during construction and operation of NIF. Table I.4.3.2.6.1–1 presents the potential impacts to the regional economy if NIF is located at NTS.

Constructing NIF at NTS would result in a peak of approximately 280 direct jobs in 1998. This construction-related procurement would indirectly create 1,360 jobs in the economic study area.

TABLE I.4.3.2.6.1–1.—*Potential Socioeconomic Impacts in the Nevada Test Site Area*

Parameters	NIF Alternative Change Over Reference Baseline: Peak Construction 1998[a]	NIF Alternative Change Over Reference Baseline: Operations 2003[b]	Reference Baseline: 1996 to 2002[a]	Reference Baseline: 2003[b]
Regional Employment				
Direct jobs	280	330		
Indirect jobs	1,360	290		
Total jobs	1,640	620	14,600 jobs projected annually	12,900 additional jobs projected
Regional Aggregate Earnings [c]				
Direct earnings	16.19	13.81		
Indirect earnings	27.22	6.29		
Total earnings	43.41	20.10		
Regional Population Migration				
ROI in-migrating population	2,340	440		13,300 additional people
Regional Housing Demand				
Number of housing units in the ROI	850	160	44,400 vacant housing units (annual average)	50,000 vacant housing units
Local Transportation				
Number of trips generated at site per day	538	630		
Public Finance	0.21	0.04	NA[d]	NA
Percent change over 1995 fund balance (Clark County)				
Public Services				
Change in service demand				
Police[e]	9	1	1,436[d]	7,839
Fire[e]	2	0	379[d]	909
General[e]	15	2	2,240[d]	2,349
Physicians[f]	3	1	1,455[d]	2,096
Teachers[f]	18	3	9,530[d]	13,725

[a] Construction period would be 1996 to 2002, with peak construction projected to occur in 1998.

[b] Operating period would be 2003 to 2033, with impacts throughout the period projected to remain stable.

[c] Regional earnings are millions of constant 1994 dollars.

[d] Projected 1998 fund balance for Public Finance, and projected 1998 level of service (LOS) for Public Services.

[e] Las Vegas.

[f] Clark County.

Note: NA - not applicable.

Source: Model results.

Employment for NIF operation would begin phasing in as construction neared completion. Direct employment related to operations is projected at 330, with nearly 290 indirect jobs created throughout the economic study region. As a result of constructing and operating NIF, the baseline compound average annual growth rate from 1995 to 2003 would increase by 0.01 percentage points.

Peak earnings associated with the 280 direct jobs created in 1998 are projected at approximately 16.2 million dollars. Construction-related procurement would indirectly create more than 27 million dollars in regional earnings. Direct earnings related to operations are projected to reach nearly 14 million dollars, with 6.3 million dollars in earnings added to the regional economy.

I.4.3.2.6.2 *Population and Housing*

Construction. Population in-migration resulting from NIF construction phase demands would peak in 1998 with a projected cumulative total of 2,340 people moving into the ROI (table I.4.3.2.6.1–1). This population increase would result in demand for an additional 850 housing units on the ROI. Baseline projections of the NTS ROI housing market from 1996 (NIF construction start date) through 1998 indicate that nearly 43,000 housing units will be available. The demand for approximately 850 vacant housing units in the ROI would use approximately 2 percent of the available housing stock in the ROI. NIF would generate little demand for new housing construction because of the number of vacant housing units within the ROI and the proximity of NTS to Las Vegas. Most of this housing demand would be temporary and would primarily affect the renter segment of the ROI housing market.

Operation. Population in-migration resulting from NIF operation phase demands could result in an additional 440 people moving into the ROI. While additional demand for housing would be longer term relative to construction, no perceptible strain on the market is expected, assuming that the general conditions associated with the housing market continue.

I.4.3.2.6.3 *Public Finance*

Construction. Given the projected population and economic growth associated with NIF during the construction phase, fiscal balances (revenues and expenditures) would be expected to increase for all the jurisdictions within the ROI. Short-term public finance impacts would peak during the year 1998 and would then decline as construction neared completion in 2002. Since the largest percentage of socioeconomic impacts are expected to occur in Clark County (assuming current residential patterns), that county would experience the greatest fiscal impacts in the ROI (table I.4.3.2.6.1–1).

Operation. The increase in population and economic growth as a result of NIF operations would increase fiscal balances for all counties within the ROI, with the greatest impact in Clark County. Fiscal impacts would remain relatively stable from the initial impact in 2003 throughout the duration of NIF operations.

I.4.3.2.6.4 *Public Services*

By the year 1998, Clark County would need to hire 9 additional police officers, and Nye County would need 18 additional teachers and 3 additional doctors to maintain its current level of service. By 2003, when operations would start, Nye County would need only three additional teachers and one additional doctor over the baseline conditions to maintain the current level of service.

I.4.3.2.6.5 *Local Transportation*

In 1995, NTS employed approximately 8,600 persons (DOE 1995c). Direct employment generated by NIF at NTS for the life cycle of the project (1996-2033) would range from a minimum of 21 new jobs in 1996 to a maximum of 280 new jobs in 1998. Peak direct employment would be approximately 280 workers in 1998. These direct jobs would generate additional trips on NTS access roads (table I.4.3.2.6.1–1); however, these additional trips should not significantly increase congestion of NTS local transportation network (table I.4.3.2.6.5–1).

A peak of nearly 1,360 indirect jobs in 1999 could be generated within the ROI if NIF was located at NTS. It is likely that the major share of these jobs would be located within Clark and Nye counties. The road network in Clark County and the city of Las Vegas is well developed and expanding and would be capable of handling the additional trips generated from operation of NIF. Because the indirect jobs would be

TABLE I.4.3.2.6.5–1.—*Future Traffic Impacts from National Ignition Facility Project on Nevada Test Site Access Roads*

Route	From	To	Estimated 1995 AADT	Estimated Background and Peak Project Year AADT (1998)	Estimated Percent Change in AADT[a] (%)	Estimated 1995 LOS	Estimated Background and Peak Construction Year LOS (1998)
U.S. 95	Indian Springs	Nye/Clark County border	4,200	4,700	12	A	A
U.S. 95	Indian Springs	SR 156	6,000	6,500	8	A	B
U.S. 95	4 miles north of Mercury	NA	3,100	3,600	16	A	A
U.S. 95	at Amargosa Valley	NA	2,200	2,300	5	A	A
SR 160	at U.S. 95 Interchange	NA	750	923	23	A	A
SR 160	at Pahrump	NA	825	968	17	A	A
SR 160	0.85 mile from Clark/Nye County	NA	3,600	3,840	7	A	A
SR 160	Nevada/ California State line	NA	775	835	8	A	A

[a] Between 1995 and Peak Construction Year.
Note: NA - not applicable; AADT - annual average daily trips; LOS - level of service; SR - State Route.
Source: Carpenter 1995; Nevada Department of Transportation 1993.

dispersed in both Clark and Nye counties, adverse impacts to the regional transportation network are unlikely.

I.4.3.2.6.6 *Environmental Justice*

For the region within 80 km (50 mi) of NTS, both minorities and low-income populations are in the same or lower proportion to other populations compared with the state of Nevada as a whole (section I.4.3.1.6.5). Thus, no environmental justice issues associated with regional impacts have been identified.

Neither minority nor low-income persons clustered disproportionately in the local vicini NTS (section I.4.3.1.6.5). Thus, the local impacts from construction and operation of would not disproportionately affect either min or low-income populations.

I.4.3.2.7 Radiation and Hazardous Chemi

This section describes potential radiologica hazardous chemical impacts that could result normal operations and postulated accidents at N NTS. Methods, data, and assumptions used in

I.4.3.2.7.1 *Normal Operations*

The general public surrounding, and workers at, NTS might be exposed to small quantities of radionuclides released and radiation emitted from routine NIF operations; however, the expected level of radioactive releases and radiation emissions would be well within regulatory limits. No impacts from hazardous chemicals should occur because only minute quantities of hazardous VOCs would be emitted during routine NIF operations. Impacts from routine transportation of tritium targets also would not be expected because there would be no detectable levels of radiation outside the package carrying the low-energy beta-emitting tritium targets.

Table I.4.3.2.7.1–1 summarizes the potential impacts of radiation exposures from operations consistent with the Conceptual Design Option and the Enhanced Option of NIF at NTS.

Impacts to the Public. For the Enhanced Option, the estimated radiation dose to a maximally exposed member of the public located about 20 km (12.5 mi) south-southeast of NIF is $4x10^{-4}$ mrem/yr, which is much less than the dose limit of 100 mrem/yr resulting from all pathways combined (DOE 1990). The likelihood of the maximally exposed individual contracting a fatal cancer is 1 in 170 million for the entire operational life of NIF (dose/yr x 30 yr x fatal cancer risk factor of $5x10^{-4}$/rem). The estimated radiation dose to the surrounding public is $1x10^{-3}$ person-rem/yr; no cancer fatalities would be expected to occur in the public for the entire NIF operations at NTS. For the Conceptual Design Option, estimated radiation impacts are about one-third the impacts of the Enhanced Option. No adverse health effects would result.

Impacts to Workers. In addition to their potential exposure to radionuclides, the general NTS workers outside NIF could be exposed to direct radiation resulting from high-yield experiments at NIF. For the Enhanced Option, the estimated radiation dose to these non-NIF workers at NTS is $9x10^{-4}$ person-rem/yr. No cancer fatalities would be expected to occur in workers for the entire NIF operations at NTS. For the Conceptual Design Option, estimated radiation impacts are about one-third the impacts of the Enhanced Option and carry extremely low risk of adverse health effects.

TABLE I.4.3.2.7.1–1.—*Potential Radiological Impacts from Normal Operations of the National Ignition Facility at Nevada Test Site*

Receptor	Conceptual Design Option	Enhanced Option
Maximally Exposed Individual		
Dose (mrem/yr)	$1x10^{-4}$	$4x10^{-4}$
Percent of natural background	$4x10^{-5}$	$1x10^{-4}$
30-year fatal cancer probability	$2x10^{-9}$	$6x10^{-9}$
Population Within 80 Km		
Dose (person-rem/yr)	$3x10^{-4}$	$1x10^{-3}$
Percent of natural background	$5x10^{-6}$	$2x10^{-5}$
30-year fatal cancers	0	0
Workers Onsite		
Dose (person-rem/y)		
Non-NIF workers	$3x10^{-4}$	$9x10^{-4}$
NIF workers	10	10
30-year fatal cancers	0	0

Source: Model results.

Potential radiation exposures inside NIF would be kept as low as reasonably achievable through facility design and administrative controls. The design objective of NIF is to keep the individual radiation worker dose to less than 500 mrem/yr. On average, it is estimated that a NIF worker would receive approximately 30 mrem/yr.

I.4.3.2.7.2 *Postulated Accidents*

Radionuclides and hazardous chemicals could be released from accidents postulated at NIF and during the transportation of tritium targets. Tables I.4.3.2.7.2–1 and I.4.3.2.7.2–2 summarize potential radiological impacts to the public and workers from postulated facility and transportation accidents, respectively. A description of each accident scenario evaluated is provided in Lazaro et al. (1996).

Radiological Impacts

Impacts to the Public. The public could be exposed to radionuclides released from a postulated accident at NIF. The bounding accident assumed that an earthquake would occur at the time of a maximum-yield

TABLE I.4.3.2.7.2–2.—*Potential Radiological Risks and Consequences of Transporting Tritium Targets from Manufacturing Facilities to Nevada Test Site*

Manufacturing Facility	Conceptual Design Option	Enhanced Option
General Atomics		
Dose risk (person-rem/yr)	1.2×10^{-6}	9.5×10^{-6}
Fatality risk (cancer fatalities/yr)	6×10^{-10}	5×10^{-9}
Nonradiological accidents[a] (fatalities/yr)	1×10^{-3}	3×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	8×10^{-4}	2×10^{-3}
Lawrence Livermore National Laboratory		
Dose risk (person-rem/yr)	1.2×10^{-6}	9.3×10^{-6}
Fatality risk (cancer fatalities/yr)	6×10^{-10}	5×10^{-9}
Nonradiological accidents[a] (fatalities/yr)	1×10^{-3}	3×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	4×10^{-4}	1×10^{-3}
Los Alamos		
Dose risk (person-rem/yr)	2.4×10^{-6}	1.9×10^{-5}
Fatality risk (cancer fatalities/yr)	1×10^{-9}	9×10^{-9}
Nonradiological accidents[a] (fatalities/yr)	2×10^{-3}	6×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	2×10^{-4}	5×10^{-4}
Savannah River		
Dose risk (person-rem/yr)	2.0×10^{-6}	1.6×10^{-5}
Fatality risk (cancer fatalities/yr)	1×10^{-9}	8×10^{-9}
Nonradiological accidents[a] (fatalities/yr)	1×10^{-3}	3×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	2×10^{-4}	5×10^{-4}
University of Rochester		
Dose risk (person-rem/yr)	2.1×10^{-6}	1.6×10^{-5}
Fatality risk (cancer fatalities/yr)	1×10^{-9}	8×10^{-9}
Nonradiological accidents[a] (fatalities/yr)	9×10^{-4}	2×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	2×10^{-4}	5×10^{-4}
Maximum Consequence Accident Population[b,c]		
Dose (person-rem)	0.33	3.3
Fatal cancers	2×10^{-4}	2×10^{-3}
Maximally Exposed Individual[b,d]		
Dose (rem)	1.2×10^{-4}	1.2×10^{-3}
Fatal cancer probability	6×10^{-8}	6×10^{-7}

[a] Collective population fatalities were calculated for 145 shipments (Conceptual Design Option) and 335 shipments (Enhanced Option). For example, a reported value of 4×10^{-3} fatalities suggests that no fatalities are expected for the proposed action. However, one single fatality out of the entire affected population might be expected over the course of 250 years if the same number of shipments were to continue for that length of time.

[b] The most severe accidents assumed that 100 percent of the target tritium was released in an oxide form during an accident. Accident consequence results were determined using the RISKIND computer program which is described in Yuan et al. 1993. Stable weather conditions (Pasquill Stability Class F) with a wind speed of 1 m/s (2.2 mph) were assumed.

[c] The maximum consequences would result from an accident occurring in an urban environment. The population was assumed to extend at a uniform density of 3,861 persons/km^2 (10,000 persons/mi^2) to a radius of 80 km (50 mi) from the accident site. The population exposure pathways for urban environments included inhalation and resuspended inhalation. Urban environments were not assumed to produce food for local use or export, hence no ingestion dose was included.

[d] The maximally exposed individual was assumed to be at the location of maximum exposure. The location of the maximally exposed individual was assumed to be 380 m (1,247 ft) from the accident under stable weather conditions. Individual exposure pathways included acute inhalation during passage of the plume. No ingestion dose was considered.

Note: The transportation risk assessment assumed 100 percent of the tritium targets would be manufactured and transported to NIF from each site. In practice, tritium targets would be produced and transported from more than one manufacturer. The transportation risk assessment was performed for offsite transportation only. Transportation risks from onsite transport of tritium targets were assumed to be negligible compared to risks from offsite transportation.

Source: Model results.

a similar manner by multiplying the state-specific accident fatality rate by the distance traveled by truck in the state.

The maximally exposed individual and population doses were calculated for a transportation accident involving the entire release of the tritium cargo (assumed to be five tritium targets). Radiological impacts resulting from a potential maximum-consequence accident were assessed for a general population located in an urban population density zone. Maximally exposed individuals were assumed to be exposed and unshielded as the plume passed at a distance, resulting in the largest dose to the individual. Radiological consequences were assessed for worst-case weather conditions (Pasquill Stability Class F) for both the collective population and the maximally exposed individual. For assessment purposes, it was assumed that the entire tritium cargo was released to the environment in oxide form. The estimated number of latent cancer fatalities from the maximum-severity transportation accident was calculated by multiplying the population-committed effective dose equivalent by 5×10^{-4} latent cancer fatalities per person-rem (ICRP 1991). Table I.4.3.2.7.2–2 summarizes the impacts of a maximum-consequence accident during transportation of tritium targets.

Hazardous Chemical Impacts. A number of possible chemical accidents (including one caused by an aircraft crash) were studied in terms of their potential impacts on workers and the public outside NTS boundaries (Lazaro et al. 1996). The five accidents likely to have the greatest impacts were studied in detail. Four of these five accidents would occur at NIF location, and the fifth accident would occur elsewhere on NTS. The four release scenarios occurring at NIF are as follows:

- A mercury release from the ignitron switches
- A combined alumina/silica release from the target chamber
- A carbonyl fluoride release from the optics treatment area
- A hydrogen fluoride release from the optics treatment area

All four accidents at NIF would occur far fro workers in other buildings and very far from th public. The fifth accident is unique to NTS becau of the presence of propane storage tanks for fuel o the site near NIF. The two largest tanks hol 28,400 L (7,500 gal) each and are positioned side t side. The worst-case scenario assumes that bo tanks would simultaneously leak from a 5-cm (2-i diameter hole 0.3 m (1 ft) from the tank bottom a continuous release over one hour.

A modeling study was conducted for each of the fi release scenarios. More details, including predict concentrations, are provided in Lazaro et al. (199 The modeling study applied a dispersion model each of the releases and used a health criteri (ERPG-2 level) representative of acute impacts fr an exposure that might happen once in a lifetir The health criterion was the concentration bel which, if exposure occurred for an hour, the expo individual could still avoid irreversible health eff by taking emergency action. The results of modeling yielded the following conclusions:

- The threat zone from each of the four accidents would not extend to the boundary with the public under either typical or extreme meteorological conditions
- Personnel in other buildings on the site are so far away that they would not be affected. The assumptions made for the four accidents in the NIF Laser and Target Area Building were that the release would not be inhibited by the walls of the NIF building and that the wind would take the plume away from the building. The distances beyond which concentrations would fall below the ERPG-2 level for each of the five accidents are as follows:
  - Mercury scenario—239 m (784 ft) for both the Conceptual Design and Enhanced options.
  - Alumina/silica scenario—231 m (758 ft) for the Conceptual Design Option and 171 m (561 ft) for the Enhanced Option.

–Carbonyl fluoride scenario—75 m (246 ft) for both the Conceptual Design and Enhanced options.

–Hydrogen fluoride release—101 m (331 ft) for both the Conceptual Design and Enhanced options.

–Propane release—755 m (2,477 ft) for both the Conceptual Design and Enhanced options.

Personnel in NIF Laser and Target Area Building and those outside in the immediate vicinity might be affected.

I.4.3.2.8 Waste Management Impacts

This section describes the proposed management of wastes generated during construction, normal operation, and the ultimate decommissioning of NIF if it were located at NTS.

I.4.3.2.8.1 *Waste Generation and Management During Construction and Operation*

During construction, waste management would be performed as described in section I.4.1.2.8 for LLNL. No water permits would be needed for withdrawal of groundwater for activities occurring on NTS. A RCRA Part B Permit would be required for the construction of hazardous and mixed waste management facilities, and a state-issued permit would be required for the construction of nonhazardous waste landfills. All construction activity would be performed in compliance with requirements identified in DOE O 47001.1. NTS has adequate capacity to handle (or contract for offsite disposal of) this waste stream.

Table I.4.1.2.8.1–2 (section I.4.1.2.8.1) describes the quantities of various low-level, mixed, hazardous, and nonhazardous wastes that would be generated during NIF operation for both the Conceptual Design Option and Enhanced Option. The following paragraphs describe how the wastes shown in that table would be managed if NIF were located at NTS.

Successive sections cover how developing technologies might be applied to minimize waste streams. Waste handling methods would be the same for both the Conceptual Design and Enhanced options. While, as shown in various tables, total estimated waste quantities are somewhat higher for the Enhanced Option, no changes in handling methods would be necessary.

Low-Level Waste. Solid LLW produced during NIF operations would be disposed of onsite. NTS currently disposes of solid LLW onsite, in compliance with NVO-325 waste acceptance criteria.

Waste that does not meet the waste acceptance criteria requirements of NVO-325 may not be disposed of at NTS. The waste must be certified to meet the requirements whether that creates the need for further treatment or characterization or whatever the area of deficiency by which the waste or the management program governing the waste was deemed unacceptable. There is and has been waste that has been unapproved or disapproved. DOE's Nevada Operations Office conducts an audit on the program managing the waste and is the approval authority for all waste streams to be disposed of on NTS.

Aqueous LLW would be treated onsite to eliminate free liquids. Currently, there are no existing facilities at NTS for the treatment of liquid radioactive waste. However, there are plans to develop this capability at NTS in the near future (FY 1997) (see next section on mixed liquid waste).

Mixed Waste. Current plans are to permit mixed solid waste disposal units on NTS for mixed waste generated both on and offsite that meets RCRA land disposal requirements. A permit application has been submitted to the State of Nevada, and it is estimated that the units will be available in fiscal year 1997, well before NIF operations would begin. NTS currently has the capability, under interim status, to dispose of mixed waste generated onsite at the Area 5 Radioactive Waste Management Site. The current remaining capacity for mixed waste disposal at NTS is over 90,000 m^3 (117,000 yd^3) and will be much greater (approximately 250,000 m^3 [325,000 yd^3]), assuming that approval and construction of permitted mixed waste disposal units takes place as anticipated. The small amount of mixed waste generated at NIF would not significantly affect mixed waste operations. In the event the mixed waste was generated before development

of acceptable NTS disposal capacity, the waste could be stored, pending approval by the State of Nevada, at a storage pad onsite at the Area 5 Radioactive Waste Management Site or could be sent to a mixed waste disposal site out of state.

Low-level mixed liquid waste would be treated to eliminate free liquids before disposal at NTS. Free liquids are not allowed for disposal, per requirements identified in the NTS Waste Acceptance Criteria, NVO-325. As with solid mixed waste, the requirements identified in the RCRA land disposal restrictions would also be met. No facilities currently exist at NTS for the treatment of liquid mixed waste; however, there are plans to develop such capability in the near future. The liquid waste treatment system, which is designed to treat large volumes of liquid waste (both radioactive and mixed) is expected to be available in fiscal year 1997. This system would use evaporation as the primary treatment method for the anticipated waste. A second mixed waste treatment facility, which is still in the preliminary planning stages, is also expected to be operational in fiscal year 1997. This facility will use stabilization as the primary method of treatment and might be more appropriate for the liquid mixed waste from NIF. This facility should be online by the time any waste would be generated by NIF operations. Therefore, upon approval of a permit modification, this planned facility would be available for the treatment of NIF liquid mixed waste.

If necessary, NIF liquid mixed waste could be stored onsite at the Area 5 Radioactive Waste Management Site until a treatment facility was available. This waste would be stored on a mixed-waste storage pad that is planned for construction in the near future. If the mixed waste storage pad were not available at the time of generation, the waste could be stored on the TRU pad with approval from the State of Nevada. The TRU pad is currently used for the storage of mixed waste (Ortego and Johnston 1995). The waste containers are protected from the environment in a covered building. Monitoring already exists and could be modified to detect hazards specific to NIF waste.

The mixed aqueous waste from the debris shield cleaning would be neutralized, stabilized, and disposed of at NTS as an approved waste stream.

Hazardous Waste. NTS has a well-establishe system for management of large quantities o hazardous waste. Both liquid and solid hazardou wastes are sent offsite to permitted treatmen storage, or disposal facilities located outsid Nevada. Hazardous waste generated at NTS is acc mulated and stored at the RCRA-permitte hazardous waste storage unit located near the Area Radioactive Waste Management Site. NTS generat approximately 300,000 L (79,250 gal) of hazardo waste annually, based on fiscal year 1994 volume The addition of an estimated 8.0 m^3 (280 ft^3) of sol and 4,500 L (1,190 gal) of liquid hazardous was from NIF could be handled by the existing was management system and would not cause a signi cant adverse impact. A subcontractor typical removes waste from the hazardous waste stora unit on a monthly basis under an existing approv EPA identification number for NTS. There are plans to construct a hazardous waste disposal unit NTS. Precious metals, such as silver and mercu and used oils are sent to approved recycling a recovery centers. Most hazardous waste from N would be shipped to an approved commercial RCI treatment, storage, and disposal facility.

Nonhazardous Waste. Sanitary wastewater would treated at a new sewage lagoon system dedicate NIF. There are a number of these sewage lagoon existence at NTS because this is the custom method for managing this type of waste. Resou would be available to construct this system for N

The development of a storm drain would depen the siting for NIF. Because of the vast availabilit usable land at NTS, it is unlikely that exten storm drain development would be necessary. Si of the facility and its subsequent design would al for alluvial flood protection. There are no pu structures in the vicinity of NTS that would req the diversion of flood waters. The only potent affected structures would be the other DOE facil in the vicinity of NIF.

Disposal of nonhazardous solid waste woul handled by onsite DOE/NV contractors. I maintains the capability to dispose of nonhazar solid waste at onsite disposal units. Landfill available for sanitary waste, construction debris hydrocarbon-contaminated soil. The onsite con tor maintains a collection schedule for the ren

TABLE I.4.3.2.8.1–2.—*Comparison of National Ignition Facility Waste to Annual Treatment Capaci at Nevada Test Site*

Category	Ratio of NIF Waste Generation to Annual Treatment Capacity	Treatment Capacity (m^3/yr)	Is Existing or Planned Treatment/Disposal Capacity Adequate
Low-Level			
Liquid			
Conceptual design total	NA	NA	Yes[a]
Enhanced total	NA		Yes[a]
Solid			
Conceptual design total	NA	NA	Yes[a]
Enhanced total	NA		Yes[a]
Mixed			
Liquid			
Conceptual design total	NA	NA	Yes[a]
Enhanced total	NA		
Solid			
Conceptual design total	NA	None	Yes[a]
Enhanced total	NA		
Hazardous			
Liquid			
Conceptual design total	NA	None	Yes[b]
Enhanced total	NA		
Solid			
Conceptual design total	NA	None	Yes[b,c]
Enhanced total	NA	None	Yes[b,c]

[a] Planned.
[b] Explosives waste only treatment capacity.
[c] Shipped offsite.
Note: NA - not applicable.
Source: Calculated from tables I.4.1.2.8–2 and I.4.3.1.8–1.

the present time. Experienced waste-handling and radiation safety personnel working at NTS would be employed for decommissioning.

A wide variety of decommissioning projects similar to those required for NIF are currently under way at NTS. All radiation-related work practices at NTS comply with the three primary requirements and guidance documents for radiation safety: 10 CFR 835, Radiation Control Manual, and DOE N 441.1. A fully implemented program has been established with complex guidelines and procedures, which forms a site-specific Radiation Safety and Control Manual. As low as reasonably achievable programs have been established and are implemented based on the above-noted program documents. All work would present the potential for exposure or cont ination would receive special consideration planning, including, but not limited to, dry-run p tices, condition monitoring experiments, personal protective equipment upgrade analy Decontamination systems designed specifically equipment in NIF would be established to optin efficiency and reduce the amount of waste resid from the decontamination process. A wide variet radiation safety and decontamination resources experience exist at NTS. These resources woul made available, as necessary, for the developn and implementation of NIF systems. Existing eq ment, such as anticontamination clothing

personal protective equipment, would be available for use at NIF. This type of reusable equipment would be decontaminated onsite at the laundering and cleaning facilities available at NTS. Residual materials from the decontamination process would be disposed of at NTS.

The following sections discuss specifics of decommissioning of NIF laser and associated components, followed by a discussion of decommissioning of equipment in the target area. The major activated/contaminated components would be located in the target area, so this facility would pose the most complex operation.

Decommissioning of National Ignition Facility Laser by Nevada Test Site. The decommissioning of the NIF laser would be handled similar to the manner described in section I.4.1.2.8 for LLNL. Mercury wastes from the ignitron switches would be sent to a permitted mercury recycling center, as is the current practice for other mercury wastes. The mixed waste from the capacitors would have to meet the requirements of NVO-325 before disposal on NTS at the Area 5 Radioactive Waste Management Site, as indicated in the discussion above on mixed wastes.

If the mixed waste from capacitors did not meet the physical requirements mandated under NVO-325, the waste might be treated to meet these requirements. If the characterization information on the capacitor mixed waste was deemed unacceptable, the characterization documentation must be redone and/or improved to meet the requirements. If the quality assurance on the capacitor mixed waste was inadequate, the management of the waste would have to be improved to meet the requirements. If the generators did not wish to achieve compliance with the requirements of NVO-325 they might wish to pursue other locations for disposal of the waste.

There should be no reason the mixed waste from the capacitors would not meet the waste acceptance criteria of NVO-325 as long as the waste was managed, treated and/or characterized properly, in compliance with the applicable requirements.

Decommissioning of National Ignition Facility Target Area. The decommissioning of the NIF target area would be handled similar to the manner described in section I.4.1.2.8 for LLNL. DOE/NV and associated contractors have experience dealing with tritium contamination in virtually all phases of operations. Routine carbon dioxide cleaning during operations of NIF would be the primary process for reducing the total amount of contamination on components at the end of life of NIF. NTS waste management operations have disposed of millions of curies of tritium during the history of Radioactive Waste Management Site operations, especially in Area 5. This disposal site, as well as operational sites throughout NTS, is equipped with tritium monitoring and detection systems. The Analytical Services Laboratory at NTS (in Area 23) can perform a variety of analyses for tritium and can carry out personnel decontamination.

Radioactive and mixed waste could be disposed of at NTS, assuming it could be managed and processed in accordance with NVO-325. Large structures that could not easily be containerized could be disposed of at the Area 3 Radioactive Waste Management Site, which is used for the disposal of bulk LLW containers.

NIF would be decommissioned according to standard engineering practices. The project would be handled in a manner similar to construction projects, per the requirements of DOE O 430.1. This planning would optimize all phases of decommissioning and provide the most efficient method for completing the work. Efficient work would lead to a reduction in time for exposure of workers, which would in turn reduce the overall exposure projections.

I.4.4 North Las Vegas Facility

I.4.4.1 *Affected Environment*

The following sections describe the affected environment associated with the construction and operation of NIF at the North Las Vegas Facility (NLVF). Land use, air quality and acoustics, water resources, biotic resources, cultural and paleontological resources, socioeconomics, radiation and hazardous chemicals, and waste management are described.

I.4.4.1.1 Location and Land Use

NLVF is located in the city of North Las Vegas, west of Losee Road, north of Carey Avenue, east of Commerce Street, and south of Brooks Avenue (figure I.3.4.4.1–2). The 32-ha (80-acre) NLVF is zoned general industrial and is bordered on the north, south, and east by general industrial zoning. The western border of the site is adjacent to Commerce Street, which separates the property from fully developed, single-family residential-zoned property. Figure I.4.4.1.1–1 shows the generalized land use in the vicinity of NLVF. NLVF is divided into three distinct areas: the A, B, and C complexes. The A complex covers 8 ha (20 acres) and housed support for the LLNL nuclear test program. The B complex covers 8 ha (20 acres) just south of A complex and housed support for the LANL nuclear test program. The C complex, located west of A and B complexes, covers 15.5 ha (38.3 acres) and housed a computer center and administrative and engineering support functions (DOE 1995h). The open space in C complex would be the primary location for NIF and for the temporary construction laydown area. Existing facilities in C complex and A complex would also be used (figure I.3.4.4.1–2).

The entire NLVF is built on cleared, previously disturbed land, and most of it is covered by buildings, pavement, concrete, or landscaping, except for the open space in C complex. That open space is void of most vegetation. The soils on NLVF range from relatively thick layers of cemented to noncemented soils, and from stiff to very stiff silty and sandy clay, and clay with interbedded medium-dense to dense clayey and silty sand.

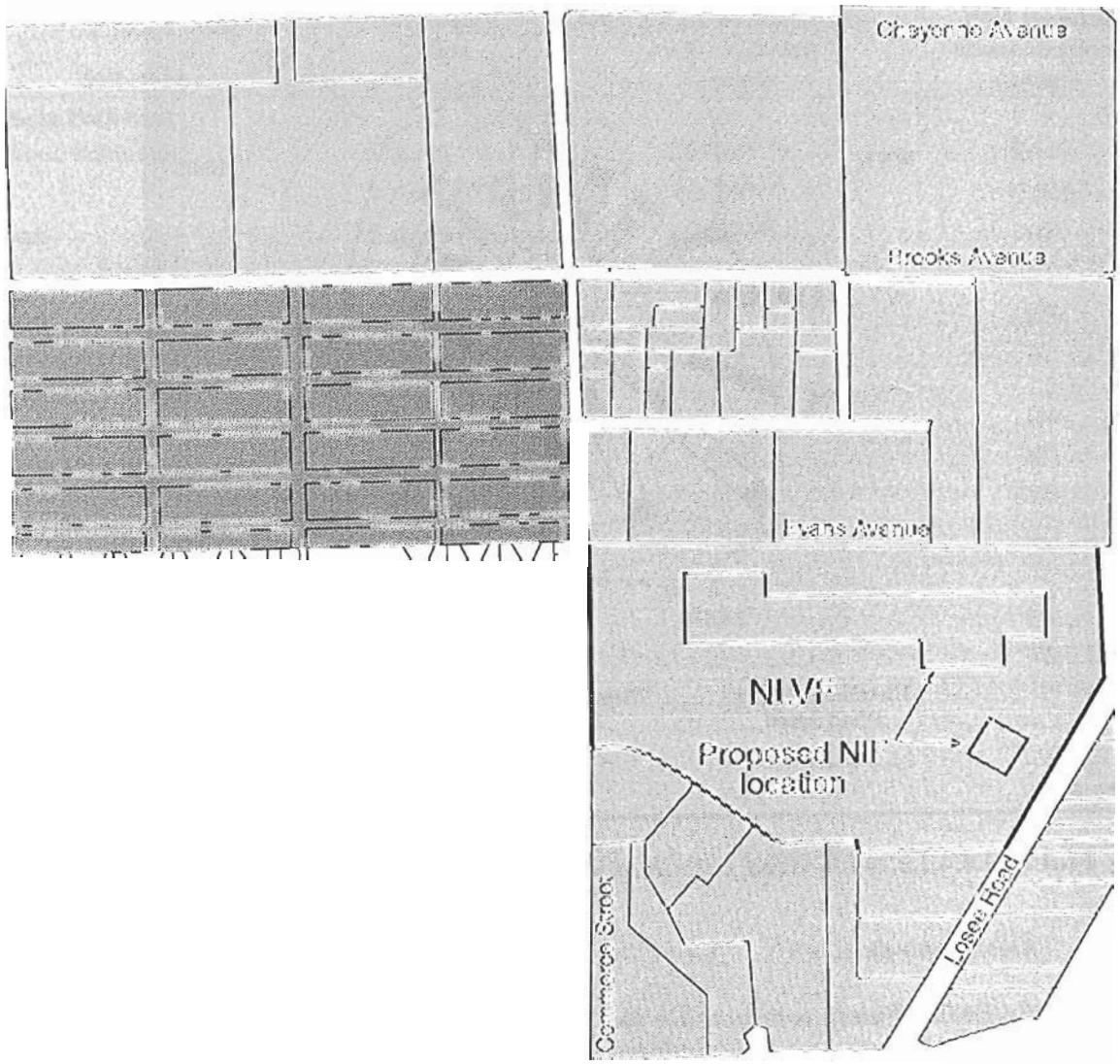
I.4.4.1.2 Air Quality and Acoustics

This discussion of existing air quality and acoustics includes a review of the meteorology, climatology, and ambient air quality characteristics near NLVF.

I.4.4.1.2.1 *Meteorology and Climatology*

The climate at NLVF and the surrounding region ha four well-defined seasons. Summers display dese conditions, with maximum temperatures usually nea 38 °C (100 °F). Winters are mild, with daytime tem peratures near 15.5 °C (60 °F). Rainy days averag less than one in June to three per month in the winte Severe thunderstorms occasionally occur in th summer. The spring and fall are generally considere the most ideal seasons, although sharp temperatu changes can occur during these months. The annu average temperature at NLVF is 19.1 °C (66.3 °F average daily temperatures range from 6.9 ° (44.5 °F) in January to 32.1 °C (89.8 °F) in July. Th average annual precipitation is 10.6 cm (4.19 in). Th prevailing winds are from the southwest at an annu average speed of 15.2 kph (9.3 mph) (Gale Researc 1992). The 5-year wind rose for NLVF (based c measurements at McCarran International Airport Las Vegas) is shown in figure I.4.4.1.2.1–1. Fro 1987 to 1991, unstable conditions occurred approx mately 28 percent of the time, neutral conditio about 37 percent of the time, and stable conditio the remaining 35 percent of the time (NOAA 1995 In general, atmospheric dispersion improves as t wind speed increases and as the atmospheric con tions become more unstable.

The limited precipitation and warm temperatur create an arid climate that limits the growth ground-covering vegetation. This condition results large areas of exposed soil that are potential sour of windborne particulate matter (dust). Ambient p ticulate matter concentrations are reduced if t exposed soil is wetted or if the airborne particul matter is "washed out" of the atmosphere by preci tation. However, the area's precipitation and temp ature seldom provide these beneficial mechanis This situation worsens the particulate matter ba ground concentration and increases the likelihood the area's PM_{10} and TSP ambient air concentrati approaching or exceeding regulatory standards.


Cheyenne Avenue
Brooks Avenue
Evans Avenue
NLVF
Proposed NIF location
Commerce Street
Lesser Road

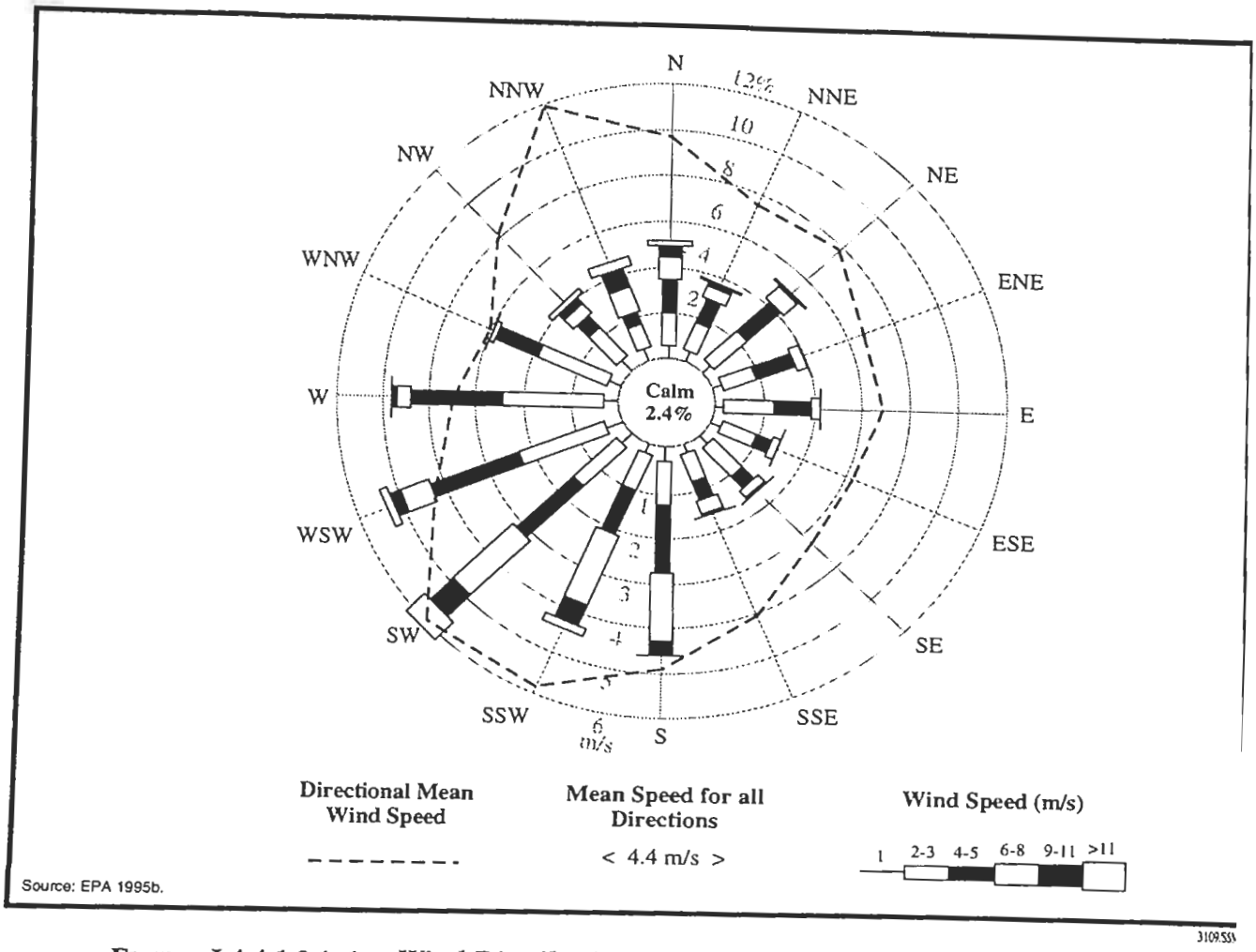


FIGURE I.4.4.1.2.1–1.—*Wind Distribution at North Las Vegas Facility, 1987-1991.*

I.4.4.1.2.2 *Ambient Air Quality*

The Clark County Health District is responsible for air pollution control and attainment of air quality standards in Clark County. In addition to NAAQS for criteria pollutants, NLVF is subject to ambient air quality standards adopted by the Clark County Health District. Applicable NAAQS and Clark County ambient air quality standards are presented in table I.4.4.1.2.2–1.

The NLVF site is in the Las Vegas Intrastate AQCR 13, which includes only Clark County. Portions of Clark County, including the NLVF site, are classified as nonattainment areas for the NAAQS for carbon monoxide, PM_{10}, and TSP (40 CFR 81.339). In general, pollutant emission increases in an area designated as nonattainment for a specific pollutant are subject to more stringent permitting requirements than if the area is desi nated as attainment.

The Clark County Health District operates a netwo of air monitoring stations in Clark County. Tl monitor closest to NLVF is at the McDaniel Pc Office at 1414 East Lake Mead Drive, approximat 1.9 km (1.2 mi) east of the proposed NIF locatic Data for this and other monitors near NLVF a provided in Lazaro et al. (1996). Table I.4.4.1.2.2 lists the 1994 baseline ambient air concentrations criteria pollutants and other pollutants at NLVF. of the baseline concentrations are in compliance w NAAQS. The emissions of criteria pollutants NLVF are discussed in section I.4.4.2.2.

The area surrounding NLVF contains two P Class I areas: Grand Canyon National Park, appr mately 110 km (65 mi) to the east in Arizona,

TABLE I.4.4.1.2.2–1.—*Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at North Las Vegas Facility*

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	1994 Baseline Concentration[a] ($\mu g/m^3$)
Criteria Pollutant			
Carbon monoxide	8 hours	10,000[b,c,d]	8,635
	1 hour	40,000[b,c,d]	13,456
Lead	Calendar quarter	1.5[b,c,d]	ND[e]
Nitrogen dioxide	Annual	100[c,d]	53
Ozone	1 hour	235[b,c,d]	192
Particulate matter 10 microns or smaller	Annual	50[b,c,d]	47
	24 hours	150[b,c,d]	114
Sulfur dioxide	Annual	60[c,d]	ND
	24 hours	260[c,d]	ND
	3 hours	1,300[b,c,d]	ND
Mandated by State			
Hydrogen sulfide	1 hour	112[c]	ND
Visibility	-	[f]	ND

[a] For short-term standards, baseline concentration is the highest concentration for the year.
[b] Federal standard (40 CFR 50).
[c] State standard.
[d] County standard.
[e] ND - No data available.
[f] In sufficient amount to reduce the prevailing visibility to less than 48 km (30 mi) when the humidity is less than 70 percent.
Source: DBHCC 1993; Lazaro et al. 1996; NAC 1995; Taipale 1995.

Joshua Tree National Monument, approximately 250 km (155 mi) to the south-southwest in California.

I.4.4.1.2.3 *Acoustic Conditions*

Major noise emission sources within NLVF include motor vehicles and various industrial facilities and equipment. The site is bordered by highways along the eastern and western NLVF boundaries. Near highways, traffic contributes to ambient noise levels, especially during peak hours. The adjacent main land uses in the vicinity of NLVF are light industrial to the north, east, and south, and urban residential to the west. The acoustic environment along the NLVF boundary is generally assumed to be that of an urban location, with typical average daytime sound noise levels of 55 to 65 dBA (EPA 1974).

I.4.4.1.3 Water Resources

NLVF is located in the Las Vegas Valley, which is a desert between sharp, rugged mountain ranges on a gently sloping alluvial fan piedmont. At the lowest point of the alluvial fan is the Las Vegas Wash, which drains an area of 2,280 km^2 (880 mi^2) toward Lake Mead. Stormwater from NLVF is discharged into local flood control systems (DOE 1995h).

The depth to groundwater at NLVF varies seasonally from 5 to 45 m (17 to 150 ft). Groundwater is the source of water supply for the city of North Las Vegas, which in turn provides water to NLVF. The nearest water well to NLVF is about 0.40 km (0.25 mi) south (DOE 1995h). Current water usage by NLVF is about 69.4 MLY (18.3 MGY) (Lazaroff 1995a). Industrial wastewater and sanitary sewage from NLVF are discharged into the city of North Las Vegas sewer system, which is connected to the city of

of NLVF employees by place of residence in the ROI is presented in Lazaro et al. (1996).

I.4.4.1.6.2 *Population and Housing*

The ROI experienced significant population growth between 1980 and 1990, with an average annual increase of about 4.5 percent, bringing the 1990 total to approximately 683,000 persons. Population growth has been strongest in Clark County. By the year 2000, population in the ROI is projected to grow to approximately 860,000 persons (BEA 1990; U.S. Department of Commerce 1994).

Between 1980 and 1990, the number of housing units in the ROI increased from 194,899 to 325,261, an increase of 67 percent (see table I.4.4.1.6.2–1). Housing in Clark County increased from approximately 190,607 units in 1980 to 317,188 in 1990. Housing in Nye County increased from 4,292 units in 1980 to approximately 8,073 in 1990. Assuming a continuation of current construction and economic trends, the number of housing units in the ROI is projected to increase to approximately 455,000 by the year 2000.

The number of vacant owner units in the ROI has increased from approximately 11,000 units in 1980 to 17,000 in 1990. It is estimated that in the year 2000 there will be approximately 25,000 vacant owner units if current construction and economic trends continue in the ROI.

In 1980 there were approximately 7,000 vacant rental units in the ROI. The number of vacant rental units increased to about 15,000 in 1990. It is estimated that in the year 2000 there will be approximately 22,000 vacant rental units if current construction and economic trends continue in the ROI.

Between 1993 and 1994, the Las Vegas Metropolitan Statistical Area experienced a sharp increase of about 30 percent in new single-family housing units. Multi-family housing construction increased by 44 percent between 1993 and 1994. The number of new housing units sold increased as well, rising 11 percent over 1993 levels. In spite of the growing supply of houses in the Las Vegas market, new housing prices continue to climb (ULI 1995).

I.4.4.1.6.3 *Public Finance and Public Services Infrastructure*

Public financial characteristics of the local jurisdictions in the ROI that are most likely to be affected by construction and operation of NIF at NLVF are summarized in this section. The data reflect total revenues and expenditures of each jurisdiction's general fund, special revenue funds, and, as applicable, debt service, capital project, and expenditure trust funds. Major revenue and expenditure categories and revenues less expenditures for counties and cities are presented in table I.4.4.1.6.3–1. Table I.4.4.1.6.3–2 summarizes public service levels for community services, health care, and education.

I.4.4.1.6.4 *Local Transportation*

The existing roadway network in the vicinity of NLVF includes Losee Road, Carey Avenue, Cheyenne Avenue, Interstate 15, Commerce Street, Brooks Avenue, and Lake Mead Boulevard. Direct access to NLVF is via Brooks Avenue, Carey Avenue, Commerce Street, Losee Road, and North 5th Street (Omni-Means 1990).

Losee Road is generally a north-south oriented roadway adjacent to the eastern boundary of NLVF. It currently begins at a signalized intersection with Lake

TABLE I.4.4.1.6.2–1.—*Population and Housing Data for the North Las Vegas Facility Area*

Category	1980	1990	1996	1997	1998	1999	2000	2001	2002	2003
Estimated ROI population	472,135	683,040	798,044	812,625	827,527	842,675	858,100	870,949	883,990	897,227
Estimated total housing units	194,899	325,261	403,478	416,514	429,551	442,587	455,623	468,659	481,695	494,732
Estimated vacant owner units	10,806	16,954	21,319	22,047	22,774	23,502	24,229	24,957	25,684	26,412
Estimated vacant renter units	7,319	15,022	18,968	19,625	20,283	25,940	21,598	22,255	22,913	23,571
Estimated total vacant units in ROI	18,125	31,976	40,287	41,672	43,057	44,442	45,827	47,212	48,597	49,982

Source: Historical data from the U.S. Department of Commerce 1994; projections by Halliburton-NUS 1995.

TABLE I.4.4.1.6.3–1.—*Public Finance—North Las Vegas Facility Area*

Revenues and Expenditures[a]	Clark County	City of Henderson	City of Las Vegas	City of North Las Vegas	Nye County
Local sources (percent)	63	39	46	44	53
State sources (percent)	37	61	54	56	47
Federal sources (percent)	0	0	0	0	0
Total revenues (dollars)	295,686,362	44,838,156	165,281,174	33,422,607	12,348,383
General government (percent)	22	25	19	15	37
Public safety, health, and community services (percent)	66	75	80	85	63
Debt service (percent)	0	0	0	0	0
Other (percent)	11	0	0	0	0
Total expenditures (dollars)	241,422,802	42,164,384	155,307,893	33,027,839	12,511,908
End-of-year fund balance (dollars)	77,826,604	1,140,575	13,712,536	3,656,142	1,374,364

[a] If reporting body did not distinguish between state and Federal revenue sources, the total for all intergovernmental revenue was combined and reported under "state sources."

Source: City of Henderson 1995; Nye County 1994; city of North Las Vegas 1994; city of Las Vegas 1994.

TABLE I.4.4.1.6.3–2.—*Public Services—North Las Vegas Facility Area*

Part I: Education

County/School District	Enrollment	Pupil-Teacher Ratio	Per Pupil Expenditure ($)
Clark County School District	145,327	16.6:1[a]	3,478[b]
Nye County School District	4,467	NA	3,662

[a] Pupil-teacher ratio for Clark County includes administrative personnel.

[b] Expenditure per pupil for Clark County is based on total expenditures.

Note: NA - not available.

Part II: Level of Service per 1,000 Population

County/Jurisdiction	Police Protection	Fire Protection	General Government	Physicians
Clark County	1.2	0.5	5.1	1.4
City of Henderson	0.8	0.8	6.4	NA
City of Las Vegas	4.5	1.2	7.0	NA
City of North Las Vegas	2.4	0.8	9.2	NA
Nye County	5.3	NA[a]	19.1	0.4

[a] Fire protection services are provided by cities in the county, and departments are predominantly volunteer.

Note: NA - not applicable.

Source: Clark County School District 1994; city of North Las Vegas 1994; city of Las Vegas 1994; Clark County 1994; Federal Bureau of Investigation 1993; American Medical Association 1994; city of Henderson Fire Department 1995; city of Henderson Personnel Department 1995; city of Las Vegas Human Resources Department 1995; Nye County School District 1995; Nye County Sheriff's Department 1995; Nye County Personnel Department 1995; city of Tonapah Fire Department 1995; Clark County Personnel Department 1995.

I.4.4.1.7 Radiation and Hazardous Chemicals

I.4.4.1.7.1 *Radiation Environment*

NLVF provides calibration services using specialized radiation fields for a variety of instrument test packages in support of DOE Nevada Operations. A detailed discussion of the radiation environment, including background, radiological releases, and doses to members of the public, is presented in *U.S. Department of Energy Nevada Operations Office Annual Site Environment Report–1993, Volume 1* (1994). The concentrations of radioactivity in various environmental media (air, water, soil) in the site region are also presented in this reference.

Calculated radiological doses were used to estimate the potential health impacts to the public and onsite workers at NLVF from any releases of radioactivity. The annual doses to the workers are summarized in table I.4.4.1.7.1–1; corresponding health risks are also presented in the table (also see Lazaro et al. 1996). These doses are in addition to those from natural background, consumer products, and medical sources, which total about 360 mrem/yr. The onsite worker doses are within regulatory limits. Background radiation doses are unrelated to NLVF operations. Regulatory limits that specify the maximum effective dose equivalent to individual members of the public and occupational workers are also presented in table I.4.4.1.7.1–1.

I.4.4.1.7.2 *Hazardous Chemical Environment*

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through contact or via the food pathway). Exposure pathways to NLVF workers during normal operation may include inhaling the workplace atmosphere, drinking NLVF potable water, and possible other contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. NLVF workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded. The maximum daily quantities of NIF-related hazardous materials stored at NLVF are presented in table I.4.4.1.7.2–1. NLVF stores and uses few hazardous materials in amounts greater th the threshold planning quantities that requi reporting under the Federal regulations at 40 CI 370–Hazardous Chemical Reporting: Communi Right-to-Know (DOE 1995h).

TABLE I.4.4.1.7.2–1.—*Maximum Daily Quantities of National Ignition Facility-Related Hazardous Materials Stored at North Las Vegas Facility*

Hazardous Material	Quantity
Acetone	37.8 L
Alumina	2,063 kg
Ammonia	275 kg
Ammonium hydroxide	37.84 L
Boron	20 kg
Copper	<4.5 kg
Ethanol	1,514 L
Hydrofluoric acid	208 L
Lead	<5.6 kg
Mercury	6,333 kg
Methylene chloride	18.9 L
Stainless steel	<1.1 kg
Tetraethylorthosilicate	378.4 L

Source: Lazaroff 1995b.

I.4.4.1.8 Waste Management

The current waste management practices at NL are outlined in table I.4.4.1.8–1. Wastes managed NLVF from research activities include hazardous a nonhazardous wastes. The NIF project is expecte generate low-level, mixed, hazardous, and nonh ardous wastes during operation.

TABLE I.4.4.1.7.1–1.—*Annual Radiation Doses to the General Public and Onsite Workers from Normal Operations at North Las Vegas Facility*

	Atmospheric Releases		Liquid Releases		Total		
Receptor	Regulatory Limit[a]	Calculated	Regulatory Limit[a]	Calculated[b]	Regulatory Limit[a]	Calculated	Risk[c]
Individual Dose							
Average exposed individual (mrem)	10	0.0[d]	4	0.0	100	0.0	0.0
Maximally exposed individual (mrem)	10	0.0[d]	4	0.0	100	0.0	0.0
Population Dose							
Population within 80 km (person-rem)	[e]	0.0[d]	[e]	0.0	[e]	0.0	0.0
Worker Dose[f]							
Average worker (mrem)	NA	NA	NA	NA	5,000	82	3.3×10^{-5}
Maximally exposed worker (mrem)	NA	NA	NA	NA	5,000	440	1.8×10^{-4}
Total workers (person-rem)[g]	NA	NA	NA	NA	None	0.57	2.3×10^{-4}

[a] The regulatory limits for individuals are given in DOE Order 5400.5. The 10 mrem/yr limit from airborne emissions is required by the *Clean Air Act*; the 4 mrem/yr limit is required by the *Safe Drinking Water Act*, and the total dose of 100 mrem/yr is the limit from all pathways combined. The occupational limit for workers is 5,000 mrem (10 CFR 835)

[b] The calculated dose values given in the column under Liquid Releases conservatively includes all water pathways, not just the drinking water pathway.

[c] Based on latent fatal cancer risk factors of 5×10^{-7}/mrem for individuals, 5×10^{-4} /person-rem for population, and 4×10^{-7}/mrem for workers (ICRP 1991).

[d] Two very small atmospheric releases occurred on July 12 and August 14, 1995. The dose to any offsite individual is expected to be a fraction of a mrem (monitoring data is not yet available from all stations).

[e] No regulatory limits exist for population doses; however, a 100 person-rem value for the population is found in the proposed 10 CFR 834 (58 FR 16268).

[f] Worker doses were estimated on the basis of readings from monitoring devices called thermoluminescent dosimeters.

[g] The number of badged workers in 1994 was approximately seven.

Note: NA - not applicable.

Source: White 1995g.

I.4.4.1.8.1 *Hazardous Waste*

NLVF generated about 17,920 kg (39,500 lb) of hazardous wastes in 1992. All hazardous wastes are treated, stored, or disposed of offsite at EPA-permitted facilities. Spills or releases of hazardous materials have historically been minor and were promptly cleaned up upon discovery.

A Waste Minimization and Pollution Prevention Awareness Implementation Plan submitted to DOE/NV on December 20, 1991, is in place for NLVF. A formalized system of waste minimization was developed through the implementation of EG&G/EM Policy No. 31-70, *Waste Minimization and Pollution Prevention;* and Standard Operating Procedure 31-006.A, *Hazardous Waste Minimization Plan*. Hazardous waste generation from various processes has already been reduced through product substitution or by permanently discontinuing the hazardous waste generating process.

There are no underground storage tanks for hazardous or petroleum substances at NLVF. All aboveground tanks are protected against accidental releases by use of either secondary containment or a double-walled tank with continuous leak detection. There are no hazardous waste treatment, storage, or disposal facilities requiring state or Federal permits at NLVF (DOE 1995h).

spraying or use of a chemical dust suppressant would reduce dust emissions from excavation by 75 percent and from traffic on unpaved roads by 90 percent. These measures would bring maximum 24-hour average concentrations down to 69 $\mu g/m^3$ over background concentration. A maximum concentration of 183 $\mu g/m^3$, including background concentration, would still be higher than the national and state standards for PM_{10}. Thus, other approaches (such as reduction of activity or use of intensified dust control measures) should be implemented to comply with the national and state standards for PM_{10}. For example, by reducing the workload by half (which would increase the site-clearing period to one month), the maximum PM_{10} concentration over background is predicted to be 35 $\mu g/m^3$. Including background concentration, the cumulative concentration would be 149 $\mu g/m^3$, which would comply with the NAAQS for PM_{10}. Site clearing at NLVF would be expected to last for less than one month; so air quality impacts associated with site clearing would be local and temporary, assuming that proper mitigation measures were employed.

TABLE I.4.4.2.2.1–1.—*Estimated National Ignition Facility Construction Emissions for the North Las Vegas Facility Location*

Pollutant	Total Emissions (t/yr)[a]
Particulate matter 10 microns or smaller	6.89[b]
Volatile organic compound	0.44
Carbon monoxide	1.23
Nitrogen dioxide	3.76
Sulfur dioxide	0.43
Lead	Negligible

[a] Metric tons (1,000 kg) per year.

[b] Includes 1.91 t/yr (2.11 ton/yr) of fugitive emissions for site clearing using water-spray control that would occur during an approximate 13-day period in the first year and 4.63 t/yr (5.10 ton/yr) of facility construction emissions that would occur for the remainder of the first year of construction.

Source: Lazaro et al. 1996.

Emissions During Operations. Sources of air pollutant emissions from operation of NIF at NLVF are expected to be primarily fuel combustion and cleaning of the debris shields. Emissions of VOCs (ethanol) from debris shield cleaning are estimated to total about 0.5 t/yr (0.55 ton/yr) (LLNL 1995b). Other potential air pollutant emission sources not considered significant are target destruction under either the direct drive or indirect drive options, emissions from vehicles used for freight shipments and employee commuting, and emissions from welding operations at the Fabrication Facility.

As indicated in table I.4.4.2.2.1–2, air pollutant emissions due to NIF operation are projected to be well below 1 t/yr (1.1 ton/yr) except for nitrogen dioxide, which is projected at approximately 2 t/yr (2.2 ton/yr). Estimated air pollutant emissions from NIF operations would constitute significant increases over 1990 emission levels, ranging from an increase of 27 percent for PM_{10} to 241 percent for carbon monoxide. However, existing ambient concentrations for these pollutants (see section I.4.4.1.2.2, table I.4.4.1.2.2–1) are well below the ambient air quality standards, and it can be concluded that NIF operation would have no adverse impact on air quality and would not contribute to a violation of the ambient air quality standards.

Table I.4.4.2.2.1–2 includes the estimated NLVF annual air pollutant emissions based on the anticipated NIF annual energy requirements provided in table I.4.1.2.2.1–3, adjusted to recognize that a NLVF, only four new support buildings (total area of 13,006 m^2 [140,000 ft^2]) would be required out of the total complement of support buildings (area of 26,722 m^2 [287,643 ft^2]).

Published emission factors (EPA 1995b) were used in the calculations. Emissions of VOCs resulting from shield cleaning with solvents are included. For comparative purposes, table I.4.4.2.2.1–2 also includes NLVF 1990 sitewide emissions. More detailed information on emission estimates is provided in Lazaro et al. (1996).

NLVF must comply with the Clark County Air Pollution Control regulations (APCR) (DBHC 1995). Abatement of visible fugitive dust emissions would be required for construction activities at NLVF. Construction activities specifically addressed include general site; haul roads; and material handling, storage, and transport (APCR, section 41).

External combustion units (boilers) would have to comply with BACT for carbon monoxide and nitrogen oxide for nonmajor sources (APCR, se

TABLE I.4.4.2.2.1–2.— *Annual Emission Increases with National Ignition Facility Operation at North Las Vegas Facility*

Pollutant	1990 Emissions (t/yr)	Projected NIF Emissions[a] (t/yr)	1990 Emissions Plus NIF (t/yr)	NIF Percent of 1990 Emissions
Particulate matter	0.78	0.21	0.99	27
Volatile organic compound	3.45	0.57	4.02	17
Carbon monoxide	0.23	0.56	0.79	241
Nitrogen oxide	1.07	2.28	3.35	213
Sulfur dioxide	0.07	0.04	0.11	50
Lead	Negligible	Negligible	Negligible	Negligible

[a] Emissions based on site-estimated natural gas external combustion, diesel internal combustion, and VOC solvent cleaning (0.5 t/yr [0.55 ton/yr]) and emission factors (EPA 1995c; Lazaro et al. 1996).

Source: DOE 1995h; EPA 1993.

tions 12.2.10.1, 12.2.11.1). In addition, emission offset credits might be required at more than twice the potential to emit for these boiler emissions (APCR, section 12.2.11.4). Gas-fired boilers with rated heat input greater than 105,600 MJ/hr (100 million Btu/hr) but not over 264,000 MJ/hr (250 million Btu/hr) are limited to NSPS nitrogen oxide emissions from 43 to 86 ng/J, depending on the heat release rate, which is a function of the furnace volume (40 CFR 60.44b). There are no NSPS emission limits for gas-fired boilers with a rated heat input at or less than 105,600 MJ/hr (40 CFR 60.40c).

Emissions of VOCs at the stated annual rate of 0.5 t/yr (0.55 ton/yr) might require additional controls, depending on the type of solvent used (APCR, section 60.1.1). Additional regulatory information is presented in section I.5.2.

I.4.4.2.2.2 *Acoustics*

During the clearing phase of NIF construction at NLVF, equipment noise would cause an increase of 8 dB in the average outdoor sound level at the nearest residence, which is in a neighborhood on the western side of Commerce Avenue, west of the site. Because of traffic noise from the street that runs along the east side of this residential area, the average daytime sound level is already high, thus reducing the effect of the added noise.

The point modeled was 210 m (690 ft) west of the facility. The results show that the average sound level at this point is expected to increase from 66 dBA to 74 dBA during hours that the clearing equipment is operating. The CNR rank, adjusted for the estimated preexisting background level, is expected to be "A." (Noise with CNR ranks "A" through "D" is generally considered to be acceptable, with "A" essentially leading to no impacts.) At the level of "D," the Modified CNR method predicts sporadic complaints from the public. The likelihood of such complaints can be lessened if the public is notified in advance that the noise will occur only over a period of approximately a month and only during daylight hours.

Because the residential area is so close to the construction area, the average daytime sound level would vary with changes in the locations of the various pieces of construction equipment as they moved about in the course of site clearing.

To illustrate the effect of equipment movement, a second point, also at the edge of the residential area, was modeled. This second point was 134 m (440 ft) south of the first residential point and immediately across Commerce Avenue from the construction site. The results showed that the average outdoor daytime sound level is expected to increase 17 dB, from 66 dBA to 83 dBA, for the same deployment of equipment. The adjusted CNR rank for this level is "C," which is not expected to elicit more than sporadic complaints.

expected that tortoises would exist at the proposed location for NIF. That location is within a fenced area and does not contain adequate cover habitat required for tortoises. Therefore, no impacts to desert tortoises would be expected at NLVF. Impacts to other listed species would not be expected because NLVF does not contain suitable habitat for listed species whose ranges encompass the facility.

I.4.4.2.5 Cultural and Paleontological Resources

Construction and operation of the proposed NIF would have no effect on archaeological sites or historic structures that are listed on or eligible for NRHP, important paleontological remains, or Native American cultural resources.

I.4.4.2.6 Socioeconomics

Construction and operation of NIF at NLVF would have a minor impact on socioeconomic conditions in the economic study region and in the ROI described in section I.4.4.1.6, because NLVF would be located in a somewhat diverse regional economy with extensive inter- and intraregional, national, and global economic interactions and linkages. None of the average annual increases in any of the socioeconomic variables would constitute a major difference from the region-specific base line average annual increases. Also, because the NIF partnership includes representatives from government, industry, and the academic sector throughout the United States, NIF-related procurement and investment would be dispersed over a number of different regions, dampening the concentration of economic effects of the program.

The following sections describe the effects on the host region's economy and employment, and on population, housing, public finances, public services infrastructure, and local transportation in the ROI.

I.4.4.2.6.1 *Regional Economic Impacts*

Slight changes in employment and economic activity levels in the economic study region would occur from local spending of employee wages, procurement of goods and services (including construction materials), and other local investment associated with constructing and operating NIF. In addition to creating new jobs (direct) at the site, the project would create indirect job opportunities, such as community support services, in the economic study area. The total new jobs created (direct and indirect) would contribute to unemployment reduction and increased income and economic output in the regional economy during construction and operation of NIF. Table I.4.4.2.6.1–1 presents the potential impacts to the regional economy if NIF were located at NLVF.

Constructing NIF at NLVF would result in a peak of approximately 280 direct jobs in 1998. This construction-related procurement would indirectly create nearly 1,360 jobs in the economic study region. Employment for operation would begin phasing in as construction neared completion. Direct employment related to operations is projected at 330, with more than 290 indirect jobs created throughout the economic study region. As a result of constructing and operating NIF, the baseline compounded annual growth rate from 1995 to 2003 would increase by 0.01 percentage points.

Peak earnings associated with the 280 direct jobs created in 1998 are projected at approximately 16.7 million dollars. Construction-related procurement would indirectly create more than 27 million dollars in regional earnings.

I.4.4.2.6.2 *Population and Housing*

Construction. Population in-migration resulting from NIF construction phase demands would peak in 1998, with a projected cumulative total of 2,340 people moving into the ROI (table I.4.4.2.6.1–1). This population increase would result in demand for an additional 850 housing units in the ROI. Baseline projections of the NLVF ROI housing market from 1996 (NIF construction start date) through 1998 indicate that nearly 43,000 housing units would be available. It has been estimated that more than 50,000 vacant housing units would be available in the ROI in 1998 and 1999. The NIF-related demand for approximately 850 housing units in the ROI would absorb approximately 2 percent of the available housing stock in the ROI. The NIF project would generate little demand for new housing construction because of the number of vacant housing units within the ROI and the proximity of NLVF to Las Vegas. Most of the housing demand would be temporary and would primarily affect the renter segment of the ROI housing market.

TABLE I.4.4.2.6.1–1.—*Potential Socioeconomic Impacts in the North Las Vegas Facility Area*

Parameters	NIF Alternative Change Over Reference Baseline		Reference Baseline	
	Peak Construction 1998[a]	Operations 2003[b]	1996 to 2002[a]	2003[b]
Regional Employment				
Direct jobs	280	330		
Indirect jobs	1,360	290		
Total jobs	1,640	620	14,600 jobs projected annually	12,900 additional jobs
Regional Aggregate Earnings[c]				
Direct earnings	16.19	13.81		
Indirect earnings	27.22	6.29		
Total earnings	43.41	20.10		
Regional Population Migration				
ROI in-migrating population	2,340	440		13,300 additional people
Regional Housing Demand				
Number of housing units in the ROI	850	160	44,000 vacant housing units (annual average)	50,000 vacant housing units
Local Transportation				
Number of trips generated at site per day	538	630		
Public Finance	0.21	0.04	NA[d]	NA
Percent change over 1995 fund balance (Clark County)				
Public Services (LOS)				
Change in service demand				
Police[e]	9	1	1,436[d]	7,839
Fire[e]	2	0	379[d]	909
General[e]	15	2	2,240[d]	2,349
Physicians[f]	3	1	1,455[d]	2,096
Teachers[f]	18	3	9,530[d]	13,725

[a] Construction period would be 1996 to 2002, with peak construction projected to occur in 1998.
[b] Operating period would be 2003 to 2033, with impacts throughout the period projected to remain stable.
[c] Regional earnings are millions of constant 1994 dollars.
[d] Projected 1998 fund balance for Public Finance, and projected 1998 level of service (LOS) for Public Services.
[e] Las Vegas.
[f] Clark County.
Source: Model results.

Operations. Population in-migration resulting from NIF operation phase demands could result in an additional 440 people moving into the ROI. While this demand for housing would be longer term relative to construction, no perceptible strain on the market is expected, assuming that the general conditions associated with the housing market continue.

I.4.4.2.6.3 *Public Finance*

Construction. Given the anticipated population and economic growth associated with NIF during the construction phase, fiscal balances (revenues and expenditures) are expected to increase for all jurisdictions within the ROI. Short-term public finance impacts would peak during 1998 and would then decline as construction neared completion in 2002. Since the largest percentage socioeconomic impacts are expected to occur in Clark County (assuming current residential patterns), the county would experience the greatest fiscal impacts in the ROI (table I.4.4.2.6.1–1).

Operations. The increase in population and economic growth as a result of NIF operations would increase both revenues and expenditures for all counties within the ROI, with the greatest impact in Clark County. Fiscal impacts would remain stable from the initial impact in 2003 through the duration of NIF operations.

I.4.4.2.6.4 *Public Services*

By the year 1998, Clark County would need to hire nine additional police officers, and Nye County would need 18 additional teachers and 3 additional doctors to maintain its current level of service. By 2003, when operations would start, Nye County would need only 3 additional teachers and 1 additional doctor over the baseline conditions to maintain the current level of service.

I.4.4.2.6.5 *Local Transportation*

In 1995, NLVF employed approximately 1,000 persons. Direct employment generated by the NIF project at NLVF for the life cycle of the project (1996-2033) would range from a minimum of 21 new jobs in 1996 to a maximum of 280 new jobs in 1998. Peak direct employment would total approximately 280 workers in 1998. These direct jobs would generate additional trips on NLVF access roads (table I.4.4.2.6.5–1); however, these additional trips should not significantly increase congestion to the NLVF transportation network (table I.4.4.2.6.5–1).

A peak of nearly 1,360 indirect jobs in 1999 could be generated within the ROI if NIF were located at NLVF. It is likely that the major share of these jobs would be located within Clark County. The road network associated with Clark County and the city of Las Vegas is well developed and expanding, and it would be capable of handling the additional trips generated from the operation of NIF. Because the indirect jobs would be dispersed across Clark County, adverse impacts to the regional transportation network are unlikely.

I.4.4.2.6.6 *Environmental Justice*

For the population in the region within 80 km (50 mi) of NLVF, minorities are in a higher proportion and low-income populations are in an equal proportion to other populations relative to Nevada as a whole (section I.4.4.1.6.5). Thus, minorities—but not low-income populations—could experience disproportionate regional socioeconomic impacts, which would be beneficial. The regional health impact of radiological doses to the population over the lifetime of NIF might result in one cancer fatality. This impact would occur to the population within the region, which is disproportionately minority. Thus, an environmental justice issue exists with the construction and operation of NIF at this site.

Minorities, but not low-income persons, are clustered disproportionately in the local vicinity of the NLVF site (section I.4.4.1.6.5). Thus, the local area impacts from the construction and operation of NIF could disproportionately affect minorities but not low-income populations. None of these local area environmental or health impacts have been judged to be highly adverse or significant.

I.4.4.2.7 Radiation and Hazardous Chemicals

This section describes potential radiological and hazardous chemical impacts resulting from normal operations and postulated accidents at NIF at NLVF. Methods, data, and assumptions used in estimating impacts are presented in Lazaro et al. (1996).

TABLE I.4.4.2.6.5–1.—*Future Traffic Impacts from National Ignition Facility Project on North Las Vegas Facility Access Roads*

Route	From	To	Estimated 1995 AADT	Estimated Background and Peak Project Year AADT (1998)	Estimated Percent Change in AADT Between 1995 and Peak Construction Year (%)	Estimated 1995 LOS	Estimated Background and Peak Construction Year LOS (1998)
Carey Ave	300 ft east of M.L. King Blvd	NA	7,730	8,290	7	A	A
Carey Ave	300 ft east of M.L. King Blvd	NA	8,400	9,000	7	A	A
Lake Mead Blvd	East of Interstate 15	NA	38,000	41,600	9	C	C
Cheyenne Ave	0.5 mi west of M.L. King Blvd	NA	19,000	20,150	6	A	A
Cheyenne Ave	200 ft east of Rancho Rd	NA	20,000	21,500	8	A	A
Losee Ave	50 ft south of Miller Rd	NA	12,000	12,950	8	D	D
Losee Ave	Between the two Crestline Loop Roads	NA	10,000	10,500	5	D	D
Losee Ave	200 ft south of Sharp Circle	NA	10,500	11,300	8	E	E

Note: AADT - annual average daily trips; LOS - level of service; NA - not applicable.
Source: Nevada Department of Transportation 1993.

I.4.4.2.7.1 *Normal Operations*

The general public around NLVF and workers at NLVF might be exposed to small quantities of radionuclides released and radiation emitted from routine NIF operations; however, the expected level of radioactive releases and radiation emissions is well within regulatory limits. No impacts from hazardous chemicals should occur because only minute quantities of hazardous VOCs are expected to be emitted during routine NIF operations. Impacts from routine transportation of tritium targets are also not expected because there would be no detectable levels of radiation outside the packages carrying the low-energy, beta-emitting tritium targets. Table I.4.4.2.7.1–1 summarizes the potential impacts of radiation exposures from the Conceptual Design Option and the Enhanced Option for NIF operations at NLVF.

Impacts to the Public. For the Enhanced Option, the radiation dose to a maximally exposed member of the public located about 210 m (689 ft) west of NIF is estimated to be 0.6 mrem/yr, which is much less than the dose limit of 100 mrem/yr resulting from all pathways combined (DOE 1990). The likelihood of the maximally exposed individual contracting a fatal cancer is 1 in 130,000 for the entire operational life of NIF (dose/yr x 30 yr x fatal cancer risk factor of $5x10^{-4}$/rem). The radiation dose to the surrounding public is estimated at 0.6 person-rem/yr; no cancer fatalities would be expected to occur in the public for the entire NIF operations at NLVF. For the Conceptual Design Option, it is estimated that radiation impacts would be one-third the impacts of the Enhanced Option. No adverse health effects would result.

Impacts to Workers. In addition to the potential for their exposure to radionuclides, the general NLVF workers outside NIF could be exposed to direct radiation resulting from high-yield experiments at NIF. For the Enhanced Option, the estimated radiation dose to these non-NIF workers at NLVF is 0.07 person-rem/yr. No cancer fatalities would be expected to occur among workers for the entire NIF operations at NLVF. For the Conceptual Design Option, estimated radiation impacts are about one-third of those of the Enhanced Option, and the risk of adverse health effects would be extremely low.

TABLE I.4.4.2.7.1–1.—*Potential Radiological Impacts from Normal Operations of the National Ignition Facility at North Las Vegas Facility*

Receptor	Conceptual Design Option	Enhanced Option
Maximally Exposed Individual		
Dose (mrem/yr)	0.2	0.6
Percent of natural background	0.06	0.2
30-year fatal cancer probability	$2x10^{-6}$	$8x10^{-6}$
Population Within 80 Km		
Dose (person-rem/yr)	0.2	0.6
Percent of natural background	$7x10^{-5}$	$2x10^{-4}$
30-year fatal cancers	0	0
Workers Onsite		
Dose (person-rem/yr)		
Non-NIF workers	0.02	0.07
NIF workers	10	10
30-year fatal cancers	0	0

Source: Model results.

Potential radiation exposures inside NIF would be kept as low as reasonably achievable through facility design and administrative controls. The design objective of NIF is to keep the individual radiation worker dose to less than 500 mrem/yr. It is estimated that on average, a NIF worker would receive approximately 30 mrem/yr. No adverse health effects are anticipated to workers inside NIF at this exposure level.

I.4.4.2.7.2 *Postulated Accidents*

Radionuclides and hazardous chemicals could be released from accidents at NIF and during the transportation of tritium targets. Tables I.4.4.2.7.2–1 and I.4.4.2.7.2–2 summarize potential impacts to the public and workers from postulated facility and transportation accidents. A description of each accident scenario evaluated is provided in Lazaro et al. (1996).

TABLE I.4.4.2.7.2–2.—*Potential Radiological Risks and Consequences of Transporting Tritium Targets from Manufacturing Facilities to North Las Vegas Facility*

Manufacturing Facility	Conceptual Design Option	Enhanced Option
General Atomics		
Dose risk (person-rem/yr)	1.2×10^{-6}	9.4×10^{-6}
Fatality risk (cancer fatalities/yr)	6×10^{-10}	5×10^{-9}
Nonradiological accidents[a] (fatalities/yr)	8×10^{-4}	2×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	8×10^{-4}	2×10^{-3}
Lawrence Livermore National Laboratory		
Dose risk (person-rem/yr)	1.2×10^{-6}	9.3×10^{-6}
Fatality risk (cancer fatalities/yr)	6×10^{-10}	5×10^{-9}
Nonradiological accidents[a] (fatalities/yr)	9×10^{-4}	2×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	4×10^{-4}	1×10^{-3}
Los Alamos		
Dose risk (person-rem/yr)	2.4×10^{-6}	1.9×10^{-5}
Fatality risk (cancer fatalities/yr)	1×10^{-9}	9×10^{-9}
Nonradiological accidents[a] (fatalities/yr)	2×10^{-3}	5×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	2×10^{-4}	5×10^{-4}
Savannah River		
Dose risk (person-rem/yr)	2.0×10^{-6}	1.6×10^{-5}
Fatality risk (cancer fatalities/yr)	1×10^{-9}	8×10^{-9}
Nonradiological accidents[a] (fatalities/yr)	8×10^{-4}	2×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	2×10^{-4}	5×10^{-4}
University of Rochester		
Dose risk (person-rem/yr)	2.1×10^{-6}	1.6×10^{-5}
Fatality risk (cancer fatalities/yr)	1×10^{-9}	8×10^{-9}
Nonradiological accidents[a] (fatalities/yr)	6×10^{-4}	1×10^{-3}
Nonradiological vehicular emissions (fatalities/yr)	2×10^{-4}	5×10^{-4}
Maximum Consequence Accident Population[b,c]		
Dose (person-rem)	0.33	3.3
Fatal cancers	2×10^{-4}	2×10^{-3}
Maximally Exposed Individual[b,d]		
Dose (rem)	1.2×10^{-4}	1.2×10^{-3}
Fatal cancer probability	6×10^{-8}	6×10^{-7}

[a] Collective population fatalities were calculated for 145 shipments (Conceptual Design Option) and 335 shipments (Enhanced Option). For example, a reported value of 4×10^{-3} fatalities suggests that no fatalities are expected for the proposed action. However, one single fatality out of the entire affected population might be expected over the course of 250 years if the same number of shipments were to continue for that length of time.

[b] The most severe accidents assumed that 100 percent of the target tritium would be released in an oxide form during an accident. Accident consequence results were determined using the RISKIND computer program which is described in Yuan et al. 1993. Stable weather conditions (Pasquill Stability Class F) with a wind speed of 1 m/s (2.2 mph) were assumed.

[c] The maximum consequences would result from an accident occurring in an urban environment. The population was assumed to extend at a uniform density of 3,861 persons/km^2 (10,000 persons/mi^2) to a radius of 80 km (50 mi) from the accident site. The population exposure pathways for urban environments include inhalation and resuspended inhalation. Urban environments were not assumed to produce food for local use or export, hence no ingestion dose was included.

[d] The maximally exposed individual was assumed to be at the location of maximum exposure. The location of the maximally exposed individual was assumed to be 380 m (1,247 ft) from the accident under stable weather conditions. Individual exposure pathways included acute inhalation during passage of the plume. No ingestion dose was considered.

Note: The transportation risk assessment assumes 100 percent of the tritium targets would be manufactured and transported to NIF from each site. In practice, tritium targets would be produced and transported from more than one manufacturer. The transportation risk assessment was performed for offsite transportation only. Transportation risks from onsite transport of tritium targets were assumed to be negligible compared to risks from offsite transportation.

Source: Model results.

- Mercury scenario—237 m (778 ft) for both the Conceptual Design and Enhanced options

- Alumina/silica scenario—171 m (561 ft) for the Conceptual Design Option and 231 m (758 ft) for the Enhanced Option

- Carbonyl fluoride scenario—75 m (246 ft) for both the Conceptual Design and Enhanced options

- Hydrogen fluoride release—101 m (331 ft) for both the Conceptual Design and Enhanced options

The personnel in nearby buildings would likely be protected because the release (typically lasting 15 minutes) would pass by the buildings with little infiltration. Personnel in the NIF Laser and Target Area Building and those outdoors in the immediate vicinity might be affected.

I.4.4.2.8 Waste Management Impacts

This section evaluates wastes generated by NIF that might impact current waste management at NLVF during construction, normal operation, and the ultimate decommissioning of NIF if it were located at NLVF.

I.4.4.2.8.1 *Waste Generation and Management During Construction and Operation*

Waste management during construction would be performed as described in section I.4.1.2.8 for LLNL. All construction activities would be performed in compliance with requirements identified in DOE Order 430.1. Table I.4.1.2.8.1–2 (section I.4.1.2.8.1) describes the quantities of wastes generated by category for both the Conceptual Design Option and Enhanced Option. NLVF has no onsite capacity to treat or dispose of low-level, mixed, or hazardous wastes.

During operation, various low-level, mixed, hazardous, and nonhazardous wastes would be generated at NIF. The quantities of these waste streams and their proposed management at NLVF are discussed below. Successive sections cover how developing technologies might be applied to minimize waste streams and, finally, the disposition of wastes from decommissioning.

Waste handling methods would be the same under both the Conceptual Design Option and the Enhanced Option. While total waste quantities would be somewhat higher for the Enhanced Option, no changes in handling methods would be necessary.

Low-Level Waste. Solid LLW would be disposed of at NTS. Hardware from the NIF chamber is an example of the type of solid LLW that would be discarded. Aqueous LLW would be treated at NTS to eliminate free liquids. Currently, no facilities exist at NLVF or at NTS for treatment of liquid radioactive waste. However, as discussed below, there are plans to develop this capability at NTS in the near future.

Mixed Waste. Current plans are to permit mixed solid waste disposal units at NTS for mixed waste generated both on and offsite that meets RCRA land disposal requirements. A permit application has been submitted to the State of Nevada, and it is estimated that the units will be available in fiscal year 1997, well before NIF would begin operations. NTS currently has the capability, under interim status, to dispose of mixed waste generated onsite at the Area 5 Radioactive Waste Management Site. This availability could conceivably be extended, if approved by the State of Nevada, to mixed waste generated at NLVF as well. The current remaining capacity for mixed waste disposal at NTS is over 90,000 m^3 (117,700 yd^3) and will be much greater (about 250,000 m^3 [327,000 yd^3]), assuming that approval and construction of permitted mixed waste disposal units takes place as anticipated. The small amount of mixed waste generated at NIF would not significantly affect mixed waste operations. In the event the mixed waste were generated before the development of acceptable NTS disposal capacity, the waste could be stored pending approval by the State of Nevada at a storage pad at the Area 5 Radioactive Waste Management Site or sent to a mixed waste disposal site out of state.

Mixed liquid waste would be treated to eliminate free liquids before disposal at NTS. Free liquids are not allowed for disposal, and must be stabilized according to the requirements stipulated in the NTS Waste Acceptance Criteria, NVO-325. As with solid

mixed waste, the requirements identified in the RCRA for the land disposal restrictions would also be met. Currently, no facilities exist at NLVF or NTS for treatment of liquid mixed waste; however, there are plans to develop this capability in the near future. The liquid waste treatment system, which is designed to treat large volumes of liquid waste (both radioactive and mixed) is expected to be available in fiscal year 1997. This system would use evaporation as the primary treatment method for the anticipated waste. A second NTS mixed waste treatment facility that is still in the preliminary planning stages is also expected to be operational in fiscal year 1997. This facility will use stabilization as the primary method of treatment and might be more appropriate for the liquid mixed waste from NIF. This facility should be online by the time any waste could be generated by NIF operations. Therefore, upon approval of a permit modification, this planned facility would be available for the treatment of NIF liquid mixed waste. If necessary, the NIF liquid mixed waste could be stored at the NTS Area 5 Radioactive Waste Management Site until a treatment facility was available. The mixed aqueous waste from debris shield cleaning would be neutralized, stabilized, and transported to NTS for disposal as an approved waste stream.

Hazardous Waste. Most hazardous waste would be shipped to an approved commercial RCRA treatment, storage, and disposal facility. Scheduled pickup and removal of hazardous waste is now done by a subcontractor. The subcontractor can be called for nonscheduled removal, if necessary.

Nonhazardous Waste. Sanitary wastewater would be handled with the existing facility sewage removal outlets connected to the city of Las Vegas wastewater treatment system. NLVF operates under an NPDES permit. The addition of an estimated 18 MLY (5 MGY) of nonhazardous liquid waste from NIF operations would not have major effects on the existing removal system at the facility or on the Las Vegas treatment system.

All facilities within NLVF are, or will soon be, provided with adequate stormwater runoff protection. The development of enhanced stormwater drainage channels is planned for fiscal year 1995 at NLVF to divert runoff flow to city flood protection channels. The primary channels diverting flow from NLVF run along the road east and adjacent to the site. These primary diversion channels feed into a large storm drain channel near NLVF and are designed to protect Interstate 15, which is located approximately 200 m (656 ft) to the east. A soil stabilization project is also planned for undeveloped land within NLVF. The existing storm drain network is capable of handling the expected floodwaters from a storm occurring on or near NLVF. The design-basis-flood-level local rainfall, based on a low-hazard-use building at this location, would not be considered a significant risk because of the low probability of flooding. NLVF encompasses 33 ha (80 acres) and is not located within a 100-year floodplain.

Disposal of solid nonhazardous wastes would be handled through the city of North Las Vegas waste removal contractor. That contractor operates a transfer location less than 1 km (0.6 mi) northwest of NLVF. Waste from this transfer station is taken to a landfill outside the city limits. The transfer station handles a large portion of the waste from the city of Las Vegas, and the estimated volume of 6,000 m^3 (8,000 yd^3) per year from NIF would not have a significant impact on the transfer station operations. Waste would be regularly removed in bulk waste collection bins provided by the city contractor. At times of unusually heavy generation of nonhazardous solid waste, the city contractor could be called for supplementary pickups.

Possible Waste Minimization During Operation. Waste minimization for NIF operations at NLVF would be handled as described in section I.4.1.2.8 for LLNL. The operation process would be subjected to a pollution prevention opportunity assessment to optimize efficiency and minimize waste generation.

Existing Waste Management Capabilities at NLVF. On the basis of the anticipated waste volume generation by NIF (table I.4.1.2.8.1–2) and on information on current waste handling practices at NLVF, comparison tables were developed that indicate the capability of the existing NLVF facilities to undertake the various waste managements tasks associated with NIF. Table I.4.4.2.8.1–1 shows the estimated impacts of the NIF operations on waste storage at NLVF and compares the NIF waste generation rate to the annual handling/treatment capacity at NLVF.

The management of NIF wastes at NLVF would represent a significant extension of current practices

TABLE I.4.4.2.8.1–1.—*Comparison of the National Ignition Facility Waste to Annual Treatment Capacity at North Las Vegas Facility*

Category	Amount of NIF-Generated Waste/Year[a] (m^3)	Ratio of NIF Waste Generation to Annual Treatment Capacity	Treatment Capacity (m^3/yr)	Is the Treatment Capacity Adequate	Is Existing or Planned Storage/ Disposal Capacity Adequate
Low-Level					
Liquid (m^3)					
Conceptual design total	0.60	NA	None	No	Yes[b]
Enhanced total	1.56	NA	None	No	Yes[b]
Solid (m^3)					
Conceptual design total	2.98	NA	None	No	Yes[b]
Enhanced total	7.25	NA	None	No	Yes[b]
Mixed					
Liquid (m^3)					
Conceptual design total	2.0	NA	None	No	Yes[b]
Enhanced total	4.98	NA	None	No	Yes[b]
Solid (m^3)					
Conceptual design total	0.34	NA	None	No	Yes[b]
Enhanced total	0.88	NA	None	No	Yes[b]
Hazardous[c]					
Liquid (m^3)					
Conceptual design total	2.30	NA	None	No	Yes[d]
Enhanced total	4.60	NA	None	No	Yes[d]
Solid (m^3)					
Conceptual design total	8.0	NA	None	No	Yes[d]
Enhanced total	8.0	NA	None	No	Yes[d]

[a] The total amount of the low-level waste was found by adding the values in the column "Cleaned" of table I.4.1.2.8–2 to the column "Low-Level" of the same table. The mass of the debris shield was assumed to be the density of iron (7.87 g/cm^3). The density of the low-level liquid was assumed equal to 1.0 g/cm^3. The amount of the "cleaned" personal protective equipment and wipes/general cleaning was added to solid low-level radioactive waste.

[b] Shipped offsite to NTS.

[c] The hazardous waste values are the sum of the values for the Laser and Target Area Building and the Optics Assembly Area.

[d] Shipped offsite to RCRA treatment, storage, and disposal facility.

Note: NA - not applicable.

Source: Calculated from table I.4.1.2.8.1–2 and Ortego 1995.

or capability. Thus, the impact of NIF waste on waste management operations at NLVF would be significant. Maximum efforts would have to be made to ensure compliance with regulatory requirements. Treatment processes for mixed and hazardous wastes would be investigated and coordinated with the State of Nevada in order to obtain appropriate permits. Radioactive and mixed waste would be managed in accordance with NVO-325 requirements and disposed of at NTS.

I.4.4.2.8.2 *Waste Management at North Las Vegas Facility During National Ignition Facility Decommissioning*

The procedures proposed by NLVF for decommissioning NIF after 30 years of operation are summarized

I.4.5 Sandia National Laboratories

I.4.5.1 *Affected Environment*

The following sections describe the affected environment associated with the construction and operation of NIF at Sandia National Laboratories (SNL). Land use, air quality and acoustics, water resources, biotic resources, cultural and paleontological resources, socioeconomics, radiation and hazardous chemicals, and waste management are described.

I.4.5.1.1 Location and Land Use

The 1,150-ha (2,842-acre) SNL site is located east of Albuquerque, New Mexico, within the boundaries of the 21,044-ha (52,000-acre) Kirtland Air Force Base military reservation. The land north of SNL, with the exception of a few vacant parcels, is part of the urbanized city of Albuquerque. Areas to the west and south, by agreements with the State of New Mexico and the Isleta Pueblo, serve as buffer zones for certain test operations. Figure I.4.5.1.1–1 shows SNL Technical Areas and surrounding Kirtland Air Force Base land use.

The proposed NIF location at SNL is in an undeveloped area in Technical Area II, north of R Street, east of 9th Avenue and south of East Ordnance Road (figure I.3.4.5.1-2). The temporary construction laydown area would be located within the location designated for NIF. Areas east of the proposed NIF location in Technical Area II have been used for testing explosive components, and the immediate vicinity of NIF location was until recently part of an extensive operational safety zone. With the completion of the Explosives Component Facility in 1995, Technical Area II will be increasingly used for laboratory service functions (SNL 1995a). To the south of the proposed NIF location is Technical Area IV, which consists of several Inertial Confinement Fusion (ICF) and pulsed-power research facilities. In the area immediately north is located an SNL facilities storage yard, and to the west is a DOE arms control treaty verification rail and truck terminal mock-up. Approximately 2.4 km (1.5 mi) to the west is the runway for Kirtland Air Force Base, which is also shared with commercial planes landing at Albuquerque International Airport. A residential development at Kirtland Air Force Base containing approximately 100 housing units is located approximately 1.5 km (0.9 mi) north of the proposed NIF location. Well-drained, gravelly soils dominate the area. No soils at SNL are classified as prime farmland.

I.4.5.1.2 Air Quality and Acoustics

This discussion of existing air quality and acoustics includes a review of the meteorology, climatology, and ambient air quality characteristics near SNL.

I.4.5.1.2.1 *Meteorology and Climatology*

The climate at SNL and the surrounding region is arid continental with abundant sunshine, low humidity, scant precipitation, and a wide seasonal range of temperatures. The annual average temperature at SNL is 13.4 °C (56.2 °F); average daily temperatures range from 1.6 °C (34 8 °F) in January to 26.0 °C (78.8 °F) in July. The average annual precipitation at SNL is 20.6 cm (8.12 in). Prevailing winds much of the year are from the southeast; however, prevailing winter and spring winds are from the north and south, respectively. The annual average wind speed is 14.5 kph (9.0 mph) (NOAA 1990). Figure I.4.5.1.2–1 shows the 5-year wind rose for SNL based on measurements at Albuquerque International Airport. During the years 1987 to 1991, unstable atmospheric conditions occurred approximately 27 percent of the time, neutral conditions about 36 percent of the time, and stable conditions the remaining 37 percent of the time (EPA 1995b). In general, atmospheric dispersion improves as the wind speed increases and as the atmospheric conditions become more unstable.

The limited precipitation and warm temperatures of the area create an arid climate that limits the growth of ground-covering vegetation, resulting in the presence of large areas of exposed soil that are a potential source of windborne particulate matter (dust). These particulate matter concentrations are reduced if the exposed soil is wetted or if the dust is "washed out" of the atmosphere by precipitation. However, the area's precipitation and temperature seldom provide these beneficial mechanisms. This condition worsens the background particulate matter concentrations and increases the likelihood of the area's particulate matter (PM_{10}) and TSP ambient air concentration approaching or exceeding regulatory standards.

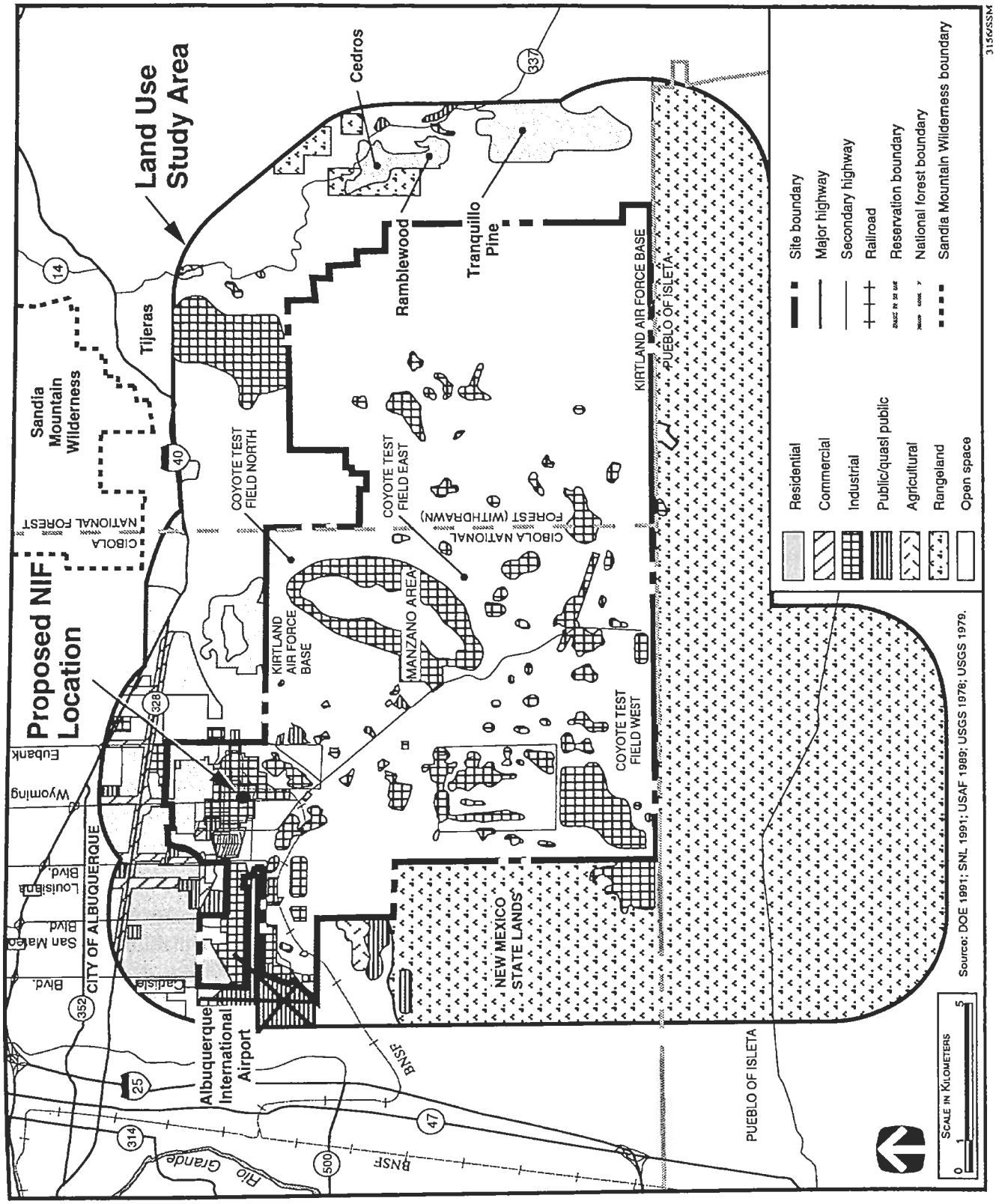


FIGURE I.4.5.1.1–1.—*Generalized Land Use at Sandia National Laboratories and Vicinity.*

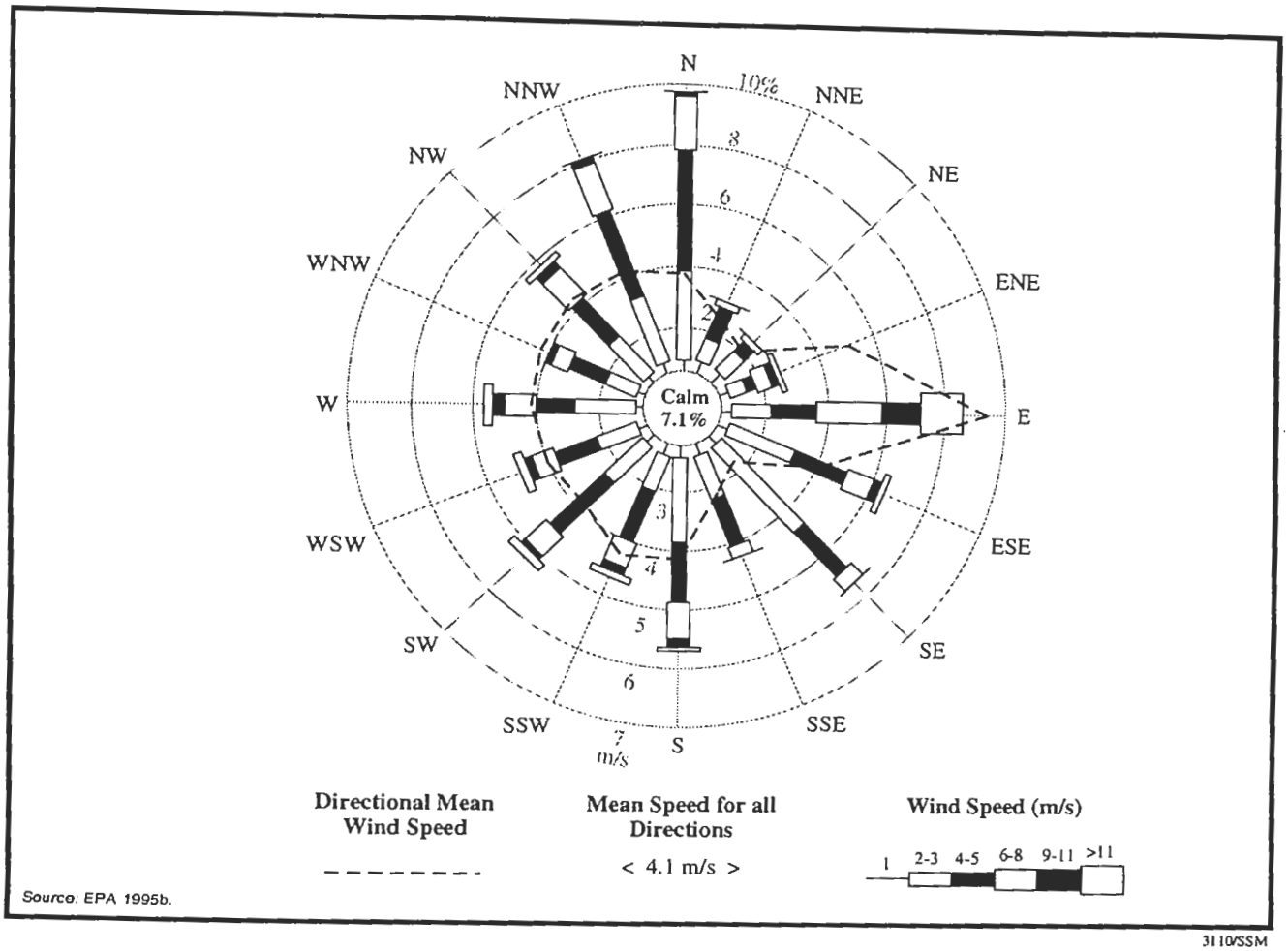


FIGURE I.4.5.1.2–2.—*Wind Distribution at Sandia National Laboratories, 1987-1991.*

I.4.5.1.2.2 *Ambient Air Quality*

The Albuquerque-Bernalillo County Air Quality Control Board is responsible for air pollution control and attainment of air quality standards in the city of Albuquerque and Bernalillo County. In addition to being subject to NAAQS for criteria pollutants, SNL is subject to ambient air quality standards adopted by the Albuquerque-Bernalillo County Air Quality Control Board. Applicable NAAQS and Albuquerque-Bernalillo County ambient air quality standards are listed in table I.4.5.1.2.2–1.

SNL is located within the Albuquerque-Mid Rio Grande New Mexico Intrastate AQCR 152. Portions of the AQCR are designated as nonattainment for carbon monoxide and TSP (40 CFR 81.332). In general, pollutant emission increases in an area designated as nonattainment for a specific pollutant are subject to more stringent permitting requirements than if the area is designated as attainment.

The New Mexico Environment Department operates a network of air quality monitors in the Albuquerque area. The state monitor closest to SNL is at the city water tank on Mesilla (Site ID 2ZE), approximately 8 km (5 mi) north-northwest of the proposed NIF location. Data for this and other monitors near SNL are shown in Lazaro et al. (1996). Table I.4.5.1.2.2–1 presents the 1993 baseline ambient air concentrations for criteria pollutants and other pollutants at SNL. All of the baseline concentrations are in compliance with the NAAQS. The 1-hour photochemical oxidant concentration exceeds the county standard, which is common in urban areas.

The nearest PSD Class I Area is the Bandelier National Monument Wilderness Area, which is

TABLE I.4.5.1.2.2–1.—*Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at Sandia National Laboratories*

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	1993 Baseline Concentration[a] ($\mu g/m^3$)
Criteria Pollutant			
Carbon monoxide	Annual	4,600[b]	1,600
	8 hours	10,000[c]	4,900
	1 hour	15,000[b]	10,000
Lead	Calendar quarter	1.5[d]	0.066
	30 days	3[b]	0.84
Nitrogen dioxide	Annual	100[d]	30
	24 hours	117[b]	77
Ozone	1 hour	235[d]	190
Particulate matter	Annual	50[d]	15.92
	24 hours	150[d]	66
Sulfur dioxide	Annual	11[b]	0.8
	24 hours	92[b]	5
	3 hours	1,300[d]	22
Mandated by County or State			
Arsenic, copper and zinc	30 days	10[b]	ND[e]
Asbestos	30 days	0.01[d]	ND
Beryllium	30 days	0.01[b,c]	ND
Heavy metals	30 days	10[d]	0.066[f]
Hydrogen sulfide	1 hour	4[b]	ND
Non-methane hydrocarbons	3 hours (6 a.m.-9 a.m.)	100[b]	ND
	3 hours	120[c]	ND
Photochemical oxidants	1 hour	20[b]	190[g,h]
Soiling index	Annual	0.3[b,i]	ND
Total reduced sulfur	30 minutes	4[b,c]	ND
Total suspended particulates	Annual	60[b,c]	ND
	30 days	90[c]	ND
	7 days	110[c]	ND
	24 hours	150[b,c]	ND

[a] For short-term standards, baseline concentration is second highest concentration for the year, for national standards and for 1-hour carbon monoxide and 3-hour nonmethane hydrocarbon county standards; baseline concentration is highest concentration for other short-term standards.

[b] County standard.

[c] State standard.

[d] Federal standard (40 CFR 50).

[e] ND - No data available.

[f] Heavy metals value assumed to be same as for lead.

[g] Photochemical oxidants value assumed to be same as ozone.

[h] Value exceeds the most stringent regulation or guideline.

[i] Units of cohs per 1,000 linear feet of air.

Source: ABCAQCB 1973; NMEIB 1981; NMAQB 1994.

located about 70 km (45 mi) north-northeast of SNL (NMAQB 1994).

The primary emission sources of criteria pollutants at SNL are the steam plant, paint shops, toxic machine shop, process development laboratory, and diesel generator plant at Technical Area I, and the explosive testing at Technical Area II (DOE 1988). Other emission sources include fugitive particulates from waste-burial activities, other processes, vehicles, and construction activities.

I.4.5.1.2.3 *Acoustic Conditions*

SNL is within Kirtland Air Force Base, which borders the Albuquerque International Airport. Commercial and military aircraft operations are the dominant source of noise at SNL because of the presence of the major east/west runway of the International Airport to the west of the northern portion of the SNL site. Military aircraft from Kirtland Air Force Base share the International Airport runways with commercial aircraft. Aircraft operations are a periodic noise source, and maximum levels are associated with aircraft takeoffs and landings (DOE 1993b). Other noise emission sources within SNL include motor vehicles and various industrial facilities and equipment.

Studies have recorded intermittent noise levels of 54 to 102 dBA for the northern portion of SNL near Technical Areas I, II, and IV east of the International Airport east/west runway. Daytime noise levels in Technical Area III, in the southern portion of SNL remote from the runway, have been measured at 64 to 72 dBA, with an average of 66 dBA (DOE 1993b). These noise levels contribute to the ambient background noise in these areas.

I.4.5.1.3 Water Resources

The major surface water feature in the area is the Rio Grande, which flows north to south through Albuquerque and lies about 10 km (6 mi) west of SNL. There are no perennial streams on the SNL site. The two primary surface channels at SNL are Tijeras Arroyo and Arroyo del Coyote. Tijeras Arroyo is directly southeast of Technical Area II and has a drainage area of about 208 km^2 (80 mi^2) above the confluence with Arroyo del Coyote. Arroyo del Coyote has a drainage area of about 70 km^2 (27 mi^2). Both arroyos flow intermittently during heavy summer thundershowers (SNL 1994). Technical Area II has no stormsewer system. Storm runoff drains into Tijeras Arroyo, which flows west to the Rio Grande. Except for the southeast corner, Technical Area II (including the proposed NIF location) is outside the 100- and 500-year floodplains of Tijeras Arroyo (figure I.4.5.1.3–1).

A fault complex separates the regional aquifer system into a deeper zone west of the fault and a shallower zone to the east. The depth to groundwater at SNL varies from 15 to 30 m (49 to 98 ft) east of the fault and 120 to 150 m (394 to 492 ft) west of the fault. Most SNL facilities, including Technical Area II where NIF would be located, are located west of the fault system.

The water supply for SNL is provided by Kirtland Air Force Base and the city of Albuquerque. Kirtland Air Force Base draws water from a system of wells, with a backup from the city of Albuquerque. In 1990, Kirtland Air Force Base pumped an average of over 5,840 MLY (1,533 MGY) of water from its production wells. SNL uses about 1,387 MLY (365 MGY) of water, of which 70 percent is provided by Kirtland Air Force Base and the rest by the city of Albuquerque (SNL 1995a; IT Corporation 1992).

SNL contains over 24 km (15 mi) of sewer lines interconnected with those of Kirtland Air Force Base. During 1993, SNL had four general wastewater streams discharging to the Albuquerque wastewater treatment plant and three industrial wastewater streams that required pretreatment before discharging to the sewer system (SNL 1994).

I.4.5.1.4 Biotic Resources

SNL is located in the Arizona, Livermore Plateau Ecoregion (Omernik 1986). Most of the undeveloped spaces located at and near the area designated for NIF support grassland vegetation. Common plant species include galleta, sand dropseed, ring muhly, and Indian ricegrass. Grassland vegetation dominates in Technical Area II, with arroyo banks occurring along the southeastern margin of that area. The arroyo banks generally contain a drought-adapted grassland community, dominated by species such as club

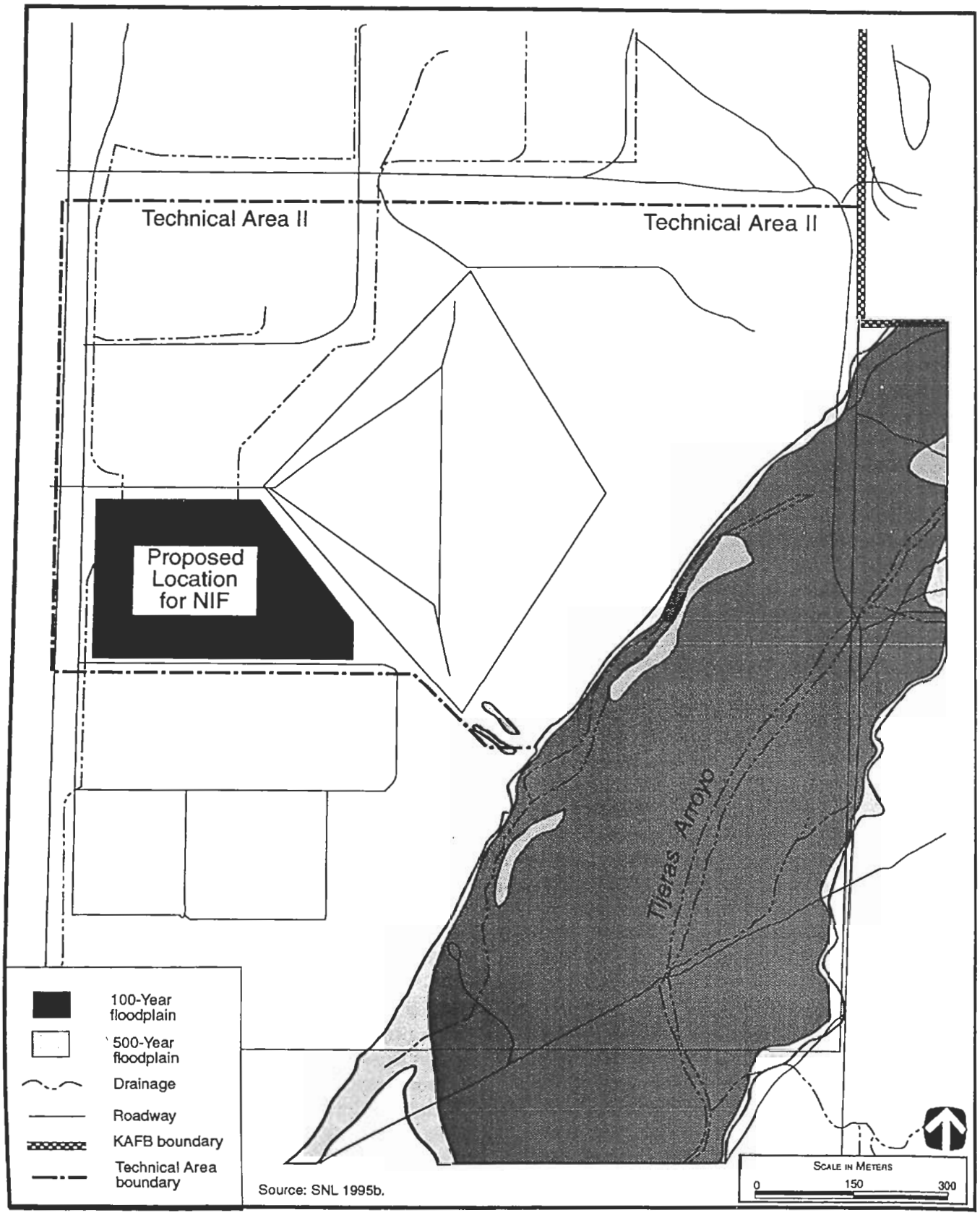


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FIGURE I.4.5.1.3–1.—*Floodplain Map for Technical Area-II at Sandia National Laboratories.*

cholla, prickly pear, soapweed yucca, and four-wing saltbush (IT Corporation 1992).

The size and diversity of the wildlife populations at SNL are limited by lack of available water (IT Corporation 1992). Amphibians and reptiles that could occur in Technical Area II include the western spadefoot toad, plains spadefoot toad, Woodhouse's toad, Great Plains toad, many-lined skink, Great Plains skink, whiptail lizard, side-blotched lizard, short-horned lizard, bullsnake, and coachwhip. The western diamondback rattlesnake and western rattlesnake also occur in grassland communities of the area (IT Corporation 1992).

Raptors that may use grassland habitats of SNL for hunting include northern harrier, red-tailed hawk, Swainson's hawk, ferruginous hawk, American kestrel, prairie falcon, barn owl, long-eared owl, great horned owl, burrowing owl, and turkey vultures. Other common grassland birds that may nest in the area include scaled quail, mourning dove, greater roadrunner, horned lark, American crow, northern mockingbird, crissal thrasher, loggerhead shrike, lark sparrow, black-throated sparrow, western meadowlark, brown-headed cowbird, and house finch (IT Corporation 1992).

Common mammals in the grassland areas include desert cottontail, black-tailed jackrabbit, spotted ground squirrel, Gunnison's prairie dog, Botta's pocket gopher, silky pocket mouse, Ord's kangaroo rat, banner-tailed kangaroo rat, Merriam's kangaroo rat, western harvest mouse, deer mouse, white-footed mouse, and northern grasshopper mouse. Coyote, kit fox, long-tailed weasel, badger, striped skunk, and bobcat are among the predatory mammals within the grassland habitats. Mule deer infrequently make use of such habitats (IT Corporation 1992).

No National Wetland Inventory maps have been prepared for SNL. If wetlands do exist on SNL, they would be in the area of the springs and intermittent drainages associated with the canyons and arroyos of Kirtland Air Force Base. These areas do not occur within the area designated for NIF.

Aquatic resources of SNL include intermittent stream channels within Arroyo del Coyote and Tijeras Arroyo. Several springs exist on Kirtland Air Force Base, including Sol de Mete Spring, Coyote Springs, and G Spring, associated with canyons and arroyos. There are also drainage ditches, Lake Christian (a 0.8-ha [2.0-acre] permanent pond in the southern portion of Kirtland Air Force Base), and golf course ponds. None of these resources occur within the area designated for NIF.

A list of Federal and state rare, threatened, and endangered species that could potentially exist at SNL is provided in Lazaro et al. (1996). Habitats that could attract several of the species (such as loggerhead shrike and New Mexico jumping mouse) are present. However, no designated critical habitats for Federal-listed species exist at SNL.

I.4.5.1.5 Cultural and Paleontological Resources

No prehistoric or historic archaeological sites or structures exist on the proposed NIF location in Technical Area II. An intensive pedestrian field survey (employing 6- to 12-m [20- to 50-ft] transects) was conducted during August 1990; no artifacts or features were encountered on or near the proposed NIF location (Hoagland 1990). The SNL Sitewide Hydrogeologic Characterization Project reports that no important paleontological remains have been recovered from deposits on SNL, including the alluvial and colluvial sediments that exist on the proposed NIF location (Wheeler 1995a). Consultation with the Isleta Pueblo indicates that no Native American cultural resources exist within the boundaries of SNL, including the proposed NIF location (Wheeler 1995a).

I.4.5.1.6 Socioeconomics

Socioeconomic characteristics described here for the SNL area include the regional economy, population and housing, public finance and public service infrastructure, and local transportation. Regional economic statistics are based on a regional economic study area that encompasses nine counties around SNL, as defined by the BEA. The economic study area is a broad labor and product market-based region linked by trade among economic sectors within the region. Statistics for population and housing, public finance, and infrastructure are based on the ROI, a three-county area in which more than 95 percent of SNL employees reside. The three counties are Bernalillo (containing 88.0 percent of the workforce),

Sandoval (4.5 percent), and Valencia (4.5 percent). The counties and cities included in the economic study region and the counties included in the ROI are listed in Lazaro et al. (1996). Assumptions, assessment methodologies, and supporting data are also presented in Lazaro et al. (1996).

I.4.5.1.6.1 *Regional Economy*

The economic study area for SNL includes the Albuquerque Metropolitan Statistical Area (Bernalillo County) and eight surrounding counties. Between 1988 and 1995, employment in the economic study region was projected to increase from 291,600 to 331,500. BEA (1990) projects a compounded average annual growth rate of 1.3 percent from 1995 to 2003 (34,646 jobs).

In 1995, SNL employed approximately 8,500 persons, accounting for 2.8 percent of employment in the regional economic study area. In 1995, employment at SNL dropped to 7,543. Data on historical and projected employment at SNL and the distribution of employees by place of residence in the ROI are presented in Lazaro et al. (1996).

I.4.5.1.6.2 *Population and Housing*

The ROI experienced steady population growth between 1980 and 1990, with an average annual increase of about 3.2 percent, bringing the 1990 total to about 605,000 persons. Population growth has been strongest in Sandoval County (84 percent between 1980 and 1990). By the year 2000, population in the ROI is expected to grow to approximately 672,000 persons (U.S. Department of Commerce 1994; BEA 1990).

Between 1980 and 1990, the number of housing units in the ROI increased by over 22 percent, from 196,765 to 241,683 units (see table I.4.5.1.6.2–1). Housing in Bernalillo County increased from 162,126 units in 1980 to 201,235 in 1990 (24 percent). Housing in Sandoval County increased from 12,286 units in 1980 to 23,667 in 1990 (93 percent), and housing in Valencia County decreased from 22,352 units in 1980 to 16,781 in 1990 (minus 25 percent). The number of housing units in the ROI is expected to increase about 19 percent between 1990 and 2000 (U.S. Department of Commerce 1994; BEA 1990; ULI 1995).

The number of vacant owner units in the ROI increased from about 11,000 units in 1980 to about 13,000 in 1990. It is estimated that by the year 2000 there will be approximately 16,000 vacant owner units if current construction and economic trends continue in the ROI.

In 1980 there were approximately 5,000 vacant rental units in the ROI. The number of vacant units increased to about 7,000 by 1990. It is estimated that by the year 2000 there will be approximately 9,000 vacant rental units if current construction and economic trends continue in the ROI.

In 1994, the residential market within the ROI continued a four-year upward trend, both in terms of

TABLE I.4.5.1.6.2–1.—*Population and Housing Data for the Sandia National Laboratories Area*

	1980	1990	1996	1997	1998	1999	2000	2001	2002	2003
Estimated ROI population	458,430	605,088	642,577	649,734	656,973	664,295	671,700	677,689	683,733	689,833
Estimated total housing units	196,765	241,683	268,634	273,126	277,617	282,109	286,601	291,093	295,585	300,076
Estimated vacant owner units	11,123	13,053	14,372	14,592	14,811	15,031	15,251	15,471	15,691	15,910
Estimated vacant renter units	5,028	7,011	8,040	8,212	8,383	8,555	8,726	8,897	9,069	9,240
Estimated total vacant housing units in ROI[a]	16,151	20,064	22,412	22,803	23,194	23,586	23,977	24,386	24,760	25,151

[a] Vacancy rate - 8 percent.
Source: Historical data from U.S. Department of Commerce (1994); projections by Haliburton-NUS (1995).

construction activity and sales of existing houses. Construction of single-family houses increased by 20 percent. Single-family development continued to be concentrated in the northwest and northeast Albuquerque submarkets, as well as in the city of Rio Rancho. The northwest and northeast submarkets contain more upscale housing, with more affordable housing in the city of Rio Rancho. After four years of declining vacancy rates, the region appears poised for a surge in new construction. Multifamily permits have increased sharply since 1993, and several residential projects are planned. In light of current economic conditions in the Albuquerque housing market, residential construction activity is expected to continue at a brisk pace (ULI 1995).

I.4.5.1.6.3 *Public Finance and Public Services Infrastructure*

Public financial characteristics of the local jurisdictions in the ROI that are most likely to be affected by NIF at SNL are presented in this section. The data reflect total revenues and expenditures of each jurisdiction's general fund, special revenue funds, and, as applicable, debt service, capital project, and expenditure trust funds. Major revenue and expenditure categories and total revenues less expenditures for counties and cities are presented in table I.4.5.1.6.3–1. Table I.4.5.1.6.3–2 summarizes public service levels for education, community service, and health care.

I.4.5.1.6.4 *Local Transportation*

Vehicular access to SNL is provided by Broadway Boulevard, Eubank Boulevard, Louisiana Boulevard, Wyoming Boulevard, and Gibson Boulevard in Albuquerque. Interstate 40 and Interstate 25 provide regional access to SNL. Table I.4.5.1.6.4–1 shows the site access roads at SNL and the average daily traffic volumes for each route.

There currently are two major road improvement projects within the SNL vicinity. These projects are (1) the Eubank Road and Interstate 40 interchange overpass project and (2) the Four Hills Road, Tramway Boulevard, and Interstate 40 interchange project. Future road improvement projects that will begin before 2000 include the Juan Tabo Road and Interstate 40 interchange project, the Wyoming Boulevard and Interstate 40 interchange project, and the Gibson Street reconstruction project (Fegan 1995).

Traffic along road segments providing access to SNL is projected to contribute to differing service level conditions in accordance with population growth. Eubank, Gibson, Louisiana, Wyoming, and, to a lesser extent, Broadway would typically experience traffic congestion, with volumes approaching or exceeding the design capacity of each roadway. Along these roadways, a motorist's speed and ability to maneuver would be restricted, and potential disruptions to traffic flow could be caused by accidents

TABLE I.4.5.1.6.3–1.—*Public Finance—Sandia National Laboratories Area*

Revenues and Expenditures[a]	Bernalillo County	City of Albuquerque	Valencia County	Sandoval County
Local sources (percent)	70	55	NA	85
State sources (percent)	30	45	NA	15
Federal sources (percent)	0	0	NA	0
Total revenues (dollars)	65,106,243	236,936,897	NA	6,218,259
General government (percent)	53	18	NA	51
Public safety, health, and community services (percent)	47	82	NA	49
Debt service (percent)	0	0	NA	0
Other (percent)	0	0	NA	0
Total expenditures (dollars)	61,559,532	202,472,160	NA	4,442,071
End-of-year fund balance (dollars)	30,597,329	17,108,146	NA	3,052,034

[a] If reporting body did not distinguish between state and Federal revenue sources, the total for all intergovernmental revenue was combined and reported under "state sources."

Source: Bernalillo County 1994; city of Albuquerque 1994; Sandoval County 1993.

TABLE I.4.5.1.6.3–2.—*Public Services—Sandia National Laboratories Area*

Part I: Education

County/School District	Enrollment	Pupil-Teacher Ratio	Per Pupil Expenditure[a] ($)
Bernalillo County[b]	89,131	19.2:1	3,733
Sandoval County	5,841	19.3:1	4,039
Valencia County	10,854	21.7:1	3,421

[a] Expenditure per pupil was based on total operating expenditures for each school district and used 40-day membership attendance numbers for the number of students.

[b] Albuquerque school district.

Part II: Level of Service per 1,000 Population

County/Jurisdiction	Police Protection	Fire Protection	General Government	Physicians
Bernalillo County	0.1	0.2	2.4	3.8
City of Albuquerque	2.6	1.3	17.7	NA
Sandoval County	0.3	NA[a]	NA	1.1
Valencia County	0.4	NA	4.1	0.5

[a] Fire protection services provided by volunteer firefighters.

Source: New Mexico Public Schools 1994; city of Albuquerque 1994; Federal Bureau of Investigation 1993; American Medical Association 1994.

or maintenance activities, resulting in considerable congestion (DOE 1993a).

Major planned improvements to roads that provide

Kirtland Air Force Base and Mesa Del Sol) is being pursued. The study is expected to determine the number of lanes and functional classification for the facility (Middle Rio Grande Council of Governments

populations. In this PSA, environmental justice is evaluated for impacts within the site region, defined as the area within an 80-km (50-mi) radius around the site, and within the local area. Lazaro et al. (1996) presents the demographic analysis of minority and low income population distributions on a regional and local basis.

In the SNL site region in 1990, 15 percent of the population was low income and 45 percent was minority. These values are lower percentages of both low-income and minority persons than the New Mexico state averages (21 percent low income and 49 percent minority). Within the area, census tracts closer to the SNL site tend not to have significantly higher or lower proportions of minority or low-income populations than tracts farther from the site.

I.4.5.1.7 Radiation and Hazardous Chemicals

I.4.5.1.7.1 *Radiation Environment*

A detailed discussion of the radiation environment at SNL, including background, radiological releases, and doses to members of the public, is presented in 1993 *Site Environmental Report*, Sandia National Laboratories (SNL 1994). The concentrations of radioactivity in various environmental media (air, water, soil) in the site region are also presented in that reference.

Calculated radiological doses were used to estimate the potential health impacts to the public and onsite workers at SNL from any releases of radioactivity. The annual doses to individuals, the surrounding population (within 80 km [50 mi]), and workers are summarized in table I.4.5.1.7.1–1; corresponding health risks are also presented in this table. These doses are in addition to those from natural background, consumer products, and medical sources, which total about 399 mrem.

Background radiation doses are unrelated to SNL operations. Regulatory limits that specify the maximum effective dose equivalent to individual members of the public and occupational workers are also presented in table I.4.5.1.7.1–1.

The doses to the public are within regulatory limits (DOE 1990) and are small in comparison to background radiation. The onsite worker doses are also within regulatory limits.

I.4.5.1.7.2 *Hazardous Chemical Environment*

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through contact or the food pathway). Exposure pathways to SNL workers during normal operation may include inhaling the workplace atmosphere, drinking SNL potable water, and possible other contact with hazardous materials associated with work assignments.

The existing inventory of hazardous chemicals at SNL of the types that may be used by NIF is listed in table I.4.5.1.7.2–1. The potential for health impacts from these chemicals varies from facility to facility and from worker to worker, and available information is not sufficient to permit a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls.

TABLE I.4.5.1.7.2–1.—*1994 Inventory of National Ignition Facility-Related Hazardous Materials Stored at Sandia National Laboratories*

Hazardous Material	Quantity
Acetone	7,069 L
Aluminum	27,092 kg
Ammonium hydroxide	3,046 L
Boron	62 kg
Copper	3,867 kg
Ethanol	3,820 L
Hydrofluoric acid	5,546 L
Lead	81,524 kg
Mercury	850 kg
Methylene chloride	1,409 L
Stainless steel	2,141 kg
Tetraethylorthosilicate	355 L

Source: Atencio 1995.

TABLE I.4.5.1.7.1–1.—*Annual Radiation Doses to the General Public and Onsite Workers from Normal Operations at Sandia National Laboratories*

	Atmospheric Releases		Liquid Releases		Total		
Receptor	Regulatory Limit[a]	Calculated	Regulatory Limit[a]	Calculated[b]	Regulatory Limit[a]	Calculated	Risk[c]
Individual Dose							
Average exposed individual[d] (mrem)	10	$4.7x10^{-5}$	4	0.0	100	$4.7x10^{-5}$	$2.4x10^{-11}$
Maximally exposed individual (mrem)	10	$1.6x10^{-3}$	4	0.0	100	$1.6x10^{-3}$	$8.0x10^{-10}$
Population Dose[e]							
Population within 80 km (person-rem)	[f]	$2.7x10^{-2}$	[f]	0.0	[f]	$2.7x10^{-2}$	$1.4x10^{-4}$
Worker Dose[g]							
Average worker (mrem)	NA	NA	NA	NA	5,000	3.2	$1.3x10^{-6}$
Maximally exposed worker (mrem)	NA	NA	NA	NA	5,000	1,000	$4.0x10^{-4}$
Total workers[h] (person-rem)	NA	NA	NA	NA	None	11	$4.4x10^{-3}$

[a] The regulatory limits for individuals are given in DOE Order 5400.5. The 10 mrem/yr limit from airborne emissions is required by the *Clean Air Act*, the 4 mrem/yr limit is required by the *Safe Drinking Water Act*, and the total dose of 100 mrem/yr is the limit from all pathways combined. The occupational limit for workers is 5,000 mrem (10 CFR 835).

[b] The calculated dose values given in the Liquid Releases column conservatively include all water pathways, not just the drinking water pathway.

[c] Based on latent fatal cancer risk factors of $5x10^{-7}$/mrem for individuals, $5x10^{-4}$/person-rem for population, and $4x10^{-7}$/mrem for workers (ICRP 1991).

[d] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.

[e] Dose for the population in an 80-km (50-mi) radius surrounding SNL, including the population on Kirtland Air Force Base; estimated for a population of approximately 578,313 people.

[f] No regulatory limits exist for population doses; however, a 100 person-rem value for the population is found in proposed 58 FR 16268 (10 CFR 834).

[g] Worker doses were estimated on the basis of readings from monitoring devices called thermoluminescent dosimeters.

[h] The number of badged workers in 1992 was approximately 3,420.

Note: NA - not applicable.

Source: SNL 1994.

SNL workers are also protected by adherence to OSHA and EPA occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded.

The chemical pollutant levels from SNL operations to which the public is exposed meet all applicable permit, regulatory, and DOE operational requirements. A review of the SNL annual environmental and accident reports indicates that there have been no significant adverse impacts to workers, the public, or the environment from hazardous chemicals.

I.4.5.1.8 Waste Management

The current waste management practices at SNL are outlined in table I.4.5.1.8–1. Wastes generated at SNL from research activities include low-level, mixed, hazardous, and nonhazardous wastes. NIF is expected to generate these same categories of wastes during operation.

I.4.5.1.8.1 *Low-Level Waste*

LLW at SNL is generated in both technical and remote test areas as a result of R&D activities. Most of LLW consists of contaminated equipment and combustible decontamination materials and cleanup

E I.4.5.1.8–1.—*Current Waste Management at Sandia National Laboratories* [Page 1 of 2]

ration ate m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
.9	Included in mixed low-level	NA	Staged at generator sites or in containers at Technical Area III aboveground storage site and other facilities	Included in mixed low-level	NA	NA
53	Included in mixed low-level	NA	Staged at generator sites or in containers at Technical Area III aboveground storage site and other facilities	Included in mixed low-level	None; pending offsite shipment to NTS	NA
0.0	Neutralization, solidification; specific preferred treatment option for each treatability group per Site Treatment Plan for mixed waste	Data not available	Technical Area III	Included in solid	NA	NA
2.0	Compaction; specific preferred treatment option for each treatability group per Site Treatment Plan for mixed waste	Data not available	Staged at generator sites or in containers at Technical Area III aboveground storage site and other facilities	3,080	Offsite commercial facilities; some waste streams have no disposal options identified	NA

TABLE I.4.5.1.8–1.—*Current Waste Management at Sandia National Laboratories* [Page 2 of 2]

Category	1994 Generation Rate (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Hazardous							
Liquid	138	Neutralization or thermal treatment (open burn)	Data for neutralization not available at this time	RCRA-permitted Hazardous Waste Management Facility	Included in solid	Offsite	NA
Solid	553 t[a,b]	Thermal treatment	9.1 kg/campaign	RCRA-permitted Hazardous Waste Management Facility	Data not available at this time	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	1,459,906	Offsite	NA	None	NA	Offsite-NPDES outfall to municipal facilities	NA
Solid	4,250 t[b]	Segregation and recycling	NA	None	NA	Offsite sanitary landfill	NA
Nonhazardous (Other)							
Liquid	Included in sanitary	Included in sanitary	NA	None	NA	Included in sanitary	NA
Solid	Included in sanitary	Included in sanitary	NA	None	NA	Onsite classified waste landfill for classified waste; off site for other nonhazardous wastes	NA

[a] Includes 86 t of RCRA-regulated and 466 t of non-RCRA-regulated wastes.

[b] This waste is not tracked by volume and the weight of material is too variable to reliably convert.

Note: NA - not applicable.

Source: SNL 1995d.

debris. All generated LLW is temporarily stored at generator sites or aboveground in transportation containers at the location of the closed Technical Area III LLW disposal site. All LLW packages currently onsite are being stored, pending approval for transport by commercial carriers to NTS for burial.

I.4.5.1.8.2 *Mixed Low-Level Waste*

Mixed wastes managed at SNL include radioactively contaminated oils and solvents and radioactively contaminated or activated lead or other heavy metals. Other mixed wastes may be generated as a result of weapons tests. The 557-m^2 (6,000-ft^2) Radioactive and Mixed Waste Management Facility will have a centralized packaging and storage function for LLW and mixed waste. Mixed waste will be stored at the facility until a decision has been made on an acceptable waste disposal site. Waste processing at the Radioactive and Mixed Waste Management Facility will include activities required to comply with the waste acceptance criteria and Federal regulations. SNL is aiding DOE in developing a compliance agreement to be negotiated with EPA Region VI Field Office. DOE and SNL are assessing their responsibilities as outlined in the FFCA and may enter into similar agreements with the State of New Mexico.

I.4.5.1.8.3 *Hazardous Waste*

Hazardous wastes are generated at SNL by the numerous R&D activities conducted throughout the Laboratory. The Hazardous Waste Management Facility can store 265,000 L (70,000 gal) of liquid and solid hazardous wastes at one time. There are no active onsite disposal facilities for hazardous/toxic wastes at SNL. All RCRA-regulated wastes are packaged, manifested, and shipped offsite by DOT-registered carriers for disposal at RCRA-permitted treatment and disposal facilities.

I.4.5.1.8.4 *Nonhazardous Waste*

SNL contains over 24 km (15 mi) of sewer lines interconnected with those of Kirtland Air Force Base. Pretreated industrial wastewater effluent and sanitary sewage are discharged to the city of Albuquerque sewer system in compliance with NPDES permit discharge limits. Solid sanitary waste is collected and taken to the municipal solid waste landfills of the city of Albuquerque and the city of Rio Rancho.

At SNL, waste minimization and pollution prevention programs have been implemented with programmatic controls such as source reduction, inventory control, product substitution, and waste exchange programs.

I.4.5.2 *Environmental Impacts*

The following sections describe the potential environmental impacts for land use and visual resources, air quality and noise, water resources, ecological resources, cultural and paleontological resources, and socioeconomics for constructing and operating NIF at SNL. In addition, impacts associated with radiation, hazardous chemicals, and waste management are described.

I.4.5.2.1 Land Use and Visual Resources

I.4.5.2.1.1 *Land Use*

Impacts to land use at and around SNL from NIF would be limited to the clearing of land, minor and temporary disruptions from construction activities at contiguous land parcels south of the proposed location, and a slight increase in vehicular traffic. The proposed location for NIF at SNL (figure I.3.4.5.1–2) is a large parcel of flat, vacant land on the southern end of Technical Area II between East Ordnance Road and R Boulevard, and a small plot of land for construction staging on the northern edge of Technical Area IV just south of R Boulevard. NIF would require the clearing of an estimated 10.5 ha (25.9 acres) of land for buildings, walkways, building access, temporary construction laydown area, and buffer space. Such acreage would account for approximately 7 percent of the land currently available for development at SNL (Wheeler 1995b). NIF would be located in an area dedicated to similar land uses (SNL 1995a). No impacts to land use in Bernalillo County, the city of Albuquerque, or nearby communities would be expected.

With appropriate erosion and sediment control measures, soil impacts during construction of NIF would be short term and minor. Seismic risk would be taken into account during construction and operation of NIF.

Table I.4.5.2.2.1–2 lists the estimated SNL annual air pollutant emissions based on the anticipated NIF annual energy requirements provided in table I.4.1.2.2.1–3, adjusted to recognize that at SNL, six new support buildings (with a total area of 9,988 m^2 [107,513 ft^2]) would be required out of the total complement of support buildings area of 26,722 m^2 [287,643 ft^2]).

Published emission factors (EPA 1993) were used in the calculations. Emissions of VOCs from solvent cleaning are included. For comparative purposes, table I.4.5.2.2.1–2 includes SNL 1993 site-wide emissions. More detailed information on emission estimates is provided in Lazaro et al. (1996). As indicated in table I.4.5.2.2.1–2, estimated air pollutant emissions due to NIF operation at SNL are well below 1 t/yr (1.1 tons/yr) except for nitrogen dioxide, which is about 2 t/yr (2.2 tons/yr). Estimated air pollutant emissions from NIF operations would constitute increases over SNL 1993 emission levels, ranging from an increase of 5.3 percent for PM_{10} to 227 percent for carbon monoxide. Existing ambient concentrations for these pollutants (see section I.4.5.1.2.2, table I.4.5.1.2.2–1) are well below the ambient air quality standards except for the Albuquerque County 8-hour standard for carbon monoxide. The additional emission of 0.52 t/yr (0.57 ton/yr) carbon monoxide from NIF operations might pose a problem in attainment of this standard.

SNL must comply with the Albuquerque-Bernalillo County Air Quality Control Board (1995) regulations. Construction activities would require a permit because 0.30 ha (0.74 acre) of land surface would be disturbed. As part of the permit, SNL would have to specify mitigation measures that would prevent the escape from the site of airborne particulate matter that would have more than 10 percent opacity relative to the surrounding background.

Installation of NIF external combustion units (boilers) would require a county permit before construction (Regulation No. 22). Gas-fired boilers with rated heat input greater than 105,600 MJ/hr (100 million Btu/hr) but not over 264,000 MJ/hr (250 million Btu/hr) are limited to New Source Performance Standard nitrogen oxides (NOx) emissions from 43 to 86 ng/J, depending on the heat release rate, which is a function of the furnace volume (40 CFR 60.44b). There are no New Source Performance Standard emission limits for gas-fired boilers with a rated heat input at or less than 105,600 MJ/hr (40 CFR 60.40c). VOC emissions without

TABLE I.4.5.2.2.1–2.— ***Annual Emission Increases with National Ignition Facility Operation at Sandia National Laboratories***

Pollutant	1993 Emissions[a] (t/yr)	Projected National Ignition Facility Emissions[b] (t/yr)	1993 Emissions with National Ignition Facility (t/yr)	NIF Percent of 1993 Emissions
Particulate matter [c]	3.76	0.20	3.96	5.3
Volatile organic compound[d]	1.65	0.57	2.22	34
Carbon monoxide	0.23	0.52	0.75	227
Nitrogen dioxide	1.07	2.15	3.22	201
Sulfur dioxide	0.07	0.04	0.11	50
Lead	NA	Negligible	NA	Negligible

[a] Based on steam plant and stand-by steam plant emissions (see Lazaro et al. 1996 for details).

[b] Emissions based on site estimated natural gas external combustion, diesel internal combustion, and VOC solvent cleaning (0.5 t/yr [0.55 ton/yr]) (see table I.4.1.2.2–1) and emission factors (EPA 1995c; Lazaro et al. 1996).

[c] Reported as total suspended particulate, assumed equivalent to particulate matter less than or equal to 10 micrometers.

[d] Reported as total organic hydrocarbons for steam plant and hydrocarbons for stand-by steam generators, assumed equivalent to VOCs.

Note: NA - not available.

Source: EPA 1993; SNL 1994.

controls would be limited to less than 45.4 kg (100 lb) in any single 24-hour day or 4.54 kg/hr (10 lb/hr) (Regulation No. 11.07). Additional regulatory information is presented in section I.5.2.

I.4.5.2.2.2 *Acoustics*

During site clearing for NIF at the SNL site, noise from construction equipment would increase the average daytime outdoor sound level by 1 dB at the location of the nearest residence. The point modeled is 1,864 m (6,116 ft) north-northwest of NIF. The average sound level at this point would be expected to increase from 64 dBA to 65 dBA during hours that clearing equipment would be operating. The CNR rank, adjusted for the estimated preexisting background level and for temporal and conceptual characteristics of the sound, is expected to be "A." Noise with CNR ranks "A" through "D" is generally considered to be acceptable, with "A" representing essentially no impacts. At the "A" level, the Modified CNR method predicts no complaints from the public. The noise would occur only over a period of approximately one month and only during daylight hours.

The average outdoor daytime sound level at the nearest laboratory building would not be expected to increase. The existing average daytime sound level at this point is estimated to be 64 dBA. The adjusted CNR rank for the resulting sound is "A."

The average daytime sound level at the residential area approximately 1.6 km (1 mi) west of the construction site would not be expected to increase. The existing average daytime sound level at this point is estimated to be 63 dBA. The adjusted CNR rank for the resulting sound is "A." This sound level is not expected to result in complaints from residents in the area.

These noise level estimates are based on the assumptions given in Lazaro et al. (1996). It is possible that actual noise levels could be lower or higher than the estimates.

I.4.5.2.3 Water Resources

About 2.95 MLY (0.78 MGY) of water would be required for NIF construction (LLNL 1995b). Water requirements for NIF operations (152 MLY [40 MGY]) would increase the water use at SNL by 11 percent. Wastewater discharge would be expected to increase by about 18 MLY (4.7 MGY), which is less than 2 percent of the current wastewater volume of 1,280 MLY (336 MGY) (Wheeler 1995c). Agreement with Kirtland Air Force Base and the city of Albuquerque would have to be reached to obtain additional water supply and to discharge additional wastewater.

The proposed location for NIF has minimal flooding potential because it is outside the 500-year floodplain of Tijeras Arroyo (figure I.4.5.1.3–1) (SNL 1995b).

I.4.5.2.4 Biotic Resources

I.4.5.2.4.1 *Terrestrial Resources*

NIF (including the temporary construction laydown area) at SNL would be constructed within 10.5 ha (25.9 acres) of previously disturbed grassland habitat. The general types of impacts that could result from NIF construction at SNL would be similar to those discussed for LLNL (section I.4.1.2.4).

I.4.5.2.4.2 *Wetlands and Aquatic Resources*

The proposed NIF location at SNL does not contain, nor is it located near, any wetlands or surface water resources. Therefore, construction and operation of NIF at SNL would not be expected to adversely affect such resources.

I.4.5.2.4.3 *Rare, Threatened, and Endangered Species*

The only impacts to rare, threatened, or endangered species that might occur from construction of NIF at SNL would be displacement or avoidance of the NIF location because of human presence and noise. No impacts from operation of NIF would be anticipated.

I.4.5.2.5 Cultural and Paleontological Resources

Construction and operation of the proposed NIF would have no effect on archaeological sites or historic structures that are listed on or eligible for the NRHP, important paleontological remains, or Native American cultural resources.

I.4.5.2.6 Socioeconomics

Construction and operation of NIF at SNL would have a minor impact on the socioeconomic conditions in the economic study region and ROI described in section I.4.5.1.6. This is because the SNL is located in a somewhat diverse regional economy with extensive inter- and intraregional, national, and global economic interactions and linkages. Also, because the NIF partnership includes representatives of government, industry, and the academic sector throughout the United States, procurement and investment would be dispersed over a number of different regions, dampening the concentration of economic effects of the program.

The following sections describe the effects of construction and operation of NIF on the host region's economy and employment, and on population, housing, public finances, public services, and local transportation in the ROI.

I.4.5.2.6.1 *Regional Economic Impacts*

Slight changes in employment and economic activity levels in the economic study region would occur from local spending of employee wages, procurement of goods and services including construction materials, and other local investment associated with constructing and operating NIF. In addition to creating new jobs (direct) at the site, indirect job opportunities, such as community support services, would also be created in the economic study area as a result of these new direct jobs. The total new jobs created (direct and indirect) would contribute slightly to unemployment reduction and increased income and economic output in the regional economy during construction and operation of NIF. Table I.4.5.2.6.1–1 summarizes the potential impacts to the regional economy if NIF were located at SNL. Construction of NIF at SNL would result in a peak of more than 280 direct jobs in 1998. This construction-related procurement would indirectly create more than 1,490 jobs in the economic study area. Employment for operation would begin phasing in as construction neared completion. Direct employment related to operations is estimated at 330, with more than 340 indirect jobs created throughout the economic study area. As a result of constructing and operating NIF, the baseline compounded average annual growth rate from 1995 to 2003 would increase by 0.02 percentage points.

Peak earnings associated with the 280 direct jobs created in 1998 are projected at approximately 16.4 million dollars. Construction-related procurement would indirectly create more than 24 million dollars in regional earnings. Direct earnings related to operations are projected to reach nearly 14 million dollars, with 7.3 million dollars in indirect earnings added to the regional economy.

I.4.5.2.6.2 *Population and Housing*

Construction. Population in-migration resulting from NIF construction phase demands would peak in 1998 with a projected cumulative total of 3,065 people moving into the ROI (table I.4.5.2.6.1–1).

This population increase would result in demand for an additional 1,120 housing units in the ROI. Baseline projections of the SNL ROI housing market from 1996 (NIF construction start date) through 1998 indicate that nearly 54,000 housing units would be available. NIF-related demand for approximately 1,120 housing units in 1998 in the ROI would absorb approximately 5 percent of the vacant housing supply in the ROI. NIF would generate little demand for new housing construction because of the number of vacant housing units within the SNL region and the proximity of SNL to many communities in the Middle Rio Grande Valley that could provide both temporary and permanent housing for in-migrating workers. Most of this housing demand would be temporary and would primarily affect the renter segment of the ROI housing market.

Operations. Population in-migration resulting from NIF operation phase demands could result in an additional 660 people moving into the ROI. While the demand for housing would be longer term relative to construction, no perceptible strain on the market is expected, assuming that the general conditions associated with the housing market continue.

I.4.5.2.6.3 *Public Finance*

Construction. Given the anticipated population and economic growth associated with NIF during the construction phase, fiscal balances (revenues and expenditures) would be expected to increase for all the

TABLE I.4.5.2.6.1–1.—*Potential Socioeconomic Impacts in the Sandia National Laboratories Area*

Parameters	NIF Alternative Change Over Reference Baseline		Reference Baseline	
	Peak Construction 1998[a]	Operations 2003[b]	1996 to 2002[a]	2003[b]
Regional Employment				
Direct jobs	280	330		
Indirect jobs	1,490	340		
Total jobs	1,770	670	6,870 additional jobs projected annually	6,895 additional jobs projected
Regional Aggregate Earnings[c]				
Direct earnings	16.44	13.81		
Indirect earnings	24.38	7.30		
Total earnings	40.82	21.11		
Regional Population Migration				
ROI in-migrating population	3,065	660		6,100 people
Regional Housing Demand				
Number of housing units in the ROI	1,120	240	23,600 vacant housing units (average annual)	25,200 vacant housing units
Local Transportation				
Number of trips generated at site per day	538	630		
Public Finance				
Percent change over 1995 fund balance (Bernalillo County)	0.06	0.01	NA	NA
Public Services				
Change in service demand				
Police[d]	7	2	1,131[e]	1,226
Fire[d]	3	1	548[e]	594
General[d]	37	11	7,592[e]	8,226
Physicians[f]	10	2	2,079[e]	2,253
Teachers[f]	24	5	4,895[e]	5,303

[a] Construction period would be 1996 to 2002, with peak construction projected to occur in 1998.
[b] Operating period would be 2003 to 2033, with impacts throughout the period projected to remain stable.
[c] Regional earnings are millions of constant 1994 dollars.
[d] Albuquerque.
[e] Projected 1998 fund balances for Public Finances, and projected 1998 level of service (LOS) for public services.
[f] Bernalillo County.
Source: Model results.

I.4.5.2.6.6 *Environmental Justice*

For the region within 80 km (50 mi) of SNL, both minorities and low-income populations constitute smaller proportions of the population than in New Mexico as a whole (section I.4.5.1.6.5). Thus, no environmental justice issues associated with regional impacts have been identified.

Neither minorities nor low-income persons are clustered disproportionately in the local vicinity of the SNL site (section I.4.5.1.6.5). Thus, local area impacts from the construction and operation of NIF would not disproportionately affect either minority or low-income populations.

I.4.5.2.7 Radiation and Hazardous Chemicals

This section describes potential radiological and hazardous chemical impacts resulting from normal operations and postulated accidents at NIF at SNL. Methods, data, and assumptions used in estimating impacts are presented in Lazaro et al. (1996).

I.4.5.2.7.1 *Normal Operations*

The general public surrounding the SNL site and workers at SNL might be exposed to small quantities of radionuclides released and radiation emitted from routine NIF operations; however, the expected levels of radioactive releases and radiation emissions are well within regulatory limits. No impacts from hazardous chemicals should occur because only minute quantities of hazardous VOCs are expected to be emitted during routine NIF operations. No impacts are expected from routine transportation of tritium targets because there would be no detectable levels of radiation outside the packages carrying the targets. Table I.4.5.2.7.1–1 summarizes the potential impacts of radiation exposures for the Conceptual Design Option and the Enhanced Option for NIF operations at SNL.

Impacts to the Public. For the Enhanced Option, the estimated radiation dose to a maximally exposed member of the public located about 1.9 km (1.2 mi) north of NIF is 0.004 mrem/yr, which is much less than the dose limit of 100 mrem/yr resulting from all pathways combined (DOE 1990). The likelihood of the maximally exposed individual contracting a fatal cancer is 1 in 17 million for the entire operational life of NIF (dose/yr x 30 yr x fatal cancer risk factor of $5x10^{-4}$/rem). The estimated radiation dose to the surrounding public is 0.2 person-rem/yr; no cancer fatalities would be expected to occur in the public for the entire NIF operations at SNL.

TABLE I.4.5.2.7.1–1.—*Potential Radiological Impacts from Normal Operations of the National Ignition Facility at Sandia National Laboratories*

Receptor	Conceptual Design Option	Enhanced Option
Maximally Exposed Individual		
Dose (mrem/yr)	0.001	0.004
Percent of natural background	$3x10^{-4}$	0.001
30-year fatal cancer probability	$2x10^{-8}$	$6x10^{-8}$
Population Within 80 Km		
Dose (person-rem/yr)	0.07	0.2
Percent of natural background	$3x10^{-5}$	$9x10^{-5}$
30-year fatal cancers	0	0
Workers Onsite		
Dose (person-rem/yr)		
Non-NIF workers	0.02	0.08
NIF workers	10	10
30-year fatal cancers	0	0

Source: Model results.

For the Conceptual Design Option, radiation impacts are estimated to be about one-third of those for the Enhanced Option. No health effects would result.

Impacts to Workers. In addition to potential exposure to radionuclides, the general SNL workers outside NIF could be exposed to direct radiation resulting from high-yield experiments at NIF. For the Enhanced Option, the estimated radiation dose to these non-NIF workers at SNL is 0.08 person-rem/yr. No cancer fatalities would be expected to occur in workers for the entire NIF operations at SNL. For the Conceptual Design Option, radiation impacts are estimated to be about one-third the impacts from the Enhanced Option but still carry no risk of adverse health effects.

Potential radiation exposures inside NIF would be kept as low as reasonably achievable through facility

design and administrative controls. The design objective of NIF is to keep the individual radiation worker dose to less than 500 mrem/yr. On average, it is estimated that a NIF worker would receive approximately 30 mrem/yr. No adverse health effects to workers inside NIF would be expected at this exposure level.

I.4.5.2.7.2 *Postulated Accidents*

Radionuclides and hazardous chemicals could be released from accidents postulated at NIF and during the transportation of tritium targets. Tables I.4.5.2.7.2–1 and I.4.5.2.7.2–2 summarize estimated impacts to the public and workers from postulated accidents. A description of each accident scenario evaluated is provided in Lazaro et al. (1996).

TABLE I.4.5.2.7.2–1.—*Potential Radiological Impacts Resulting from Postulated Bounding Accident Involving the National Ignition Facility at Sandia National Laboratories*

Receptor	Conceptual Design Option	Enhanced Option
Maximally Exposed Individual		
Dose (rem)	0.07	0.1
Fatal cancer probability	$4x10^{-5}$	$6x10^{-5}$
Risk (cancer fatalities/yr)	$7x10^{-13}$	$1x10^{-12}$
Population Within 80 Km		
Dose (person-rem)	1,100	1,800
Fatal cancers	0	1
Risk (cancer fatalities/yr)	$1x10^{-8}$	$2x10^{-8}$
Workers Onsite		
Dose (person-rem)	20	33
Fatal cancers	0	0
Risk (cancer fatalities/yr)	$2x10^{-10}$	$3x10^{-10}$

Source: Model results.

Radiological Impacts

Impacts to the Public. The public could be exposed to radionuclides released from a postulated accident at NIF. The bounding accident assumes that an earthquake would occur at the time of a maximum-yield experiment with an accidental release frequency of $2x10^{-8}$/yr. For the Enhanced Option, the estimated radiation dose to the maximally exposed member of the public is 0.1 rem. The likelihood of the maximally exposed individual contracting a fatal cancer from this exposure would be 1 in 17,000. The estimated radiation dose to the surrounding public is 1,800 person-rem. At this level of dose, one cancer fatality would be expected within the surrounding population if the accident were to occur. However, as indicated in table I.4.5.2.7.2–1, the actual risk of radiation-caused cancer fatalities from the postulated accident at SNL is essentially zero when the extremely low probability of the accident occurring during NIF operations is taken into account. The risk is the product of the estimated radiation dose, fatal cancer risk factor of $5x10^{-4}$/rem, and accident release frequency of $2x10^{-8}$/yr.

For the Conceptual Design Option, estimated radiation impacts would be about one-half the impacts from the Enhanced Option. No cancer fatalities would be expected to occur in the public if the postulated accident occurred at NIF.

Impacts to Workers. For the Enhanced Option, the estimated radiation dose to all workers at SNL is 33 person-rem. No cancer fatalities would be expected to occur among workers following the postulated accident at SNL. For the Conceptual Design Option, the estimated radiation impacts are about half the impacts from the Enhanced Option. No adverse health effects would be expected to result. The risk of radiation-caused cancer fatalities among workers would essentially be zero considering the extremely low potential for the postulated accident to actually occur. SNL has a comprehensive emergency plan, which would be expanded to incorporate NIF to ensure protection of workers in case of an accident or natural disaster.

Transportation Impacts. Radiological impacts associated with the transportation of tritium targets would result from a release of tritium into the environment following a transportation accident. Because tritium is a low-energy beta emitter with no associated gamma rays, there would be no radiological risks associated with incident-free (routine) transportation operations. The potential radiological impacts of transporting tritium targets were calculated for truck and air travel. It was assumed that trucks would be used to transport the tritium targets from the manufacturing sites to the nearest major airport and that cargo aircraft would be used to

transport the tritium targets to Albuquerque International Airport. After arriving at the Albuquerque airport, the targets would be transferred to a truck for shipment to NIF at SNL.

Table I.4.5.2.7.2–2 summarizes the risks associated with the transportation of tritium targets from each of the tritium manufacturing facilities to NIF at SNL. Radiological risk from transportation activities is defined as the product of the accident consequence (dose) and the probability of the accident occurring, and was calculated by considering a wide range of accidents, from high-probability, low-consequence events to low-probability, high-consequence events (see Lazaro et al. 1996). Latent cancer fatality risks were obtained by multiplying the dose risk by 0.0005 latent cancer fatalities per person-rem (ICRP 1991). Estimated latent cancer fatality risks range from $6x10^{-10}$ to $6x10^{-9}$ per year for all cases.

Nonradiological impacts associated with the ground transport of tritium targets were calculated for both routine (incident-free) and accident conditions. Nonradiological population risks for routine operations were calculated by multiplying the distance traveled by truck in urban population density zones by a risk factor for latent mortality from pollutant inhalation (Rao et al. 1982). Nonradiological population risks resulting from vehicular accidents were calculated in a similar manner by multiplying the state-specific accident fatality rate by the distance traveled by truck in the state.

The maximally exposed individual and population doses were calculated for a transportation accident involving the release of the entire tritium cargo (assumed to be five tritium targets). Radiological impacts resulting from a potential maximum-consequence accident were assessed for a general population located in an urban population density zone. The maximally exposed individual was assumed to be exposed unshielded as the plume passed at a distance resulting in the largest dose to the individual. Radiological consequences were assessed for worse-case weather conditions (Pasquill Stability Class F) for both the collective population and the maximally exposed individual. For assessment purposes, it was assumed that the entire tritium cargo would be released to the environment in oxide form. The estimated number of latent cancer fatalities from the maximum-severity transportation accident was calculated by multiplying the population committed effective dose equivalent by 0.0005 latent cancer fatalities per person-rem (ICRP 1991). Table I.4.5.2.7.2–2 summarizes the impacts of a maximum-consequence accident during transportation of tritium targets.

Hazardous Chemical Impacts. A number of chemical accidents (including one caused by an aircraft crash) were considered in evaluating potential impacts on members of the public or nearby workers at NIF (Lazaro et al. 1996). The four accidents likely to have the greatest impacts were selected for more detailed study. These four accident scenarios are as follows:

- A mercury release from the ignitron switches
- A combined alumina/silica release from the target chamber
- A carbonyl fluoride release from the optics treatment area
- A hydrogen fluoride release from the optics treatment area

A modeling study was conducted for each of the four release scenarios. More details, including predicted concentrations, are provided in Lazaro et al. (1996). The modeling study applied a dispersion model to each of the releases and used a health criterion representative of acute impacts from an exposure that might happen once in a lifetime. The health criterion (ERPG-2 level) was the concentration below which, if exposure occurred for an hour, the exposed individual could still avoid irreversible health effects by taking emergency action. The results of the modeling yielded the following conclusions:

- The threat zone from each of the four accidents would not extend to the boundary with the public under either typical or extreme meteorological conditions.
- Nearby buildings and personnel outside would be at risk if any of the four accidents occurred. The assumptions were made that the release would not be inhibited by walls of NIF Laser and Target Area Buildings and that the wind

would take the plume away from the building. The distances beyond which concentrations would fall below the ERPG-2 level from each of the accidents are as follows:

- Mercury scenario—237 m (778 ft) for both the Conceptual Design and Enhanced options
- Alumina/silica scenario—174 m (571 ft) for the Conceptual Design Option and 231 m (758 ft) for the Enhanced Option
- Carbonyl fluoride scenario—70 m (230 ft) for both the Conceptual Design and Enhanced options
- Hydrogen fluoride release—101 m (331 ft) for both the Conceptual Design and Enhanced options

The hazard zones for the Conceptual Design Option and Enhanced Option are the same for accidents 1, 3, and 4. These zones are for persons outdoors. People in nearby buildings would likely be protected because the release (typically lasting for 15 minutes) would pass by the buildings with little infiltration. Typically, the concentrations experienced inside single-story structures are a factor of five or more lower than the outdoor levels. Personnel in the Laser and Target Area Building and those outside in the immediate vicinity might be affected.

I.4.5.2.8 Waste Management Impacts

This section evaluates wastes generated by NIF that might affect current waste management practices at SNL during construction, normal operation, and the ultimate decommissioning of NIF if it were located at SNL.

I.4.5.2.8.1 *Waste Generation and Management During Construction and Operation*

The contractor would be required to remove construction-related wastes, including fill generated by site foundation work, from SNL for disposal by the contractor.

During operation, various low-level, mixed, hazardous, and nonhazardous wastes would be generated at NIF. The same waste-handling methods would be used for both the Conceptual Design Option and the Enhanced Option. Although total waste quantities would be somewhat higher for the Enhanced Option, no changes in handling methods would be necessary. Table I.4.1.2.8.1–2 (section I.4.1.2.8.1) lists the quantities of wastes that would be generated (by category) for both the Conceptual Design Option and Enhanced Option, and the following sections describe the proposed disposition of those wastes.

Low-Level Waste. Onsite disposal of LLW at SNL was terminated in December 1988. Currently, all newly generated LLW is stored temporarily above ground at generator sites or in transportation containers at the inactive Technical Area III disposal site.

The Radioactive and Mixed Waste Management Facility at SNL was completed in 1990. Because of changes in regulations during construction, some facility upgrades are required before operations can begin. This 730-m^2 (7,858-ft^2) facility will serve as a centralized packaging and storage facility for LLW and LLW-mixed waste that meet the facility waste acceptance criteria. It is projected that the Radioactive and Mixed Waste Management Facility will be operational in 1996.

Additionally, SNL has an approved program for the NVO-325 "Nevada Test Site Defense Waste Acceptance Criteria, Certification and Transfer Requirements." All NIF solid LLW could be added to the program and disposed of at the NTS LLW disposal site. Liquid radioactive waste could be solidified and disposed of at NTS as well.

Mixed Waste. As was the case for LLW, onsite disposal of mixed waste at SNL was also terminated in December 1988, and all newly generated mixed wastes are stored temporarily above ground at generator sites or in transportation containers at the inactive Technical Area III disposal site. The Radioactive and Mixed Waste Management Facility is expected to be operational in 1996 and would be able to accept NIF-generated mixed wastes. When the treatment of the hazardous portion of the mixed waste is not feasible, the waste would be stored onsite until DOE determined the appropriate disposal option for mixed waste.

Hazardous Waste. All RCRA-regulated wastes generated by SNL (except mixed waste) are transported offsite for disposal at EPA-permitted treatment, storage, and disposal facilities. Chemical wastes generated by SNL R&D activities are collected from generator locations, segregated according to DOT hazard class, and transported to the RCRA-permitted Hazardous Waste Management Facility for storage. At Hazardous Waste Management Facility, the wastes are consolidated and packaged according to EPA-permitted treatment, storage, and disposal facilities or recyclers for final disposition. Packaged wastes are transported by EPA-permitted carriers to EPA-permitted treatment, storage, and disposal facilities or recyclers for final disposition. The same procedure would be used for NIF-generated hazardous wastes.

During 1993, 484 t (533 tons) of chemical waste were managed by SNL's chemical waste management program, including 141 t (155 tons) of RCRA-regulated hazardous waste and 343 t (378 tons) of nonregulated industrial waste. NIF-generated hazardous waste would not adversely affect SNL's capacity to manage this waste stream.

Nonhazardous Wastes. SNL nonhazardous wastes are managed by the Waste Operations Department of the Environmental Operations Center and are disposed of at the solid waste landfills of two local cities of Albuquerque and Rio Rancho. NIF-generated, nonhazardous waste streams would be incorporated into the existing procedures.

Possible Waste Minimization During Operation. A formal Waste Minimization and Pollution Prevention Awareness Program was initiated in 1989. The program addresses waste reduction activities for all media (air, water, and solid) for nonhazardous, hazardous, mixed, and radioactive wastes. The program's objective is to foster a philosophy to conserve resources and make pollution prevention an integral part of design, operations, and maintenance.

If NIF were to be sited at SNL, the Waste Minimization and Pollution Prevention Awareness Program staff would work with NIF design and operations staff to identify opportunities for waste minimization and pollution prevention. Strategies for achieving these opportunities would be designed by the program staff in conjunction with NIF staff.

Impacts on Existing Waste Management Capabilities at SNL. Data on the estimated waste generation by NIF (table I.4.1.2.8.1–2) and on current waste management capacities at SNL have been used to evaluate the capability of the existing SNL facilities to undertake the various waste management tasks associated with NIF. For reference, table I.4.5.1.8–1 lists the current waste management capacity at SNL, and table I.4.5.2.8.1–1 shows the anticipated impact of NIF wastes on that capacity. Table I.4.5.2.8.1–2 compares the NIF waste generation rate to the annual handling/treatment capacity at SNL.

As discussed above, SNL waste management operations are focused around two facilities, the Hazardous Waste Management Facility for hazardous waste management, and the Radioactive and Mixed Waste Management Facility for radioactive and mixed waste management. All hazardous wastes are staged, processed, and packaged for shipment to RCRA-permitted commercial treatment, storage, and disposal facilities at the Hazardous Waste Management Facility. All mixed and radioactive wastes are currently stored at the generator sites throughout SNL or in transportation containers at SNL's inactive disposal site in Technical Area III. These wastes will be transferred to the Radioactive and Mixed Waste Management Facility when it is opened for operations. At the Radioactive and Mixed Waste Management Facility, LLW will be temporarily stored and then packaged for shipment to offsite disposal facilities to be selected by DOE. Mixed wastes will be processed and treated, then packaged for shipment to offsite facilities approved for either treatment or disposal.

I.4.5.2.8.2 *Waste Management at Sandia National Laboratories During National Ignition Facility Decommissioning*

NIF would be decommissioned after 30 years of operation. The major activated/contaminated components would be located in the target area, so decommissioning of this component poses the most complex operation. The procedures would be similar to those discussed in previous sections for NIF decommissioning at other candidate sites.

Decommissioning of NIF Laser. During decommissioning of the laser systems, the waste quantities

TABLE I.4.5.2.8.1–1.—*Impact of Estimated National Ignition Facility-Generated Waste on Waste Storage at Sandia National Laboratories*

Category	NIF-Generated Waste/Year (m^3)		Years to Fill Storage with NIF Flow Alone[a]		Is Existing or Planned Storage Capacity Adequate	
	Solid[b]	Liquid[b]	Solid	Liquid	Solid	Liquid
Low-Level						
Conceptual design total	2.98	0.60	$0.3x10^3$	NA[c]	Yes	Yes
Enhanced total	7.25	1.56	$0.1x10^3$	NA[c]	Yes	Yes
Mixed						
Conceptual design total	0.34	2.00	297	NA[c]	Yes	Yes
Enhanced total	0.88	4.98	114	NA[c]	Yes	Yes
Hazardous[d]						
Conceptual design total	8.0	2.3	NA[e]	NA[e]	NA[e]	Yes[f]
Enhance total	8.0	4.6	NA[e]	NA[e]	NA[e]	Yes[f]

[a] The following values for the densities of the materials were assumed: molecular sieves: density of diatomaceous earth (0.27 g/cm^3); personal protective equipment and wipes: density of paper (0.4 g/cm^3); pre- and high-efficiency particulate air filters: density of charcoal (1.8 g/cm^3); paper capacitors: density of paper (0.4 g/cm3); hardware from chamber: density of 50 percent aluminum and 50 percent stainless steel (5.3 g/cm^3).

[b] The total amount of the low-level waste was found by adding the values in the column "Cleaned" of table I.4.1.2.8.1–2 to the column "Low-Level" of the same table. The density of the debris shield was assumed to be the density of iron (7.87 g/cm^3). The density of the low-level liquid waste was assumed equal to 1.0 g/cm^3. The amount of the "cleaned" personal protective equipment and wipes/general cleaning was added to he solid low-level radioactive waste.

[c] All liquid low-level waste and mixed waste are currently stored temporarily at the site of generation. SNL is conducting treatability studies before applying for RCRA permit for treating and storage of liquid low-level waste and mixed waste.

[d] The values for the hazardous waste are the sum of Laser and Target Area Building and Optics Assembly Area values.

[e] Hazardous waste is stored temporarily and then shipped offsite to a commercial RCRA waste disposal facility.

[f] Temporarily stored, then shipped offsite to RCRA-permitted storage/disposal facility.

Note: NA - not applicable.

Source: Calculated from tables I.4.1.2.8–2 and I.4.5.1.8–1.

listed in table I.4.1.2.8.2–1 would be handled as discussed in the sections on hazardous, nonhazardous, radioactive, and mixed waste management above.

Decommissioning of NIF Target Area. The waste quantities listed in table I.4.1.2.8.2–2 from target area decommissioning would be handled as discussed in the sections on hazardous, nonhazardous, radioactive, and mixed waste management above. There are no special issues related to any waste topics, including tritium handling. All waste handling would be done in accordance with the waste management procedures outlined above. Quantities and dose rates listed in tables I.4.1.2.8.2–3 and I.4.1.2.8.2–4 do not present any special problems.

TABLE I.4.5.2.8.1–2.—*Comparison of National Ignition Facility Waste to Annual Treatment Capacity at Sandia National Laboratories*

Category	Ratio of NIF Generation to Annual Treatment Capacity	Treatment Capacity (m^3/yr)	Is Existing or Planned Treatment/Disposal Capacity Adequate
Low-Level			
Liquid			
Conceptual design total	NA	Included in mixed low-level	Yes
Enhanced total	NA		Yes
Solid			
Conceptual design total	NA	Included in mixed low-level	Yes
Enhanced total	NA		Yes
Mixed			
Liquid			
Conceptual design total	NA	Data not available	Yes
Enhanced total	NA		Yes
Solid			
Conceptual design total	NA	Data not available	Yes
Enhanced total	NA		Yes
Hazardous			
Liquid			
Conceptual design total	NA[a]	Data not available[a]	Yes[b]
Enhanced total	NA[a]		
Solid			
Conceptual design total	NA	9.1 kg/campaign[a]	Yes[b]
Enhanced total	NA		

[a] Treatment capacities are expanded to meet requirements.
[b] Shipped offsite to a RCRA-permitted storage/disposal facility.
Note: NA - not applicable.
Source: Calculated from tables I.4.1.2.8–2 and I.4.5.1.8–1.

I.4.6 No Action

Under the No Action alternative, NIF would not be constructed or operated. Without the facility, the missions to be accomplished by operation of NIF (sections I.2.2 and I.2.3) would be adversely affected. Any other course of action could have its own unique set of environmental impacts that would differ from those of NIF. Thus, while the No Action alternative would avoid the direct impacts of NIF, it might also result in other impacts. The nature and extent of such impacts would depend on the ultimate course of action taken to ensure the Nation's nuclear deterrent and cannot be analyzed at this time.

If NIF were not constructed and operated, the impacts of these activities would not occur at any of the alternative sites. Land use, air quality, noise, water resources, biotic resources, cultural and paleontological resources, radiological and hazardous chemical environments, and waste management would remain as described in the affected environment sections for each of the alternative sites (sections I.4.1.1, I.4.2.1, I.4.3.1, I.4.4.1, and I.4.5.1). Current land use would continue. There would be no changes in the visual environments. Other programs at the alternative sites would continue to generate air pollutants, use water, and produce wastes.

If NIF were not constructed and operated, a number of socioeconomic and operational impacts could occur at several of the candidate sites. At LLNL, the Nova Facility would continue to operate, but with a changed mission to support stockpile stewardship (section I.3.3). All NIF-dependent functions of the ICF program would be discontinued at LLNL, LANL, and SNL. For the purpose of this PSA, it was assumed that no NIF would directly result in the loss of approximately 100 full-time equivalent employees at LLNL, 20 employees at LANL, and 20 employees at SNL. Reductions in personal consumption expenditures by laboratory personnel and in program-related operational procurement expenditures would result in additional indirect effects on the regional economy surrounding each of these sites because the demand for capital investment, commodities, and services would decline. These additional indirect effects would include the loss of approximately 53 additional jobs in the economic study region for LLNL, 7 jobs in the economic study region for LANL, and 9 jobs in the economic study region for SNL. Overall, the loss of jobs as a result of NIF not being constructed would cause a decrease in projected average annual employment growth in the economic study region of the three candidate sites. Although the loss of jobs in the economic study region might lead to some out-migration from the ROI at each site under the No Action alternative, the extent of out-migration is not known. The impact of the No Action alternative on population, housing, public finance, and public services in the ROI at each site cannot, therefore, be estimated. The No Action alternative would slightly reduce the average number of daily trips to each site (100 at LLNL, 20 at LANL, and 20 at SNL).

No change in socioeconomic conditions would occur at NTS and NLVF under the No Action alternative. Baseline conditions would continue as described in sections I.4.3.1 and I.4.4.1.

I.4.7 Mitigation

I.4.7.1 *Summary of Mitigation Commitments*

The following section addresses specific mitigative measures that the candidate sites have enacted for any construction action, including potential NIF construction. While each of these mitigative measures may be minor, their overall combined contribution would significantly reduce impacts to the environmental resources of the candidate sites. The evaluations of environmental consequences of NIF construction and operation addressed in sections I.4.1.2, I.4.2.2, I.4.3.2, I.4.4.2, and I.4.5.2 are based on the assumption that the mitigative measures would be carried out if the proposed action was undertaken.

I.4.7.1.1 Biotic Resources

No more than 60 days before the start of construction at LLNL, a preconstruction survey for protected and sensitive biological resources would be conducted within the proposed NIF and laydown locations, as well as the access routes and bridge that would connect these locations. Exclusion or buffer zones would be established around any sensitive locations in these areas. Appropriate mitigation measures would be implemented to avoid or minimize potential adverse impacts to protected and sensitive resources, such as Federal- or state-listed species.

Reclamation plans for the staging area, bridge, and access road are to be developed. Reclamation activities would include removal of all temporary construction features, stabilization of soils to prevent erosion, and reseeding with appropriate plant species.

At LANL, an ecological studies team (see DOE 1995b) would be consulted for the following:

- To conduct a preconstruction site-specific survey
- To determine whether any raptor nesting sites were present in or around the construction area (if nesting sites were discovered, an ecological studies team would recommend spatial and/or temporal restrictions on construction activities)
- To approve all tree removal (live or snag)
- To recommend mitigation measures before construction disturbance
- To help determine plant species for revegetation activities

At LANL, all light sources during construction and operation of NIF would have to be arranged so that light is not directed toward LANL canyons in order to protect habitat that might be used by the Mexican spotted owl (Risberg 1995). Because fencing could affect wildlife movements, an ecological studies team would be contacted to determine whether fencing around NIF would need to be minimized.

At NTS, preconstruction surveys would be required to determine the occurrence of listed plant species in the area to be disturbed (DOE 1995c). Mitigative measures required for the desert tortoise would include (1) conducting surveys for the tortoise and removing any tortoises found in affected areas; (2) conducting periodic inspections and eventual backfilling, covering, or installing of tortoise-proof fencing around open construction trenches and excavations; and (3) reducing vehicle speed limits on site roadways (DOE 1995c).

I.4.7.1.2 Cultural and Paleontological Resources

No archaeological sites or historic structures currently listed on or eligible for the NRHP, or paleontological resources, are present within the areas proposed for NIF at the five candidate sites. Thus, mitigation measures would not be necessary.

I.4.7.2 Potential Mitigation

The candidate sites have committed to a broad spectrum of mitigative measures that would minimize adverse environmental impacts from the construction and operation of NIF. The following are additional mitigative measures that may be adopted at one or more of the candidate sites.

I.4.7.2.1 Land Use

During construction at the LLNL site, traffic should be monitored along Greenville Road between Interstate 580 and East Avenue. A road directly accessing the proposed site from Greenville Road could reduce traffic congestion if monitoring indicated a problem. If the option I staging area is selected, the temporary access road from Patterson Pass Road could also serve as access to NIF during operations. For NLVF, traffic on Commerce Avenue along the western edge of the installation and on Losee Road near the facility's south gate should be monitored during and after the construction phase. At all sites, construction traffic should be encouraged to avoid essential gates and other site access points during morning traffic peaks.

I.4.7.2.2 Visual Resources

Fugitive dust suppression techniques during the construction phase of the NIF project would be impacted. While landscaping could improve the visual quality of any buildings constructed for NIF, landscaping is particularly recommended for the proposed site at LANL. Tree removal on the proposed NIF location at LANL should be monitored to ensure that the fewest trees possible are taken.

I.4.7.2.3 Air Quality

Generation of fugitive particulate (PM_{10}) emissions (dust) during site clearing and facility construction

could be mitigated with the use of appropriate dust control measures. With conventional dust control methods using water spray, an estimated 50 percent control can be achieved during earthmoving activities, and 60 percent control can be achieved for traffic on unpaved roads (EPA 1989). The addition of dust suppressants such as calcium to the water can decrease unpaved road traffic emissions by up to 90 percent of uncontrolled levels (Nalco 1987). Additives can also decrease earthmoving dust emissions by up to 65 percent (EPA 1989). Uncontrolled nitrogen oxide air pollutant emissions from gas- or liquid petroleum gas-fired external-combustion (boiler) sources can be reduced by best available control technology (for example, by use of boilers equipped with nitrogen oxide controls). Boilers above a specific size are required by regulation to install best available control technology, which defines the amount of reduction of nitrogen oxide emissions required.

The public should be notified in advance that elevated noise levels would occur during daylight hours for up to several months (depending on the candidate site selected) during the construction period.

I.4.7.2.4 Biotic Resources

To ensure compliance with the *Migratory Bird Treaty Act*, a determination should first be made as to whether protected migratory birds nest in the areas to be cleared for NIF (this activity would include conducting site surveys to locate any nests of migratory birds). If nests or eggs of migratory birds were present, the U.S. Department of the Interior would be consulted regarding the appropriate precautions that might be necessary during construction. This consultation should occur as far in advance of construction as practicable.

Additionally, the following mitigation measures might be needed:

- If migratory birds were nesting at the proposed NIF construction areas, clearing operations would be avoided during the breeding season, where practicable.
- To minimize disturbance of wildlife, construction workers would be prevented from entering undisturbed areas adjacent to any construction sites.
- The area around NIF (and the staging area at LLNL) would be revegetated with native plants, in keeping with the spirit of the Presidential Memorandum of April 26, 1994 (*Environmentally and Economically Beneficial Practices on Federal Landscaped Grounds*).
- Construction crews would receive environmental briefings as appropriate to alert them to specific areas of concern and to explain the reasons for such concerns.
- Passive reminders (such as signs) to warn work crews to use only designated access roads or to inform them that they are working in an environmentally sensitive area should be considered (particularly at LANL and NTS). Passive reminders should also be considered for the option I staging area and its access road at LLNL to avoid potential impacts to wetlands in the Arroyo Las Positas. Use of temporary physical barriers (such as fencing) to remind crews to avoid short cuts across sensitive areas should also be considered.
- Construction traffic would be restricted to existing roads, whenever possible.
- Parking and equipment storage areas would be limited to as few designated sites as possible, in order to limit unnecessary disturbance of vegetation.
- Pre-construction surveys of the NIF location would be made to determine if any rare, threatened, or endangered species were present. If listed species are found, specific mitigation measures would be developed in conjunction with the U.S. Fish and Wildlife Service and/or appropriate state agencies entrusted with natural resources management authorities to minimize impacts to the species from construction of NIF.

guidelines. Concentrations of particulate matter and TSPs are expected to be close to or exceed the 24-hour ambient PM_{10} and TSP standards during peak construction periods under dry and windy conditions. Such exceedances are not uncommon for large construction projects. Air pollutant concentrations during operation are expected to remain within Federal and state ambient air quality standards, except for 1-hour ozone concentrations at LANL and SNL, 1-hour nitrogen dioxide concentrations at LLNL, 1-hour carbon monoxide levels at SNL, and 24-hour PM_{10} at NTS.

For each of the candidate sites, use of water is unavoidable, but would not represent an adverse impact.

Loss of wildlife habitat within the disturbed areas would be unavoidable. However, only one percent or less of uncommitted lands at candidate sites with high-quality habitat (LANL and NTS) would be potentially disturbed by NIF construction. Additionally, the potential NIF locations at these sites are not critical habitat for threatened or endangered species and do not consist of ecotypes rare to the area. Construction of NIF would have some unavoidable adverse effects on biota. Larger and more mobile animals could move out of the construction areas to similar habitats nearby, but smaller, less mobile animals could be destroyed during land-clearing activities. Rare, threatened, or endangered species could be affected directly or indirectly by construction of NIF. Where potential exists for impacts on listed species, mitigation measures would be developed in consultation the U.S. Fish and Wildlife Service or the state's Department of Natural Resources.

No unavoidable adverse impacts to cultural resources would be expected at any of the NIF candidate sites.

Few unavoidable adverse impacts related to socioeconomic issues would occur in any of the ROIs for the NIF candidate sites. Burdens on community infrastructure would increase, but subsequent effects on the public finances of local governments in the ROI would be positive for the most part. Localized increases in traffic would result from construction and operation of NIF. No adverse, disproportionate environmental justice concerns would be expected at any of the candidate sites, except for a minor potential to impact minority populations in the ROI for NLVF.

Over the 30-year operational life of NIF, the public would be exposed to a very small dose of radiation (table I.3.6.1–1). No cancer fatalities would be expected to occur from exposures associated with routine NIF operations under either the Conceptual Design or Enhanced options. A radiological accident at NIF would not cause any cancer fatalities to the public, except possibly at NLVF and SNL. At NLVF, one death could occur from a maximum-release accident scenario under the Conceptual Design Option or two cancer deaths could occur for the maximum-release accident under the Enhanced Option. At SNL, one cancer death is calculated as possible for a maximum-release scenario under the Enhanced Option. However, because the chance of such an accident actually occurring is so low, the risk of such deaths is extremely unlikely. The cancer fatality risk associated with radiological exposure from an accident involving transport of the NIF tritium targets would range from $8x10^{-10}$ to $1x10^{-8}$; the nonradiological fatality risks associated with vehicular emissions and accidents are in the $1x10^{-3}$ to $1x10^{-4}$ range (table I.3.6.1–1).

Although each candidate NIF site would implement waste minimization techniques, the generation of additional low-level, hazardous, and nonhazardous wastes would be unavoidable. However, all candidate sites have current or planned capacity to handle wastes associated with NIF (although this would entail offsite shipment for some of the wastes for all sites but LANL) (table I.3.6.8–1).

I.4.9 Irreversible and Irretrievable Commitments of Resources

Resources that would be committed irreversibly or irretrievably during construction and operation of NIF include materials that could not be recovered or recycled and materials or resources that would be consumed or reduced to irrecoverable forms. Use of concrete, steel, fuel, power, and other materials would constitute an irreversible and irretrievable commitments of those resources (see table I.4.9–1). The use and consumption of these resources are believed appropriate and justified in terms of the national importance of the missions and objectives of NIF.

TABLE I.4.9–1.—*Irreversible and Irretrievable Commitments of Resources*

Resources	No Action	LLNL	LANL	NTS	NLVF	SNL
Construction Materials						
Concrete (m^3)	None	$5.3x10^4$	$5.6x10^4$	$5.5x10^4$	$5.7x10^4$	$5.6x10^4$
Steel (t)	None	$7.0x10^3$	$8.5x10^3$	$8.0x10^3$	$9.0x10^3$	$8.5x10^3$
Water (L/yr)[a]	None	$1.5x10^6$	$2.0x10^6$	$1.8x10^6$	$2.3x10^6$	$2.0x10^6$
Fuel						
Diesel fuel (L)	None	$8.0x10^5$	$1.1x10^6$	$1.0x10^6$	$1.2x10^6$	$1.1x10^6$
Natural gas (m^3)	None	$4.8x10^3$	$6.5x10^3$	$6.0x10^3$	$7.3x10^3$	$6.5x10^3$
Electricity (kWh)	None	$1.3x10^4$	$1.7x10^4$	$1.6x10^4$	$2.0x10^4$	$1.7x10^4$
Operations (Annual)						
Water (L)	None	$1.1x10^7$	$2.1x10^7$	$2.0x10^7$	$2.2x10^7$	$2.1x10^7$
Diesel fuel (L)	None	$7.0x10^2$	$2.8x10^3$	$2.2x10^3$	$3.7x10^3$	$2.8x10^3$
Natural gas (m^3)	None	$6.1x10^5$	$8.1x10^5$	$7.5x10^5$	$9.0x10^5$	$8.1x10^5$
Electricity (kWh)	None	$3.0x10^7$	$4.2x10^7$	$3.8x10^7$	$4.9x10^7$	$4.2x10^7$

[a] Based on 250 construction days/yr.
Note: Based on new buildings required for each site.
Source: Foley 1996.

The land that would be occupied by NIF could ultimately be returned to open space if buildings, roads, and other structures were removed and the land revegetated. Alternately, the NIF buildings could be modified for use in other programs. Therefore, the commitments of land to the NIF project is not necessarily irreversible. However, land rendered unfit for other purposes, such as that set aside for radiological and hazardous chemical waste disposal facilities, represents an irreversible commitments of those resources because wastes in belowground disposal areas may not be completely removed at the end of the project. The land could not be restored to its original condition or to minimum cleanup standards, nor could the site feasibly be used for any other purposes following closure of the disposal facility. This land would be perpetually unusable because the substrata would not be available for other potential intrusive uses such as mining, utilities, or foundations for other buildings. However, the surface area appearance and biological habitat lost during construction and operation of the disposal facilities could, to a large extent, be restored.

The irreversible and irretrievable commitments of material resources for NIF would include construction materials that could not be recovered or recycled, materials that would be rendered radioactive but could not be decontaminated, and materials consumed or reduced to unrecoverable forms of waste. Where construction is necessary, the required materials would include wood, concrete, sand, gravel, plastics, steel, aluminum, and other metals. These construction resources, except for those that could be recovered and recycled with current technology, would be irretrievably lost. However, none of these identified construction resources are in short supply, and all are readily available in the vicinity of locations being considered for NIF. The commitment of materials to be manufactured into new equipment that could not be recycled at the end of the project's useful lifetime would be irretrievable.

Consumption of operating supplies, miscellaneous chemicals, and gases, while irretrievable, would not constitute a permanent drain on local resources or involve any material in critically short supply in the United States as a whole. Materials consumed or reduced to unrecoverable forms of waste, such as radioactive waste, are also irretrievable. However, strategic and critical materials, or resources having small natural reserves, are of such value that economics promotes recycling. Plans to recover and recycle as much of these valuable, depletable resources as is practical would depend on need, and each item would be considered individually at the time a recovery decision is required.

justice issues were identified for either regional or local area impacts.

NIF operations would involve both radioactive and hazardous materials. NIF would be classified as a low hazard radiological facility on the basis of predictions of very low exposures from potential accidents at the facility. The radiological dose to the general public from 30-year NIF operations would be 6 person-rem, which is about 25 percent of the 23 person-rem (based on constant 1994 level) resulting from all other LLNL operations for 30 years. The cumulative dose of 29 person-rem is less than one millionth of the dose to the population from normal background radiation, consumer products, and medical sources. No cancer fatalities are expected in the region from the operation of NIF and other facilities at LLNL. Risks to the public from a NIF accident at LLNL would also be extremely low. The risk of a NIF accident-related cancer fatality occurring in the population within an 80-km (50-mi) radius of LLNL over the 30-year lifetime of the facility is approximately 1 in 10 million. Risks of a radiation-related cancer fatality from accidents during transportation of tritium targets to LLNL are also very low (less than 1 in 1 million over 30 years) in comparison with the risk from fatal vehicular accidents during transportation (about 1 in 8 over 30 years) or the cancer risk associated with exhaust emissions from transportation vehicles (about 1 in 16 over 30 years).

LLNL has the plans and capacity to handle wastes from NIF operations without facility expansion and resultant cumulative effects on either site or regional waste management.

I.4.11.2 *Los Alamos National Laboratory*

Although the proposed location for NIF at LANL is in an undeveloped forested area, placing NIF in that area would be consistent with the area's designation as an experimental science land-use zone. New buildings at the NIF location would alter the local visual environment and contribute to the developed aspect of the central portion of LANL.

Emissions of air pollutants from NIF construction and operation would not contribute to the violation of any air quality standard or to any regional air quality problem.

Construction and operation of NIF at LANL would contribute to the cumulative water demand of continuing operation of LANL and continuing urban developments in the region. Operation of NIF would add about 8 percent to LANL's site water requirement. Water requirements for projected development, including NIF, would be adequately met with utility upgrades under a long-range utility development plan. Stormwater runoff from the NIF location would contribute to the cumulative adverse effect of all industrial, commercial, and municipal developments on stormwater quality. However, the incremental effect of NIF would be minor because stormwater pollution prevention measures would be implemented during both construction and operation of the project.

Construction of NIF at the proposed LANL location would convert natural ponderosa pine and pinyon juniper habitats to managed habitats, pavement, and buildings. This conversion would extend the influence of urbanized/industrial habitats and increase fragmentation of wooded habitat. However, natural wooded habitats are abundant at LANL. Minor habitat loss might be experienced by several listed species at LANL, should they be present at the NIF location. No critical habitats would be affected.

Construction and operation of LANL would not affect any known or suspected cultural, historical, or paleontological sites. No cultural resources are known for the NIF location.

The construction and operation of NIF would result in a small incremental increase in employment, housing demand, and expenditures in a community developed around the presence of a large Federal facility. Housing demand for 1,500 NIF-related workers would be 17 percent of the expected housing vacancies, and such a high demand for housing could stimulate housing starts and affect housing costs in the area. The potential development of NIF would sustain employment at LANL in non-NIF jobs in the physics of ICF, dense materials applications, and weapons physics. If NIF were not constructed at any site (No Action), then employment at LANL would decline from current levels by about 20 workers. No environmental justice issues were identified for either regional or local area impacts.

NIF operations would involve both radioactive and hazardous materials. NIF would be classified as a low hazard radiological facility on the basis of predictions of very low exposures from potential accidents at the facility. The radiological dose to the general public from 30-year NIF operations would be 2 person-rem, which is about 5 percent of the 42 person-rem (based on constant 1994 level) resulting from all other LANL operations for 30 years. The cumulative dose of 44 person-rem is less than 0.002 percent of the dose to the population from normal background radiation, consumer products, and medical sources. No cancer fatalities are expected in the region from the operation of NIF and other facilities at LANL. Risks to the public from a NIF accident at LANL would also be extremely low. The risk of a NIF accident-related cancer fatality occurring in the population within an 80-km (50-mi) radius of LANL over the 30-year lifetime of the facility is approximately 1 in 10 million. Risks of a radiation-related cancer fatality from accidents during transportation of tritium targets to LANL are also very low (less than 1 in 1 million over 30 years) compared with the risk from fatal vehicular accidents during transportation (about 1 in 8 over 30 years) or the cancer risk associated with exhaust emissions from transportation vehicles (about 1 in 16 over 30 years).

LANL has the plans and capacity to handle wastes from NIF operations without facility expansion and resultant cumulative effects on either site or regional waste management.

I.4.11.3 *Nevada Test Site*

The proposed location for NIF at NTS is in Area 22 at an undeveloped desert site. NTS has not designated land-use zones for the area. However, development of NIF in Area 22 would not be a change to the historical land-use for the general area because the Mercury Base Camp and Desert Rock Air Strip are nearby. New buildings at the NIF location would alter the local and area-wide visual environment. Buildings would be visible from U.S. Highway 95, about 6.5 km (4 mi) away.

At the NTS location, the 24-hour average background concentration for particulates, as measured by PM_{10}, is currently above both the national and state ambient air quality standards. Fugitive dust emissions during construction of NIF would be an incremental addition to this existing regional environmental impact. Greatest potential fugitive dust emission would occur during the 2.5-month site clearing phase of construction. Construction activities at NTS would require an operating permit for any surface area disturbance of more than 2 ha (5 acres). During construction, fugitive dust air pollutant emissions would be controlled by using the best practical methods.

Construction and operation of NIF at NTS would not be expected to contribute cumulatively to regional water supply problems. Operation of NIF would add about 21 percent to NTS's site water requirements, but the NTS water supply system has adequate production and storage capacity to meet the additional demand.

Construction of NIF at the proposed NTS location would convert natural creosote bush desert habitats to managed habitats, pavement, and buildings. Creosote bush desert habitats are widespread in the NIF location area and would not be fragmented. Minor loss of desert tortoise habitat would occur, and individual tortoises might be threatened by construction activities. The ferruginous hawk would be discouraged from hunting in areas of human disturbance, but loggerhead shrikes would use the surrounding fence for perching and hunting. No critical habitats would be affected.

Construction and operation of NIF at NTS would not affect any known or suspected cultural, historical, or paleontological sites. No cultural resources are known for the NIF location.

The construction and operation of NIF would have little influence on the socioeconomics of the diverse regional economy in the Las Vegas area. Because of the number of vacant housing units in the region, there would be little demand for new construction. The No Action alternative would not affect NTS because NIF-related studies in ICF, high-density materials, or weapons physics are not pursued at NTS. No environmental justice issues were identified for either regional or local area impacts.

NIF operations would involve both radioactive and hazardous materials. NIF would be classified as a low hazard radiological facility on the basis of predic-

tions of very low exposures from potential accidents at the facility. The radiological dose to the general public from 30-year NIF operations would be 0.03 person-rem, which is about 8 percent of the 0.36 person-rem (based on constant 1994 level) resulting from all other NTS operations for 30 years. The cumulative dose of 0.4 person-rem is less than two millionths of the dose to the population from normal background radiation, consumer products, and medical sources. No cancer fatalities are expected in the region from the operation of NIF and other facilities at NTS. Risks to the public from a NIF accident at NTS would also be extremely low. The risk of a NIF accident-related cancer fatality occurring in the population within an 80-km (50-mi) radius of NTS over the 30-year lifetime of the facility is less than 1 in 10 million. Risks of a radiation-related cancer fatality from accidents during transportation of tritium targets to NTS are also very low (less than 1 in 1 million over 30 years) compared with the risk from fatal vehicular accidents during transportation (about 1 in 6 over 30 years) or from the cancer risk associated with exhaust emissions from transportation vehicles (about 1 in 16 over 30 years).

NTS has the plans and capacity to handle wastes from NIF operations without facility expansion and resultant cumulative effects on either site or regional waste management.

I.4.11.4 *North Las Vegas Facility*

Siting NIF at NLVF would not change land use because this area is zoned for general industrial use. New buildings at the NIF location would alter the local visual environment and be visible from nearby residential areas. However, the visual environment in this area is characterized by industrial-type structures, so NIF would not substantially change the visual character of the local area.

In the NLVF region, the 24-hour average background concentration for particulates, as measured by PM_{10}, is just slightly less than the national and state standards. Fugitive dust emissions from construction of NIF would raise PM_{10} above the standard at the site boundary, but use of calcium-based dust suppressant and a reduction in workload would result in a cumulative concentration that complies with the standard. Otherwise, standards would be exceeded for the period of one month during the site-preparation phase of construction. Abatement of visible fugitive dust emissions is required under the Clark County Air Pollution Control regulations.

Construction and operation of NIF at NLVF would contribute to the cumulative water demand of continuing operation of NLVF and urban developments in the region. Operation of NIF would add about 220 percent to NLVF site water requirements, but current water supply capacity would be adequate to meet the additional demand. Stormwater runoff from the NIF location would contribute to the cumulative adverse effect on stormwater quality from all industrial, commercial, and municipal developments in the region. However, the incremental effect of NIF would be minor because stormwater pollution prevention measures would be implemented during both construction and operation of the project. Similarly, the siting of NIF at NLVF would contribute to the reduction of groundwater recharge through addition of impervious areas. However, the incremental effect of NIF would be minor because the area around the proposed location is already built-up with a high percentage of impervious area.

Construction of NIF at the proposed NLVF location would not result in the conversion of any natural habitats; the disturbed soil and scattered grasses and forbs in this industrial area are of negligible value to wildlife. Landscaping around the NIF buildings could improve the wildlife value of the site and contribute to maintenance of urban wildlife in this industrial area. NLVF does not contain any habitat of value to listed species.

Construction and operation of NIF at NLVF would not affect any known or suspected cultural, historical, or paleontological sites. No cultural resources are known for the NIF location.

The construction and operation of NIF would have little influence on the socioeconomics of the diverse regional economy. Because of the number of vacant housing units in the region, there would be little demand for new housing construction. The No Action alternative would not affect the North Las Vegas area because NIF-related studies in ICF, high-density materials, and weapons physics are not pursued at NTS. Environmental justice issues were identified for the NLVF location. The proportion of minority populations is higher in the local area than in Nevada as a whole. Thus, beneficial socioeco-

dose of 6.8 person-rem is extremely low; about one millionth of the dose to the population from normal background radiation, consumer products, and medical sources. No cancer fatalities are expected in the region from the operation of NIF and other facilities at SNL. Risks to the public from the postulated bounding NIF accident would also be low. Such an accident might result in one cancer death in the population within an 80-km (50-mi) radius, but the risk of that actually happening is less than 1 in 1 million. Risks of a radiation-related cancer fatality from accidents during transportation of tritium targets to SNL are also very low (less than 1 in 1 million over 30 years) compared with the risk from fatal vehicular accidents during transportation (about 1 in 8 over 30 years) or the cancer risk associated with exhaust emissions from transportation vehicles (about 1 in 8 over 30 years).

SNL has the plans or capacity to handle some of the wastes that would be generated by NIF operations without facility expansion and resultant cumulative effects on either site or regional waste management.

I.5 Environmental, Occupational Safety, and Health Permits and Compliance Requirements

I.5.1 Introduction

This chapter identifies the major laws, regulations, Executive Orders, and compliance instruments that apply to the National Ignition Facility (NIF) proposed action and alternatives. Various Federal environmental statutes impose environmental protection and compliance requirements upon the Department of Energy (DOE). Further, certain state and local environmental authorities are also applicable because they are delegated to the state for enforcement or implementation under Federal law. It is DOE policy to conduct its operations in an environmentally safe manner in compliance with all applicable statutes, regulations, and standards. Although this chapter does not address pending legislation or regulations that may become effective in the future, DOE recognizes that the regulatory environment is rapidly changing and that the construction and operation of NIF must be conducted in compliance with the applicable statutes, regulations, and standards in effect at the time.

Under the *National Environmental Policy Act* (NEPA) of 1969 (42 *United States Code* [U.S.C.] 4321 et seq.), Federal agencies are required to prepare an environmental impact statement (EIS) for proposed major Federal actions that might significantly affect the quality of the human environment. DOE has determined that the proposed siting, construction, and operation of NIF is such an action. Therefore, this project-specific analysis has been prepared as a part of the *Stockpile Stewardship and Management Programmatic Environmental Impact Statement* in accordance with the Council on Environmental Quality (CEQ) Regulations (40 *Code of Federal Regulations* [CFR] 1500-1508) implementing NEPA and DOE NEPA Implementing Procedures (10 CFR 1021).

Under the *California Environmental Quality Act* (California Statutes, Public Resources Code, Division 13 - Environmental Quality, Section 21000 et seq.), any California state public agency taking any action that may cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment must consider qualitative factors, economic and technical factors, long-term benefits and costs, and alternatives to the proposed action. Public agency actions include the issuance of a state permit, license, certificate, or other entitlement. The public agency must determine whether it will prepare an environmental impact report to identify the significant effects of the proposed project on the environment. All applicants for permits, license, certificates, or other entitlements from a public agency in support of the NIF proposed action may be required to submit data and information necessary to enable the public agency to determine whether the proposed project may have a significant affect on the environment and whether to prepare an environmental impact report.

The *Atomic Energy Act* of 1954 (42 U.S.C. 2011 et seq.) authorized DOE to establish standards to protect health or minimize dangers to life or property for its facilities and operations. DOE has established an extensive system of standards and requirements through DOE orders to ensure safe operation of its facilities.

Executive Order No. 12088, Federal Compliance with Pollution Control Standards, requires Federal agencies—including DOE—to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the *Clean Air Act* (section I.5.2.1), the *Noise Control Act* (section I.5.2.1.4), the *Clean Water Act* (section I.5.3.1), the *Safe Drinking Water Act* (section I.5.3.2), the *Toxic Substances Control Act* (section I.5.7.2), and the *Resource Conservation and Recovery Act* (section I.5.8.1).

I.5.2 Air Quality and Noise Requirements

I.5.2.1 *Clean Air Act*

Construction and operation of NIF would result in air emissions of criteria and noncriteria pollutants, including sulfur dioxide, nitrogen dioxide, volatile organic compounds (VOCs), carbon monoxide, and particulates (PM_{10}). These emissions would be subject to the *Clean Air Act* (CAA) (42 U.S.C. 7401 et seq.), as amended. NIF would also be a source of

radionuclide emissions, also subject to the CAA. No other emissions of hazardous air pollutants would be anticipated during construction or operation of NIF.

CAA requires the U.S. Environmental Protection Agency (EPA) to establish national primary and secondary ambient air quality standards as necessary to protect public health with an adequate margin of safety from any known or anticipated adverse effects of a pollutant. CAA also requires promulgation of national standards of performance for new major stationary sources, setting emissions limitations for any new or modified building, structure, facility, or installation that emits or may emit an air pollutant (42 U.S.C. 7411) and standards for emission of hazardous air pollutants (42 U.S.C. 7412). CAA also requires that specific emission increases from major sources be evaluated so as to prevent a significant deterioration in air quality (42 U.S.C. 7470). In addition, CAA requires EPA to promulgate rules to ensure that Federal actions conform to the appropriate state implementation plans (42 U.S.C. 7506).

Pursuant to such direction, EPA promulgated the primary and secondary National Ambient Air Quality Standards, including standards for emissions of sulfur oxides (measured as sulfur dioxide), nitrogen dioxide, carbon monoxide, PM_{10}, ozone, and lead (40 CFR 50); the standards of performance for new stationary sources within specific source categories enumerated in 40 CFR 60.16, including electric steam generating units, industrial-commercial-institutional steam generating units, and stationary gas turbines (40 CFR 60); the National Emission Standards for Hazardous Air Pollutants, including radionuclides (40 CFR 61); and the Prevention of Significant Deterioration (PSD) of Air Quality review regulations (40 CFR 52.21).

On November 30, 1993, EPA published its final rule for Determining Conformity of General Federal Actions to State or Federal Implementation Plans (58 *Federal Register* [FR] 63214). This rule requires states to file revisions to their state implementation plans to include conformity requirements (40 CFR 51.850-860). Once the state plans are revised, Federal agencies are subject to those revised state implementation plans. Until such revisions are submitted and approved, however, the rule adopts conformity requirements applicable to all Federal agencies (40 CFR 93.150-160). Only New Mexico and the Albuquerque/Bernalillo County Air Quality Control Board have revised their regulations to require conformity determinations for Federal actions (*New Mexico Regulations*, Title 20, Part 98 [uncodified]; Board Regulation No. 43). The regulations apply to all nonattainment and maintenance areas for criteria pollutants for which the area is designated.

Under the new rules, a Federal agency must make a formal determination that a Federal action conforms to the applicable implementation plan before such action may be taken. For Federal actions, a conformity determination is required for each pollutant when the total of direct and indirect emissions in a nonattainment or maintenance area caused by a Federal action would equal or exceed certain limits (40 CFR 51.853 or 93.153) (table I.5.2.1–1).

The direct and indirect emissions from the construction and operation of NIF at any site would not exceed these limits (sections I.4.1.2.2, I.4.2.2.2, I.4.3.2.2, I.4.4.2.2, and I.4.5.2.2). In addition, the total of direct and indirect emissions of any pollutant from a Federal action must not equal or exceed 10 percent of a nonattainment or maintenance area's total emissions of that pollutant. If it does, it is defined as a regionally significant action and a conformity determination is required. It is not expected that emissions from NIF would equal or exceed this 10 percent limit.

CAA provides that each state must develop and submit for approval to EPA implementation plans for controlling air pollution and air quality in that state. Under EPA regulations, California, Nevada, and New Mexico all have approved state implementation plans; however, not all parts of the CAA requirements are met in such plans and, in some cases, dual Federal/state regulations must be implemented.

California and Nevada have not been delegated the authority to regulate the emission of radionuclides from DOE facilities, and, therefore, Federal regulations would apply to such emissions at the

TABLE I.5.2.1–1.—*Conformity Determination Exceedance Limits*

Pollutant	Limit (tons/yr)[a]
Nonattainment Areas	
Ozone (volatile organic compounds or nitrogen oxides)	
Serious Nonattainment Areas	50
Severe Nonattainment Areas	25
Extreme Nonattainment Areas	10
Other ozone nonattainment areas outside an ozone transport region	100
Marginal and moderate nonattainment areas inside an ozone transport region	
Volatile organic compounds	50
Nitrogen oxides	100
Carbon monoxide	100
Sulfur dioxide or nitrogen dioxide	100
Particulate matter 10 microns or smaller	
Moderate Nonattainment Areas	100
Serious Nonattainment Areas	70
Lead	25
Maintenance Areas	
Ozone (nitrogen oxides), sulfur dioxide or nitrogen dioxide	100
Ozone (volatile organic compounds)	
Maintenance areas inside an ozone transport region	50
Maintenance areas outside an ozone transport region	100
Carbon monoxide	100
Particulate matter 10 microns or smaller	100
Lead	25

[a] To determine metric tons/year (t/yr), multiply values by 0.90718.

Source: 40 CFR 51.853 and 93.153.

Lawrence Livermore National Laboratory (LLNL) and the Nevada Test Site (NTS). In Nevada, the District Board of Health of Clark County and the Albuquerque/Bernalillo County Air Quality Control Board have adopted the Federal regulations, which would then be applicable to radionuclide emissions from the North Las Vegas Facility (NLVF) and Sandia National Laboratories/New Mexico (SNL). New Mexico has adopted the Federal standards for the emission of hazardous air pollutants (40 CFR 61); however, it has excluded from adoption Subparts H (National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities) and Q (National Emission Standards for Radon Emissions from Department of Energy Facilities). Therefore, Federal regulations would apply in New Mexico for the Los Alamos National Laboratory (LANL).

The Federal regulations for emissions of radionuclides and radon-222 from DOE facilities are set in 40 CFR 61, Subparts H and Q. Pursuant to 40 CFR 61.07, an application for approval of construction must be filed before construction begins (with Region IX for LLNL and NTS, with Region VI for LANL, with the District Board of Health of Clark County for NLVF, and with the Albuquerque/Bernalillo County Air Quality Control Board for SNL). Further, DOE must provide written notification to EPA (or appropriate authority) no more than 60 nor less than 30 days before the anticipated date of initial start-up of operations (40 CFR 61.09). However, if it is estimated that radionuclide emissions from the new construction or modification would be less than 1 percent of the effective dose equivalent of 10 mrem/yr to any member of the public, no application for approval of construction or notification of start-up is necessary (40 CFR 61.96).

I.5.2.1.1 *Clean Air Act* Requirements for California

The LLNL site is within the Bay Area Air Quality Management District (BAAQMD), and the district's regulations would apply to air emissions from NIF. NIF is not expected to have sufficient emissions to meet the definition of a major facility under California air regulations. The definition of one facility, however, includes related sources on a single property or contiguous properties, even though under different ownership, and related sources on noncontiguous properties under the same ownership. For this review, facilities under the same ownership that are located within a distance of 4.8 kilometers (km) (3 miles [mi]), property line to property line, are considered one facility if the facilities have the same first two digits in the Standard Industrial Classification code. However, current calculations show that LLNL's existing sources do not meet the definition of a major facility under the California regulations. Therefore, there is no

emissions must apply for an "Authority to Construct" certificate before construction is begun (APCR, section 12.1.1.1).

Certain requirements must be met for specific air contaminants before a permit will be issued. NIF project, as a nonmajor source of PM_{10} in Las Vegas Valley (with a potential to emit less than 64 t [70 tons] per year), must incorporate BACT (APCR, section 12.2.1.1). The applicant must also provide documentation of emission reduction credits against other emissions if the total potential to emit for the new source will exceed 23 kg (50 lb) per day of total suspended particulates (APCR, section 12.2.1.3). Qualified road paving projects approved by the local public works department are recognized by the Control Officer as emission reduction credits for PM_{10} (APCR, section 12.4.1). Such credits are good for seven years. A one-year emission reduction credit is available by payment to the closest local participating public works department (APCR, section 12.4.2).

As a nonmajor source of VOCs in Las Vegas Valley (VOC emissions under 45 t [50 tons] per year), NIF must incorporate emissions controls that are designed for BACT (APCR, section 12.2.4.1). The applicant must also provide documentation of emission reduction offsets to all anticipated annual emission increases (APCR, section 12.2.4). The applicant must also apply BACT for sulfur dioxide and lead emissions and demonstrate that the total potential to emit will not cause, or contribute to, ambient concentrations that exceed ambient air quality standards for sulfur dioxide or lead (APCR, sections 12.2.8 and 12.2.10).

An applicant must apply BACT for all emissions of nitrogen oxides and must demonstrate that the total potential to emit will not cause, or contribute to, ambient concentrations exceeding the ambient air quality standard for nitrogen oxides (APCR, section 12.2.10.1). Emission credits equivalent to twice the new source's potential to emit are required (APCR, section 12.2.10.4). As a nonmajor source of carbon monoxide in Las Vegas Valley (potential to emit less than 64 t [70 tons] per year), NIF must incorporate emission controls that are designed with the BACT (APCR, section 12.2.11.1), and emission reduction credits must be greater than twice the potential to emit for the new source (APCR, section 12.2.11.4).

In addition, an operating permit is required for the operation of any emission unit in a stationary source (APCR, section 16). Such an operating permit might contain conditions, including emission limits, production rates, control methods, or operation limitations, subject to annual review.

For construction activities at NIF within Clark County, a Permit for Construction Activities is required (APCR, section 17) to satisfy the Authority to Construct requirements of APCR, section 12.2.1. As a condition of such a permit, the applicant must present and agree to implement an acceptable method to prevent particulate matter from becoming airborne. In addition, any person engaged in the operation of machines and equipment, the grading of roads, and the operation and use of unpaved parking facilities must take all reasonable precautions to abate fugitive dust from becoming airborne. Reasonable precautions may include, but are not limited to, the conditions agreed upon in the permit for the project, sprinkling, compacting, enclosure, chemical and asphalt sealing, cleaning up, sweeping, or other such measures as the Control Officer may specify.

APCR, section 41, also requires control of fugitive emissions during construction activities. Fugitive emission prohibitions include the following:

- Visible plume of dust, resulting from construction activities beyond the nearest property line, whichever is less
- Visible dust emissions on an unpaved road at a construction site being used by haul trucks
- Visible dust emissions generated by vehicles traveling over mud and directly carried out to a paved road near or adjacent to a construction site
- Handling, transporting, or storing material in such a manner as to become airborne

Both NTS and NLVF have requested the Department of Conservation and Natural Resources to issue a determination that stormwater from the sites does not discharge to waters of the state, and, therefore, no stormwater permits, for construction or industrial activity are necessary.

I.5.3.1.3 *Clean Water Act* Requirements in New Mexico

New Mexico has not been delegated NPDES permitting authority; therefore, EPA, Region VI, would issue any new NPDES permits or modify existing permits as necessary. The New Mexico Environment Department reviews and certifies NPDES draft permits issued by EPA to ensure that they meet all state and Federal regulations and standards. Sanitary wastewater from NIF construction and operations would be discharged into LANL's existing sewer system, which has been permitted by the Federal EPA (NPDES Permit NM 0028355). All reporting requirements under the permit regarding changes in the quantity, quality, or character of the discharge resulting from NIF operations must be made to EPA, Region VI (40 CFR 122.41(l), 122.62, 122.63). This requirement would include significant changes in process and quantity or quality of effluent discharged into the existing system and any new discharges. DOE, LANL, and New Mexico Environment Department have entered into a Settlement Agreement to study the stream uses associated with LANL effluent discharges under its NPDES regulations.

In addition to Federal requirements, the New Mexico Water Quality Control Commission regulations require that any person intending to make a new water contaminant discharge, or to alter the character or location of an existing discharge, must file a notice with the Water Pollution Control Bureau of the Environmental Improvement Division (WQCC 821-1-201). If it were necessary to modify the sewer system in a manner that would substantially change the quantity or quality of the discharge from the system, LANL would also have to file plans and specifications of the construction or modification with the Bureau. Otherwise, modifications having a minor effect on the character of the discharge would only have to be reported as of January 1 and June 30 of each year (WQCC 821-1-202).

Sanitary and industrial wastewater from SNL are discharged to the Albuquerque Wastewater Treatment Plant, which holds a Federal NPDES permit. SNL has pretreatment agreements with the plant to meet certain pretreatment standards for SNL industrial wastewaters prior to discharge to the plant. Therefore, it would have to notify the plant of any changes in discharges associated with the operation of NIF (40 CFR 403.12).

Since New Mexico has not been delegated NPDES permitting authority, LANL has submitted a Notice of Intent to the Federal EPA, Region VI, to participate in the Federal General Permit for Stormwater Discharges Associated with Construction Activities. As a condition of the permit, each facility must have a Stormwater Pollution Prevention Plan. Any construction associated with NIF would have to conform to the conditions of this permit.

I.5.3.2 *Safe Drinking Water Act*

The primary objective of the *Safe Drinking Water Act* (42 U.S.C. 300(f) et seq.) is to protect the quality of public water supplies, water supply and distribution systems, and all sources of drinking water. Sections of the Act address public water systems, protection of underground sources of drinking water, emergency powers, general provisions, and additional requirements to regulate underground injection wells. The National Primary Drinking Water regulations (40 CFR 141 et seq.), administered by EPA, establish standards applicable to public water systems. The regulations include maximum contaminant levels, including those for radioactivity, for community and noncommunity water systems. No new public water supply system is anticipated to be constructed at any of the sites.

I.5.3.2.1 *Safe Drinking Water Act* Requirements in California

Water used at the LLNL site is purchased primarily from the city of San Francisco Hetch Hetchy Aqueduct and from the Alameda County Flood and Water Conservation District, Zone 7. Significant alterations to LLNL's drinking water supply requirements due to NIF construction and operation might require that the suppliers be notified of such modification to ensure the new service connection would

not cause pressure reduction below state standards (22 *California Code of Regulations* [CCR] 64568).

I.5.3.2.2 *Safe Drinking Water Act* Requirements in Nevada

Nevada has adopted the National Drinking Water regulations (40 CFR 141) for its public water systems regulations (NAC 445.247). NTS will acquire domestic water from its permitted water supply system to serve NIF requirements. Notification of any modification to accommodate NIF operations would be made to the Department of Health Services, including submission of water system modification plans for approval (NAC 445A.657). NLVF would acquire domestic water for NIF from the city of North Las Vegas under an existing agreement. The city would have to be notified of any increase in NLVF water supply usage (Monroe 1995).

I.5.3.2.3 *Safe Drinking Water Act* Requirements in New Mexico

New Mexico has a comprehensive water supply program (NM Regulations [NMR] Title 20, Chapter 7 [uncodified]), under which every public water supply system must site, construct, and maintain its operation in compliance with the requirements of such program. Domestic water to be used at NIF would come from LANL's public water supply system. Under the New Mexico regulations, prior written approval from the New Mexico Environment Department must be obtained before starting any addition to, or modification of, an existing public water supply system that may affect the system reliability or the quantity or quality of the water supplied (NMR 20-7 502). Such approval is not required if the construction or modification is less than 305 m (1,000 ft) of distribution piping appurtenance during any 60-day calendar period, or if such construction or modification takes place at a facility where the water utility staff includes a professional engineer registered in New Mexico who will have responsibility for the project (NMR 20-7-502).

SNL does not own or operate a public water supply system but instead obtains its domestic water supply from the city of Albuquerque system or the Kirtland Air Force Base system. Official approval for any additional usage might have to be obtained from these water suppliers, although current water supply capacity is expected to be sufficient to meet the requirements of NIF (section I.4.5.2.3). Any new hookups would have to conform with any requirements of those suppliers.

I.5.3.3 *Executive Order 11988—Floodplain Management; Executive Order 11990—Protection of Wetlands*

Executive Order 11988 (May 21, 1977) requires Federal agencies to establish procedures to ensure that any actions undertaken in a floodplain consider the potential effects of flood hazards and floodplain management and that floodplain impacts be avoided to the extent practicable. Executive Order 11990 (May 24, 1977) requires all Federal agencies to consider protection of wetlands in decision making for a proposed action.

DOE has established procedures for compliance with these orders entitled "Compliance with Floodplain/Wetlands Environmental Review Requirements" (10 CFR 1022). These regulations require DOE to assess the effects of a proposed action on the survival, quality, and natural or beneficial values of wetlands and to avoid impacts to floodplains to the extent practicable. Pursuant to the regulations and concurrent with DOE's review of a proposed action, DOE shall prepare a floodplain/wetlands assessment that evaluates the positive and negative, direct and indirect, and long- and short-term effects of NIF construction on wetlands and floodplains and alternatives to the proposed action that might avoid adverse effects to floodplains or wetlands, and measures to mitigate the adverse effects of actions in a floodplain or wetlands area (10 CFR 1022.12). None of the sites selected for the construction are located in floodplains or wetlands (sections I.4.1.2.3, I.4.2.2.3, I.4.3.2.3, I.4.4.2.3, I.4.5.2.3, I.4.1.2.4.2, I.4.2.2.4.2, I.4.3.2.4.2, I.4.4.2.4.2, and I.4.5.2.4.2). However, the option I temporary construction staging area for LLNL would be built in the 500-year floodplain, and the bridge spanning Arroyo Las Positas would be within the 100-year floodplain. The bridge would be designed not to increase the risk of flooding. Also, no highly volatile, toxic, or water reactive materials would be stored in the staging area.

I.5.4 Ecological Resources Requirements

I.5.4.1 *Endangered Species Act*

The *Endangered Species Act* (16 U.S.C. 1531 et seq.) is intended to prevent the further decline of endangered and threatened species of animals and plants and to bring about the restoration of these species and their habitats. The Act is jointly administered by the U.S. Department of Commerce (marine species and their habitats under 5 CFR 222.23 and 227.4) and the U.S. Department of the Interior (all other plant and animal species and their habitats). Section 16 U.S.C. 1536 requires DOE to consult with the Department of the Interior, Fish and Wildlife Service, and/or Department of Commerce, National Marine Fisheries Service, to determine whether endangered and threatened species are known to have critical habitats on or in the vicinity of the sites for the proposed action. The identification of endangered and threatened species and their habitats is provided in 50 CFR 17 and 402. Each site has consulted with the Department of the Interior, Fish and Wildlife Service, concerning impacts on endangered and threatened species, migratory birds, and their critical habitats in the vicinity of the proposed locations for NIF.

I.5.4.2 *Migratory Bird Treaty Act*

The *Migratory Bird Treaty Act*, as amended (16 U.S.C. 703 et seq.), is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and the former Union of Soviet Socialist Republics. It regulates the harvest of migratory birds by specifying the mode of harvest, hunting seasons, and bag limits. The Act stipulates that it is unlawful at any time, by any means, or in any manner to "kill . . . any migratory bird." Although no permit is required under this Act, DOE would consult with the U.S. Fish and Wildlife Service, as appropriate, regarding impacts to migratory birds and to evaluate ways to avoid or minimize these impacts.

I.5.4.3 *Bald and Golden Eagle Protection Act*

The *Bald and Golden Eagle Protection Act* (16 U.S.C. 668-668d) makes it unlawful to take, pursue, molest, or disturb bald (American) and golden eagles, their nests, and their eggs anywhere in the United States. No permits or approval procedures are required unless a nest is found to interfere with resource development; in that case, a permit must be obtained from the Department of the Interior to relocate the nest. If a bald (American) or golden eagle nest was found in the vicinity of NIF activities during NIF development and construction, DOE would consult with the Department of the Interior regarding requirements under this Act.

I.5.5 Cultural and Paleontological Resources Requirements

Executive Order 11593, Protection and Enhancement of the Cultural Environment (May 15, 1971), requires Federal agencies to locate, inventory, and nominate qualifying properties under their jurisdiction or control to the National Register of Historic Places (NRHP). This process requires DOE to provide the opportunity for the Advisory Council on Historic Preservation to comment on the possible impacts of the proposed action on any potentially eligible or listed resources.

I.5.5.1 *National Historic Preservation Act*

The *National Historic Preservation Act* (16 U.S.C. 470 et seq.) provides that places with significant national historic value be placed on the NRHP. No permits or certifications are required under this Act. However, pursuant to regulations in 36 CFR 800 et seq., if a proposed action might impact a historic property resource, consultation with the State Historic Preservation Officer and the Advisory Council on Historic Preservation is required. Such consultation generally results in execution of a Memorandum of Agreement that includes stipulations that must be followed to minimize adverse impacts. No historic places were identified by the appropriate State Historic Preservation Officers at any of the sites.

I.5.5.2 *Archaeological and Historic Preservation Act*

The *Archaeological and Historic Preservation Act* (16 U.S.C. 469a et seq.) is directed at the preservation of historic and archaeological data that would otherwise be lost as a result of Federal construction.

TABLE I.5.7.1–1.—*U.S. Department of Energy Orders Applicable to the National Ignition Facility Project*

Order	Subject
O 151.1	Comprehensive Emergency Management System
O 232.1	Occurrence Reporting and Processing of Operations Information
O 430.1	Life Cycle Asset Management
O 440.1	Worker Protection Management for DOE Federal and Contractor Employees
O 460.1	Packaging and Transportation Safety
O 460.2	Departmental Materials Transportation and Packaging Management
O 470.1	Safeguards and Security Program
5400.1	General Environmental Protection Program
5400.5	Radiation Protection of the Public and the Environment
5480.4	Environmental Protection, Safety, and Health Protection Standards
5482.1B	Environment, Safety, and Health Appraisal Program
5484.1	Environmental Protection, Safety, and Health Protection Information Reporting Requirements
5630.12A	Safeguards and Security Inspection and Assessment Program
5700.6C	Quality Assurance

Substances Control Act (15 U.S.C. 2601-2671). If any such PCB articles are removed during the renovation of existing buildings, they must be stored and disposed of properly. PCB transformers and equipment would be disposed of at licensed incinerators or chemical waste landfills. Shipment offsite of transformers or equipment contaminated with waste PCBs would be manifested, and a proper Certificate of Destruction would be obtained.

I.5.7.3 *Emergency Planning and Community Right-to-Know Act* of 1986

Under the *Emergency Planning and Community Right-to-Know Act* of 1986 (EPCRA or SARA, Title III) (42 U.S.C. 1101 et seq.), industrial facilities are required to provide information, such as inventories of specific chemicals used or stored there, to the appropriate State Emergency Response Commission and Local Emergency Planning Committee (LEPC) to ensure that emergency plans are sufficient to respond to accidental releases of hazardous substances. This Act originally did not appear to apply to Federal agencies; however, on August 3, 1993, Executive Order 12856 was issued making each Federal agency and its jurisdictional facilities subject to the provisions of EPCRA and the *Pollution Prevention Act* of 1990. Under EPCRA, facilities with more than a threshold quality of an "extremely hazardous substance" (40 CFR 355, appendixes A and B) must provide a representative to the LEPC, promptly inform LEPC of any "relevant changes" at the facility, and upon request, promptly provide LEPC with "information . . . necessary for developing and implementing the emergency plan." Also, all covered facilities that exceed certain volume thresholds must provide an inventory of the types and quantities of hazardous materials stored or used onsite to LEPC (40 CFR 370). It is not anticipated that NIF operations would require storage of extremely hazardous substances; however, if the site already has submitted information to LEPC, any relevant changes resulting from NIF operations should be communicated to LEPC.

The transportation of radioactive or hazardous materials is governed by the *Hazardous Materials Transportation Act* (49 U.S.C. 1801 et seq.). The implementing regulations by the Department of Transportation (DOT) (49 CFR 171-179) establish requirements for shipments along public highways, including shipping papers, marking, labeling, placarding, training, emergency response information, and packaging. Therefore, any shipments of radioactive or hazardous materials to or from the NIF location would have to comply with DOT shipping requirements.

I.5.8 Waste Management

I.5.8.1 *Solid Waste Disposal Act*, as Amended by *the Resource Conservation and Recovery Act* and the *Hazardous Solid Waste Amendments* of 1984

The treatment, storage, or disposal of solid, both nonhazardous and hazardous, waste is regulated under the *Solid Waste Disposal Act*, as amended by the *Resource Conservation and Recovery Act* (RCRA) (42 U.S.C. 6901 et seq.) and the *Hazardous Solid Waste Amendments* of 1984 (HSWA). Under Section

3006 of the Act, any state that seeks to administer and enforce a hazardous waste program pursuant to RCRA may apply for EPA authorization of such program. Approved state programs are not static, and as new Federal regulations, limitations, and restrictions are promulgated by EPA, state programs must be revised in response to such changes. Prior to HSWA, changes to Federal requirements were not enforced in authorized states until the state's program was appropriately modified and approved by EPA. Now, EPA enforces Hazardous Solid Waste Amendments requirements in an authorized state until the state receives approval under section 3006(g).

California, Nevada, and New Mexico have all received authorization to enforce a hazardous waste program under Subpart C of RCRA. Nevada and New Mexico have adopted the Federal requirements for hazardous waste management. California has an authorized hazardous waste program; however, not all the Hazardous Solid Waste Amendments to RCRA have been incorporated, and California operates under a dual state-Federal regulatory system.

Under RCRA, "source, special nuclear, and by-product materials," as defined by the *Atomic Energy Act* of 1954, are excluded from the definition of solid waste and, therefore, cannot be considered hazardous waste. However, by definition, a mixture of hazardous and radioactive wastes (mixed waste) contains constituents that require regulation under RCRA. On July 3, 1986, EPA issued a clarification that the hazardous components of radioactive mixed waste are regulated under RCRA, and the radioactive components are governed by applicable *Atomic Energy Act* regulations. Because of the dual nature of this waste, it was not until 1988 that EPA issued another clarification that states could submit for authorization to regulate mixed waste storage, treatment, and disposal under state programs. When treatment standards for the land disposal restrictions were issued for mixed waste in 1990, problems arose with the long-term storage of mixed waste, since under land disposal restrictions, restricted wastes may not be stored for more than one year (40 CFR 268.50). The storage and treatment capacity problems for mixed wastes created an enforcement problem for those storing mixed wastes, including DOE.

Congress addressed the problems of DOE mixed waste storage in the *Federal Facility Compliance Act* (FFCA) of 1992 (Public Law 102-386, 106 Stat. 1505, October 6, 1992). Although FFCA made it clear that sovereign immunity is waived for the enforcement of state RCRA regulations, it granted DOE facilities a 3-year extension period before waiving sovereign immunity concerning the enforcement of land disposal restrictions regulations as applied to mixed waste (October 1995). Section 104 of the Act requires DOE to submit a draft report to EPA and to authorized states that lists national inventories of all mixed waste on a state-by-state basis and analyzes mixed waste treatment capacities and technologies. To extend the application of such sovereign immunity beyond the 3-year period, DOE must also comply with section 105 of the Act, which requires DOE to develop a comprehensive plan to treat mixed wastes for all DOE facilities. Such plans must include a comprehensive requirement for developing schedules for almost all phases of mixed waste disposal. The plans are submitted to EPA, which in turn submits them to the authorized state. DOE announced it would develop such a National Compliance Plan for its mixed waste (57 FR 57710).

Currently California, New Mexico, and Nevada have been authorized to regulate mixed waste under RCRA. Therefore, any necessary permitting of facilities for the treatment, storage, or disposal of mixed waste resulting from NIF operations in California, New Mexico, and Nevada would proceed through their normal RCRA permitting process.

I.5.8.1.1 *California Resource Conservation and Recovery Act* Requirements

LLNL operates treatment, storage, or disposal facilities under Part A interim status pursuant to filings to the California Environmental Protection Agency, Department of Toxic Substances Control (previously the Department of Health Service). Under California regulations, no facility operating under interim status may manage hazardous wastes that are not specified in Part A of the facility's permit application, employ processes not described in Part A of the permit application, or exceed the design capacities specified in Part A of the permit application (22 CCR § 66265.1[c]). LLNL's Part A Permit application does have limitations as to the waste streams that may be

stored or treated in the facilities and capacity limitations. However, if all hazardous waste and mixed waste generated at NIF were accumulated onsite and shipped offsite for treatment and disposal within 90 days, such permit requirements would not apply (22 CCR § 66265.1[d]). If hazardous or mixed wastes were to be stored for more than 90 days in the permitted treatment, storage, or disposal facility, it might be necessary to amend the facility permit to include new waste streams or new capacity requirements resulting from NIF operations (22 CCR § 66270).

I.5.8.1.2 *Nevada Resource Conservation and Recovery Act* Requirements

NTS has a permitted treatment, storage, or disposal facility for storage of hazardous wastes near the Radioactive Waste Management Site in Area 5; however, it is anticipated that hazardous waste, except mixed waste, will be accumulated onsite and shipped offsite for treatment and disposal. Such accumulation does not require a permit if it meets all Federal RCRA generator requirements (40 CFR 262), as adopted by Nevada (NAC 444.8632). NTS has submitted a revised Part B Permit application, which includes a separate storage and disposal unit for solid mixed waste. Such application is pending action by the Nevada Division of Environmental Protection. NTS operates a mixed waste storage facility under Part A interim status. Under agreement between DOE and the State of Nevada, no offsite mixed waste is being accepted, pending the permit review (DOE, Permit No. NV 3890090001; Settlement Agreement for Transuranic Mixed Waste Storage Issues between the State of Nevada and DOE; Mutual Consent Agreement for the Storage of Low Level Land Disposed Restricted Mixed Waste between the State of Nevada and DOE). No mixed waste disposal is currently being conducted at the Part A interim status land disposal unit, pending land disposal restriction treatment determination. Mixed liquid waste may not be disposed of at NTS pursuant to the NTS Waste Acceptance Criteria, NVO-325. However, there are plans to develop this capability, and such a liquid mixed waste treatment facility would have to be permitted by the Nevada Division of Environmental Protection. Otherwise, mixed liquid waste can be stored at the NTS Part A interim status mixed waste storage facility for shipment to an offsite facility for treatment and disposal.

NLVF does not have a permitted treatment, storage, or disposal facility, and hazardous waste at NIF would be accumulated for transportation to offsite treatment, storage, or disposal facilities. Mixed waste would be accumulated for shipment to NTS, once the NTS Part B Permit is issued. Such accumulation would not require a permit if it met all Federal RCRA generator requirements (40 CFR 262), as adopted by Nevada (NAC 444.8632). If hazardous or mixed waste were to be stored for more than 90 days, a treatment, storage, or disposal facility would have to be sited, permitted, and operated under the regulations governing and operators of such facilities (40 CFR 264).

I.5.8.1.3 *New Mexico Resource Conservation and Recovery Act* Requirements

SNL has a permitted treatment, storage, or disposal facility for storage of hazardous waste. Hazardous waste generated at NIF would be stored in this facility until it is shipped offsite to an approved disposal facility. SNL is currently storing its liquid mixed waste at the site of generation (Wheeler 1995). Such accumulation does not require a permit if it meets all Federal RCRA generator requirements (40 CFR 262), as adopted by New Mexico (NM Regulations, Title 20, chapter 4). SNL is currently performing treatability studies at its Radioactive and Mixed Waste Management Facility to obtain a Part B Permit from the State of New Mexico. Once the facility is permitted, mixed waste will be treated there to remove the hazardous component. The residue will be disposed of as radioactive waste. When treatment of the hazardous component is not feasible, the mixed waste will be stored onsite until a disposal option becomes available. It may be necessary to amend the facility permit or the Part A application to include new waste streams or new capacity (40 CFR 270.42 and 270.72).

LANL has a permitted treatment, storage, or disposal facility; however, it is anticipated that all hazardous waste and mixed waste at NIF would be accumulated onsite and shipped offsite for treatment and disposal. Such accumulation would not require a permit if it met all Federal RCRA generator requirements (40

CFR 262), as adopted by New Mexico (NM Regulations, Title 20, chapter 4). LANL also has Part A interim status facilities. It might be necessary to amend the facility permit to include new waste streams or new capacity (40 CFR 270.42).

I.5.8.2 *Low-Level Radioactive Waste*

It is anticipated that low-level radioactive waste (LLW) will be generated as a result of the operation of NIF. As stated above, the *Atomic Energy Act* of 1954 authorized DOE to establish standards to protect health or minimize dangers to life or property. In accordance with the *Energy Reorganization Act* of 1974, DOE-related operations, including the treatment, storage, and disposal of LLW, are not subject to licensing by the U.S. Nuclear Regulatory Commission (10 CFR 50.11). Under the *Low-Level Radioactive Waste Policy Act* (42 U.S.C. 2021b et seq.), the Federal Government is responsible for the disposal of LLW owned or generated by DOE. The disposal of LLW at disposal facilities established or operated exclusively for the disposal of waste generated by the Federal Government is not subject to the other portions of the Act concerning the establishment of state-governed compacts for the disposal of LLW in those states. Therefore, the transportation, treatment, storage, and disposal of LLW generated by DOE is governed by DOE orders. The major DOE orders pertaining to LLW resulting from operation of NIF are listed in table I.5.8.2–1. DOE Order 5820.2A establishes policies and guidelines that are the framework for the LANL LLW management program.

TABLE I.5.8.2–1.—*U.S. Department of Energy Orders Concerning Low-Level Waste*

Order	Subject
O 232.1	Occurrence Reporting and Processing of Operations Information
5400.5	Radiation Protection of the Public and the Environment
5820.2A	Radioactive Waste Management

On March 25, 1993, DOE published a Notice of Proposed Rulemaking to establish standards for the protection of the public and the environment against radiation from DOE activities (Draft 10 CFR 834). The requirements would be applicable to the control of radiation exposures to the public and the environment from normal operations under the control of DOE and DOE contractor personnel. The regulations include the four basic elements of the radiation protection system:

- Establish dose limits for exposure of members of the public to radiation and implementation of DOE's as low as reasonably achievable policy.
- Manage radioactive materials in liquid waste discharges, in soil columns, and in selected solid-waste-containing radioactive materials, including groundwater protection programs for each DOE site.
- Establish requirements for decontamination, survey, and release of buildings, land, equipment, and personal material; and for the management, storage, and disposal of wastes generated by these activities.
- Establish an environmental radiation protection program and plan, including an effluent monitoring and environmental surveillance program, to set forth the programs, plans, and other processes to protect the public from exposure to radiation. On August 31, 1995, DOE issued a Notice of Limited Reopening of Comment Period for the draft regulation.

Once promulgated as a final rule, 10 CFR 834 would govern the management of radioactive materials and wastes at all the proposed NIF sites.

I.6 List of Preparers

Name	Education/Expertise	Contribution
Timothy Allison	M.S. Mineral and Energy Resource Economics, M.A. Geography; 11 years experience in regional analysis and economic impact analysis	Socioeconomic Analysis
John Arnish	M.S. Nuclear Engineering, B.S. Physics; 2 years experience in transportation risk analysis	Radiological Transportation Risk Analysis
Susan Barisas	M.S. Water Resources; 7 years experience in environmental management; 10 years experience in environmental site assessment	Affected Environment
Bruce M. Biwer	Ph.D. Chemistry; 5 years experience in radiological pathway analysis, dose calculations, radiological transportation risk analysis	Radiological Transportation Risk Analysis
Christopher Burke	M.S. Technology Management, B.A. Geology; 20 years experience in environmental and energy impact assessment; 5 years experience in site and technology assessment	Purpose and Need, Site Descriptions
Young-Soo Chang	Ph.D. Chemical Engineering; 9 years experience in air quality impact analysis	Air Quality
John D. DePue	M.S. Biology; 20 years experience in technical editing of environmental assessment documents	Technical Editor
Lisa Durham	M.S. Geology; 7 years experience in hydrogeologic analysis; 8 years experience in environmental impact statements	Environmental Impacts Assessment
Rebecca Haffenden	J.D. Law; 15 years experience in legal research and analysis; 5 years experience in environmental impact statements	Environmental, Occupational Safety and Health Permits and Compliance Requirements
John F. Hoffecker	Ph.D. Anthropology; 20 years experience in archaeology; 12 years experience in environmental assessment and cultural resources management	Cultural and Paleontological Resources
Kou-John Hong	P.E., C.H.P., Ph.D. Nuclear Engineering; 16 years experience in radiological engineering and risk assessment	Radiological Impact Assessment
Sunita Kamboj	Ph.D. Health Physics, M.S. Physics; 5 years experience in health physics instrumentation, environmental monitoring; 1 year experience in radiological risk assessment	Proposed Action
Fred Kirchner	Ph.D. Radiation Biology, Diplomate, American Board of Toxicology; 16 years experience in toxicology	Affected Environment
David Kuhaneck	P.E., M.S. Environmental Engineering, B.S. Civil Engineering; 15 years experience in environmental analysis, permitting, and regulations	Air Quality, Acoustics

Name	Education/Expertise	Contribution
Michael A. Lazaro	P.E., M.S. Environmental/Atmospheric Sciences; M.S. Nuclear Engineering; 19 years experience in atmospheric and environmental science research and assessment; 12 years experience in project management; 6 years experience in hazard/consequence assessment	Project Manager
William Metz	Ph.D. Geography; M.I.S. Information Management; 20 years experience in socioeconomic assessment and mitigation; 10 years experience in public participation	Public Participation, Scoping
George H. Miley	Ph.D. Chemical Engineering/Nuclear Engineering; Professor of Nuclear Engineering and Electrical and Computer Engineering; Director of Fusion Studies Laboratory; 37 years experience; pioneer in the development of nuclear-pumped lasers; extensive experience in fission reactor safety, advanced ICF target design, laser-plasma interactions, and fusion technology	Waste Management Environment
Marshall Monarch	M.A. Administration; B.S. Chemical Engineering, P.E.; 25 years experience in technology and regulatory evaluation of industrial air pollution/control systems and energy analysis	Air Quality Impacts
Lee Northcutt	Program Assistance; 20 years of editorial and program management assistance; 5 years experience in environmental impact statement preparation	Glossary, List of Preparers, Abbreviations, Chemical Symbols and Units of Measure, Metric Conversion Chart
Edwin D. Pentecost	Ph.D. Zoology/Ecology; 25 years experience in environmental assessment, terrestrial ecosystem analysis, natural resources management and planning	Assistant Project Manager
John M. Pfingston	M.A. History, M.P.A. Environmental Administration; 4 years experience in energy and natural resource research; 5 years experience in environmental assessment and land-use analysis	Land Use
Anthony J. Policastro	Ph.D. Civil Engineering; 20 years experience in air quality analyses; 15 years experience in environmental assessment	Air Quality, Hazardous Chemical Impact Assessment, Acoustics
Markus Puder	Master Law; 3 years experience in environmental and energy legislation, regulation, and policy; 1 year of experience in environmental impact statements	Public Participation, Scoping
Elisabeth Ann Stull	Ph.D. Zoology; 25 years experience in environmental assessment and ecological sciences	Project Description, Purpose and Need
William Vinikour	M.S. Ecological Resources; 20 years experience in environmental research and assessment; 19 years experience in environmental impact statements	PSA Coordinator, Ecological Resources

Name	Education/Expertise	Contribution
David Walitschek	M.S. History; 8 years experience in archaeological research; 3 years experience in environmental assessment	References, Distribution List
Dee Wernette	Ph.D. Sociology/Demographics; 15 years experience in social impacts, demographics, and related social science analyses	Environmental Justice Analysis
Stephen Yin	M.S. Civil Engineering; 10 years experience in environmental impact studies; 15 years experience in hydrologic analysis and water resources planning and design	Water Resources

I.7 GLOSSARY

acoustic: Containing, producing, carrying, arising from, actuated by, related to, or associated with sound.

activation products: The radionuclides formed as a result of a material being activated. For example, cobalt-60 is an activation product resulting from neutron activation of cobalt-59.

acute exposure: The absorption of a relatively large quantity of radiation or intake of radioactive material over a short period of time.

Air Quality Control Region (AQCR): An interstate or intrastate area designated by the Environmental Protection Agency for the attainment and maintenance of National Ambient Air Quality Standards.

air quality maintenance area: An area which, due to current air quality or projected residential and industrial growth, has the potential for exceeding a national ambient air quality standard.

air quality: Measure of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances. Air quality standards are the prescribed level of constituents in the outside air that cannot be exceeded during a specific time in a specified area.

ALARA (as low as reasonably achievable): A philosophy of protection that controls and maintains exposures to individuals and to the work force and general public as low as technically and economically feasible below the established limits.

alluvial fan: Cone-shaped deposits of alluvium made by a stream. Fans generally form where streams emerge from mountains onto the lowland.

alluvial/alluvium: Relating to material deposited by running water, such as clay, silt, sand, and gravel. Sedimentary material transported and deposited by the action of flowing water.

alpha particle: A positively charged particle consisting of two protons and two neutrons that is emitted during radioactive decay from the nucleus of certain nuclides. It is the least penetrating of the three common types of radiation (alpha, beta, and gamma). Symbol: α.

ambient air: The surrounding atmosphere as it exists around people, plants, and structures.

ambient noise levels: All encompassing background noise levels associated with a given environment, usually a composite of sounds from many sources, near and far.

ambient sound level (LDN): The 24-hour equivalent continuous sound level with a night-time penalty added, i.e., the time-averaged A-weighted sound level, in decibels, from midnight to midnight, obtained after the addition of 10 dB to sound levels from midnight to 7:00 a.m. and from 10:00 p.m. to midnight.

***American Indian Religious Freedom Act* of 1978:** This Act establishes national policy to protect and preserve for Native Americans their inherent right of freedom to believe, express, and exercise their traditional religions, including the rights of access to religious sites, use and possession of sacred objects, and the freedom to worship through traditional ceremonies and rites.

AP-42: see "emission factors".

aquifer: A saturated geologic unit through which significant quantities of groundwater can migrate under natural hydraulic gradients.

Argus: Laser system at Lawrence Livermore National Laboratory.

arithmetic mean: The average of a set of terms, computed by dividing their sum by the number of terms. See "geometric mean".

arroyo: A gully or channel cut by an intermittent stream.

atmospheric dispersion: The spreading downwind of airborne material due to wind speed and atmospheric turbulence; the greater the spread, the greater the dilution and the smaller the airborne material concentrations.

***Clean Air Act Amendments* of 1990:** Expands the Environmental Protection Agency's enforcement powers and adds restrictions on air toxins, ozone-depleting chemicals, stationary and mobile emissions sources, and emissions implicated in acid rain and global warming.

***Clean Air Act*:** Federal Act that mandates the promulgation and enforcement of air pollution control standards for stationary sources and motor vehicles.

***Clean Water Act* of 1972, 1987:** Federal Act regulating the discharge of pollutants from a point source into navigable waters of the United States in compliance with a National Pollution Discharge Elimination System permit as well as regulating discharges to or dredging of wetlands.

climatology: The science that deals with climates and investigates their phenomena and causes.

***Code of Federal Regulations* (CFR):** All Federal regulations in force are published in codified form in the *Code of Federal Regulations*.

collective committed effective dose equivalent: The committed effective dose equivalent of radiation for a population.

colluvium: A general term applied to any loose, heterogeneous, and incoherent mass of soil material and/or rock fragments deposited by rainwash, sheetwash, or slow continuous downslope creep, usually collecting at the base of gentle slopes or hillsides. Deposition by a combination of gravity and water.

committed dose equivalent: The predicted total dose equivalent to a tissue or organ over a 50-year period after an intake of radionuclides into the body. It does not include external dose contributions. Committed dose equivalent is expressed in units of rem or Sievert. The committed effective dose equivalent is the sum of the committed dose equivalents to various tissues of the body, each multiplied by the appropriate weighting factor.

Composite Noise Rating: see "Modified Composite Noise Rating" (CNR).

Conceptual Design Option: This option would use an ICF approach called indirect drive. In indirect drive, laser beams would illuminate and heat the interior surfaces of a metal case (hohlraum) containing a deuterium-tritium-filled capsule. The beams would cause the case to emit x rays that would strike the fusion target capsule and drive the fusion reaction.

criteria pollutants: Six air pollutants for which national ambient air quality standards are established by the Environmental Protection Agency under Title I of the Federal *Clean Air Act*. The six pollutants are sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, particulate matter smaller than 10 microns in diameter (PM_{10}), and lead.

critical habitat: Air, land, or water area and constituent elements, the loss of which would appreciably decrease the likelihood of survival and recovery of a listed species or a distinct segment of its population.

cryogenic target positioner: The system that is composed of a telescoping arm that is used to insert and withdraw the complete target cryogenic system and target, and allows aiming, alignment, and engagement by the NIF laser.

cultural resources: Archaeological sites, architectural features, traditional use areas, and Native American sacred sites or special use areas.

curie (Ci): A unit of radioactivity equal to 37 billion disintegrations per second; also, activity of that quantity of material in which 3.7×10^{10} atoms are transformed per second.

dBA (Decibel, A-weighted): A unit of weighted sound pressure level that correlates overall sound pressure levels with the frequency response of the human ear; measured by the use of a metering characteristic and the "A" weighting specified by the American National Standard Institute S1.4-1971(R176).

decommissioning: The process of removing a facility from operation, followed by decontamination, entombment, dismantlement, or conversion to another use.

decontamination: The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environ-

ment—such as radioactive contamination from facilities, soil, or equipment—by washing, chemical action, mechanical cleaning, or other techniques.

deuterium: The hydrogen isotope that is twice the mass of ordinary hydrogen and that occurs in water; also called heavy hydrogen.

diatomaceous: Composed of or containing numerous diatoms or their siliceous remains.

DOE Orders: Requirements internal to the U.S. Department of Energy (DOE) that establish DOE policy and procedures, including those for compliance with applicable laws.

dose: The amount of energy deposited in body tissue due to radiation exposure. Various technical terms—such as dose equivalent, effective dose equivalent, and collective dose—are used to evaluate the amount of radiation an exposed individual or population receives.

driver: A device for supplying the primary source of energy to an inertial fusion energy target; drivers can be lasers, ion beams, or intense gamma ray sources.

effective dose equivalent (EDE): The sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated. The EDE includes the dose from radiation sources internal and/or external to the body and is expressed in units of rem. The International Commission on Radiological Protection defines this as the effective dose.

emission factors: An average value that relates to the quantity of an air pollutant released to the atmosphere with the activity associated with the release of the pollutant and usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity that emits the pollutant. Emission factors are widely used for estimating air pollutant emissions and are often acceptable by regulatory authorities as an appropriate estimation of air pollution emissions to determine compliance with regulations.

emission offsets: Areas that allow no net increase in air pollution emissions require that a new source offset emission increases by decreasing an equivalent amount of emissions from an existing source. In some cases emission offsets or credits can be obtained from a depository that collects emission credits from retired sources.

endangered species: Any species that is in danger of extinction throughout all or a significant portion of its geographic range.

Enhanced Option: The Enhanced Option would include the indirect drive operations of the Conceptual Design Option and a second approach called direct drive. The Enhanced Option would also include the capability to perform an increased number of yield experiments to accommodate greater user needs. No hohlraum would be used in the direct drive approach. Instead, a large number of laser beams would be employed to ensure good uniformity of the driving force (laser light) over the face of the target. The laser beams would impinge directly on the deuterium-tritium-filled capsule to drive the fusion reaction.

Environmental Assessment (EA): A concise public document that provides sufficient evidence and analysis for determining whether to prepare an environmental impact statement (EIS) or a finding of no significant impact for a proposed action. An EA includes brief discussions of the need for the proposed action, the features of alternatives, the environmental impacts of the proposed action and alternatives, and a listing of agencies and persons consulted.

Environmental Impact Statement (EIS): A document required of Federal agencies by the *National Environmental Policy Act* for major proposals or legislation significantly affecting the environment. A tool for decisionmaking, it describes the positive and negative effects of the undertaking and alternative actions.

environmental justice: The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations,

and policies. Fair treatment implies that no population of people should be forced to shoulder a disproportionate share of the negative environmental impacts of pollution or environmental hazards due to a lack of political or economic strength.

ERPG-2 (Emergency Response Planning Guidelines-2): Concentration level for a 1-hour inhalation exposure that would allow a person to take protective action and avoid irreversible health effects.

exposure pathways: The course a chemical or physical agent takes from the source to the exposed organism. An exposure pathway describes a unique mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from a release site. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium such as air is also included.

exposure: The condition of being made subject to the action of radiation. Sometimes also used as a generic term to refer to the dose of radiation absorbed by an individual or population.

fault: A fracture in the earth's crust accompanied by displacement of one side of the fracture with respect to the other and in a direction parallel to the fracture.

federally listed species: see "threatened, endangered, candidate, or rare species".

fission: The splitting of a heavy atomic nucleus into two nuclei of lighter elements, accompanied by the release of energy and generally one or more neutrons. Fission can occur spontaneously or be induced by neutron bombardment.

flood, 100-year: A flood event of such magnitude it occurs, on average, every 100 years (equates to a 1-percent probability of occurring in any given year).

flood, 500-year: A flood event of such magnitude it occurs, on average, every 500 years (equates to a 0.2-percent probability of occurring in any given year).

floodplain: The lowlands adjoining inland and coastal waters and relatively flat areas including, at a minimum, that area inundated by a 1-percent or greater chance flood in any given year. The base floodplain is defined as the 100-year (1.0 percent) floodplain. The critical action floodplain as defined as the 500-year (0.2 percent) floodplain.

footprint: The layout of a facility on the ground; also refers to an area affected by release of radioactive materials.

fugitive dust: The dust released from activities associated with an alternative such as construction, manufacturing, or transportation.

fugitive emissions: Uncontrolled emissions to the atmosphere from pumps, valves, flanges, seals, and other process points not vented through a stack. Also includes emissions from area sources such as ponds, lagoons, landfills, and piles of stored material.

fusion: Nuclear reaction in which light nuclei are fused together to form a heavier nucleus, accompanied by the release of immense amounts of energy and fast neutrons.

fusion fuel: Mixture of deuterium and tritium contained in a small capsule called the target.

fusion reaction: When two nuclei of lighter elements are brought into close enough proximity, they can undergo thermonuclear fusion forming a single nucleus and releasing energy at the slight expense in mass of the original constituents. Typically, a deuterium and tritium nucleus are fused in such a reaction to produce a helium nucleus plus one free neutron. The released energy of 17.6 MeV (million electron volts) is carried mostly as kinetic energy by the neutron (14 MeV).

gamma: High-energy, short-wavelength electromagnetic radiation (a packet of energy) emitted from the nucleus. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded against by dense materials such as lead or uranium. Gamma rays are similar to x rays, but are usually more energetic. Symbol: γ.

geometric mean: For a set of n terms, the nth root of their product. For a set of positive numbers, the geometric mean is always less than or equal to the arithmetic mean (see "arithmetic mean").

habitat: Area where a plant or animal lives.

hazardous chemical: Any chemical that is a physical hazard or a health hazard as defined by the Occupational Safety and Health Administration (29 CFR 1910.1201). For *Superfund Amendments and Reauthorization Act* (SARA) Title III, Section 311, the term is defined the same with certain named exceptions.

hazardous waste: Under the *Resource Conservation and Recovery Act*, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. Source, special nuclear material, and byproduct material, as defined by the *Atomic Energy Act*, are specifically excluded from the definition of solid waste.

hohlraum: The metal case surrounding the target on indirect-drive inertial confinement fusion.

igneous: Refers to a rock or mineral that solidified from molten or partly molten material, i.e., from a magma; also, applied to processes leading to, related to, or resulting from the formation of such rocks. Igneous rocks constitute one of the three main classes into which rocks are divided, the others being metamorphic and sedimentary.

ignition: Ignition (fusion) is defined as the conditions leading to the self-heating of the fusion fuel by the fusion driver (such as laser beams). That condition occurs during the final part of the laser pulse when the fuel core is compressed to 20 times the density of lead (226 g/cm^3) and simultaneously heated to 100 million °C. The self heating of the fuel capsule is caused by alpha particle (fusion reaction byproduct) deposition. Ignition occurs when the reaction product deposition becomes faster than the heating caused by compression.

ignitron switch: A high current switch used to discharge energy storage capacitors, which are used to fire laser flashlamps.

inertial confinement fusion (ICF): An energetic driver beam (laser, x ray, or charged particle) initiated nuclear fusion using the inertial properties of the reactants as a confinement mechanism.

inertial fusion energy (IFE): The use of high-repetition-rate lasers or ion drivers (about 10 pulses per second) to accomplish laboratory and commercial thermonuclear fusion.

ingestion dose: An internal dose that results from the oral intake of food, water, soil, or other media contaminated with radioactive material.

input parameters: Values of variables needed to run a computer model.

interim (permit) status: Period during which treatment, storage, and disposal facilities coming under the *Resource Conservation and Recovery Act* of 1980 are temporarily permitted to operate while awaiting denial or issuance of a permanent permit.

isotope: An atom of a chemical element with a specific atomic number and atomic mass. Isotopes of the same element have the same number of protons but different numbers of neutrons and different atomic masses.

Joule: A metric unit of energy, work, or heat, equivalent to 1 watt-second, 0.737 foot-pound, or 0.239 calorie.

Key Decisions (KDs): The Department of Energy's procedure for approving large projects such as NIF is based on "Critical Decisions" (formerly known as Key Decisions) made by the Secretary of Energy. In January 1993, the Secretary approved "Key Decisions" 0, which affirmed the need for NIF and authorized a collaborative effort by the three DOE defense laboratories and the University of Rochester Laboratory for Laser Energetics to produce a conceptual design report. This report was completed in April 1994. "Key Decisions" 1 was signed by the Secretary

laser beam energy and power amplification using a single-pass MOPA chain. The MOPA chain starts with a small oscillator (the master oscillator) that produces a laser pulse, which enters a preamplifier before making a single pass through a chain of amplifiers of gradually increasing size.

Master Oscillator Room (MOR): A self-contained special-purpose room that would house the NIF Master Oscillators and their supporting equipment. The purpose of this facility is to supply the 192 individually shaped and timed low-level laser pulses to the Preamplifier Modules located beneath the Spatial Filters in the main laser hall.

maximally exposed individual (MEI): A hypothetical individual who could potentially receive the maximum possible dose of radiation (or hazardous chemical).

maximum contaminant levels: Maximum permissible concentration of a contaminant in water which is delivered to any user of a public water system.

maximum design yield: The NIF Target Area has been designed to safely confine and withstand the effects of the yield of its targets up to this yield on some routine basis (e.g., weekly).

maximum yield experiment: A fusion ignition experiment that generates maximally expected fusion energy.

meteorology: The science dealing with the atmosphere and its phenomena, especially as it relates to weather.

millirem (mrem): One-one-thousandth of a rem (see "rem").

minority populations: Includes individuals who report themselves as belonging to any of the following racial groups: Black (reported their race as "Black or Negro," or reported entries such as "African American, Afro-American, Black Puerto Rican, Jamaican, Nigerian, West Indian, or Haitian"); American Indian, Eskimo, or Aleut; Asian or Pacific Islander, or "Other Race." In addition, individuals identifying themselves as Hispanic origin are also included in the minority category. Hispanics can be of any race, however. To avoid double-counting minority Hispanic individuals, only white Hispanics were included in the number of racially based minorities in a tabulation, since nonwhite Hispanics had already been counted under their minority racial classification.

Miocene: A geologic epoch in the Cenozoic Era dating from 26 to 7 million years ago.

mixed waste: Radioactive waste that contains nonradioactive toxic or hazardous materials that could cause undesirable effects in the environment. Such waste has to be handled, processed and disposed of in such a manner that considers the chemical as well as its radioactive components.

model: A conceptual, mathematical, or physical system obeying certain specified conditions, whose behavior is used to understand the physical system to which it is analogous.

Modified Composite Noise Rating (CNR): Noise rating system that determines impacts from a fixed noise source using objective and subjective factors. Noise ranked A through D is generally considered to be acceptable with "A" representing essentially no impacts. Rankings above "D" are usually addressed with mitigative measures unless the source is temporary.

molecular sieve: A material with a rigid, uniform pore structure that completely excludes molecules larger than the structure pore openings and that can absorb certain classes of small molecules from a fluid in contact with the material.

MOR: see "Master Oscillator Room".

mrem: One one-thousandth of a rem (see "rem").

NAAQS: see "National Ambient Air Quality Standards".

National Ambient Air Quality Standards (NAAQS): Air quality standards established by the *Clean Air Act*, as amended. The primary National Ambient Air Quality Standards are intended to protect the public health with an adequate margin of safety, and the secondary National Ambient Air Quality Standards are intended to protect the public

welfare from any known or anticipated adverse effects of a pollutant.

***National Environmental Policy Act* (NEPA) of 1969:** The Act that established the national policy to protect humans and the environment, requiring environmental reviews of Federal actions that have the potential for significant impact on the environment, and established the Council on Environmental Quality.

***National Historic Preservation Act* of 1966, as amended:** This Act provides that property resources with significant national historic value be placed on the National Register of Historic Places. It does not require any permits but, pursuant to Federal code, if a proposed action might impact an historic property resource, it mandates consultation with the proper agencies.

National Ignition Facility (NIF): The proposed international research center comprising the world's most powerful laser, NIF would achieve ignition of fusion fuel and energy gain for the first time in a laboratory.

National Pollutant Discharge Elimination System (NPDES): Federal permitting system required for hazardous effluents regulated through the *Clean Water Act*, as amended.

***National Register of Historic Places*:** A list maintained by the National Park Service of architectural, historic, archaeological, and cultural sites of local, state, or national significance.

neodymium: A rare-earth metal listed in the periodic table of elements with an atomic number of 60 and an atomic weight of 144.24. The metal has a bright silvery metallic luster. Neodymium is one of the more reactive rare-earth metals and quickly tarnishes in air, forming an oxide that spalls off and exposes the metal to oxidation. Besides its use in producing coherent light in glass lasers, this metal has been used in astronomical work to produce sharp bands by which spectral lines may be calibrated. Neodymium salts are also used as a colorant for enamels, and in its separated form it is used to color glass in delicate shades ranging from pure violet to wine-red and warm gray.

neodymium glass laser: A type of solid-state laser that uses neodymium-doped optical fibers, rods, or glass slabs, with small amounts neodymium added, in which laser generation and amplification equipment are made. This equipment includes a master oscillator, preamplifier, and a series of amplifiers needed to generate and propagate laser beamlines that are highly stable and with the desired peak power level and frequency.

NEPA: see *National Environmental Policy Act.*

neutron: An uncharged elementary particle with a mass slightly greater than that of the proton, found in the nucleus of every atom heavier than hydrogen-1; a free neutron is unstable and decays with a half-life of about 13 minutes into an electron and a proton.

nitrogen oxides (NO_x): Refers to the oxides of nitrogen, primarily NO (nitrogen oxide) and NO_2 (nitrogen dioxide). These are produced in the combustion of fossil fuels and can constitute an air pollution problem. When nitrogen dioxide combines with volatile organic compounds, in sunlight, ozone is produced.

No Action alternative: Under this alternative, DOE would not construct and operate NIF and its support facilities. In the absence of NIF, the Nova Facility at LLNL would continue to operate beyond the year 2000.

***Noise Control Act* of 1972:** This Act directs all Federal agencies to carry out programs in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health or welfare.

nonattainment area: An air quality control region (or portion thereof) in which the Environmental Protection Agency has determined that ambient air concentrations exceed national ambient air quality standards for one or more criteria pollutants.

nonhazardous wastes: Routinely generated, nonhazardous wastes include general facility refuse such as paper, cardboard, glass, wood, plastics, scrap, metal containers, dirt, and rubble. These wastes are segregated and recycled whenever possible.

normal operations: All normal conditions and those abnormal conditions that frequency estimation techniques indicate occur with a frequency of more than 0.1 event per year.

Nova: A 10-beam, neodymium glass fusion laser facility at Lawrence Livermore National Laboratory capable of operating at 50 terawatts at 1/3 micrometers that was completed in 1984 and used for inertial confinement fusion target irradiation experiments.

NPDES: see "National Pollutant Discharge Elimination System".

nuclear weapon: The general name given to any weapon in which the explosion results from the energy released by reactions involving atomic nuclei, either fission, fusion, or both.

Occupational Safety and Health Administration (OSHA): Oversees and regulates workplace health and safety, created by the *Occupational Safety and Health Act* of 1970.

opacity restrictions: Visible-emission regulations that are based on the light-scattering properties of suspended matter in the ambient atmosphere and apply to near-field emissions of fixed sources.

ozone (O_3): The triatomic form of oxygen. In the stratosphere, ozone protects the Earth from the sun's ultraviolet rays; in lower levels of the atmosphere, ozone is considered an air pollutant.

paleontology: The study of fossils.

particulate (airborne): Small particles that are emitted from fixed or mobile sources and dispersed in the atmosphere.

Pasquill stability categories: Classification scheme that describes the degree of atmospheric turbulence. Categories range from extremely unstable (A) to extremely stable (F). Unstable conditions promote the rapid dispersion of atmospheric contaminants and result in lower air concentrations as compared with stable conditions.

perennial stream: A watercourse that flows year-round.

Permissible Exposure Limit (PEL): Occupational exposure limits endorsed by OSHA. May be for short-term or 8-hour duration exposure.

person-rem: The unit of collective radiation dose commitment to a given population; the sum of the individual doses received by a population group.

pH (potential of hydrogen): A measure of the hydrogen ion concentration in aqueous solution. Pure water has a pH of 7, acidic solutions have a pH less than 7, and basic solutions have a pH greater than 7.

photochemical oxidant: A class of compounds typified by ozone that represents oxidizing compounds created in the atmosphere with sunlight as a catalyst under low wind conditions.

piedmont: An area, plain, slope glacier, or other feature at the base of a mountain.

playa: Level area at the bottom of a desert basin that at times is temporarily covered with water; a dry lake bed.

Pleistocene: The geologic epoch that began approximately 1.8 million to 10,000 years ago (is generally equated with the "Ice Age").

Pliocene: Geologic epoch between the Miocene and the Pleistocene epochs approximately 5.5 to 1.8 million years ago.

plume: The spatial distribution of a release of airborne or waterborne material as it disperses in the environment.

PM_{10}: Particulate matter of aerodynamic diameter less than 10 micrometers.

population dose (population exposure): Summation of individual radiation doses received by all those exposed to the source or event being considered. The collective radiation dose received by a population group, usually measured in units of person-rem.

Precambrian: Dating from before the Cambrian geologic period more than 570 million years ago.

resuspended inhalation: Exposure route in which radioactive materials enter the body through inhalation of air contaminated with radioactive particulates that were previously deposited on the ground following an accidental release.

riparian: Of, on, or pertaining to the bank of a river, stream, or lake.

risk factor: Numerical estimate of the severity of harm associated with exposure to a particular risk agent.

roentgen: a unit of exposure to ionizing x- or gamma radiation equal to or producing 1 electrostatic unit per cubic centimeter of air. It is approximately equal to 1 rad.

***Safe Drinking Water Act*, as amended:** This Act protects the quality of public water supplies, water supply and distribution systems, and all sources of drinking water.

SARA: see *Superfund Amendments and Reauthorization Act.*

sedimentary rock: A rock resulting from the consolidation of loose sediment that has accumulated in layers, consisting of mechanically formed fragments of older rock transported from its source and deposited in water or from air or ice.

seismic zone: An area defined by the Uniform Building Code (1991), designating the amount of damage to be expected as the result of earthquakes. The United States is divided into six zones: (1) Zone 0 - no damage; (2) Zone 1 - minor damage; corresponds to intensities V and VI of the modified Mercalli intensity scale; (3) Zone 2A - moderate damage; corresponds to intensity VII of the modified Mercalli intensity scale (eastern United States); (4) Zone 2B - slightly more damage than 2A (western United States); (5) Zone 3 - major damage; corresponds to intensity VII and higher of the modified Mercalli intensity scale; (6) Zone 4 - areas within Zone 3 determined by proximity to certain major fault systems.

seismicity: The tendency for the occurrence of earthquakes.

severity: Function of the magnitudes of the mechanical forces (impact) and thermal forces (fire) to which a package may be subjected during an accident; any sequence of events that results in an accident in which a transport package is subjected to forces within a certain range of values is assigned to the accident severity category associated with that range.

shielding: Any material or obstruction (bulkheads, walls, or other constructions) that absorbs radiation in order to protect personnel or equipment.

shot: Refers to all (192) laser beams hitting the target simultaneously.

site: In this PSA, the term "site" refers to a DOE-controlled Federal site, such as Los Alamos National Laboratory or the Nevada Test Site.

socioeconomics (analyses): Analyses of those parts of the human environment in a particular location that are related to existing and potential future economic and social conditions. The welfare of human beings as related to the production, distribution, and consumption of goods and services.

Solid Waste Management Unit (SWMU): Any discernible unit at which solid wastes have been placed at any time regardless of whether the unit was intended for solid or hazardous waste management.

source: Any physical entity that may cause radiation exposure, for example by emitting ionizing radiation or releasing radioactive material.

stability class: see "Pasquill stability categories".

Stockpile Stewardship and Management Program: A single, highly integrated technical program for maintaining the safety and reliability of the U.S. nuclear stockpile in an era without nuclear testing and without new weapons development and production.

Stormwater Pollution Prevention Plan: A plan required by an NPDES permit for controlling stormwater pollution resulting from construction or industrial activities.

sulfur oxides (SO_x): A general term used to describe the oxides of sulfur; pungent, colorless gases formed primarily by the combustion of fossil fuels. Sulfur oxides, which are considered major air pollutants, may damage the respiratory tract as well as vegetation.

***Superfund Amendments and Reauthorization Act* (SARA):** Public Law 99-499 passed in 1986 which amends the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) of 1980. SARA more stringently defines hazardous waste cleanup standards and emphasizes remedies that permanently and significantly reduce the mobility, toxicity, or volume of wastes. Title III of SARA, the *Emergency Planning and Community Right-to-Know Act*, mandates establishment of community emergency planning programs, emergency notification, reporting of chemicals, and emission inventories.

targets: Refers to a microstructure containing a tiny fuel capsule at which the lasers are directed.

tectonic: Pertaining to the processes causing, and the rock structures resulting from, deformation of the earth's crusts.

terawatt (TW): The equivalent of one trillion watts (10^{12}).

terrestrial: Pertaining to plants or animals living on land rather than in water.

thermoluminescent dosimeter: A radiation detection device that accumulates a dose or exposure over a period of time.

threatened species: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

threshold limit value (TLV): The recommended concentration of a contaminant that a worker may be exposed to according to the American Council of Governmental Industrial Hygienists.

time-weighted average (TWA): Time-weighted average representing 8 hours per day for 40 weeks for 40 years of exposure.

total suspended particulates (TSP): Particulate matter present in the atmosphere.

***Toxic Substances Control Act* of 1976 (TSCA):** Act authorizing the Environmental Protection Agency to secure information on all new and existing chemical substances and to control any of these substances determined to cause an unreasonable risk to public health or the environment. This law requires that the health and environmental effects of all new chemicals be reviewed by the Environmental Protection Agency before they are manufactured for commercial purposes.

transuranic (TRU) waste: Waste contaminated with alpha-emitting radionuclides of atomic numbers greater than 92 with half-lives greater than 20 years and concentrations greater than 100 nanocuries/gram at time of assay. It is not a mixed waste.

tritium: A radioactive isotope of the element hydrogen with two neutrons and one proton. Common symbols for this isotope are H-3 and T.

tuff: A rock formed of compacted volcanic fragments, generally smaller than 4 millimeters in diameter.

Type A packaging: Packaging designed to retain the integrity of containment and shielding required by regulation under normal conditions of transport as demonstrated by the required test. Type A packaging (e.g., 55-gallon drums) is typically used to transport materials such as low-level radioactive waste.

volatile organic compounds (VOCs): A broad range of organic compounds (such as benzene, chloroform, and methyl alcohol), often halogenated, that vaporize at ambient or relatively low temperatures.

waste management: The planning, coordination, and direction of those functions related to generation, handling, treatment, storage, transport, and disposal of waste, as well as associated surveillance and maintenance activities.

waste minimization: Actions that economically avoid or reduce the generation of waste by source reduction, reducing the toxicity of hazardous waste, improving energy usage, or recycling. These actions will be consistent with the general goal of minimiz-

ing current and future threats to human health, safety, and the environment.

weapons effects: Deals with outputs of nuclear weapons and the associated effects on materials and the environment.

wetland: Land or area containing hydric soils, saturated or inundated soil during some portion of the plant growing season, and containing plant species tolerant of such conditions (includes swamps, marshes, and bogs).

wind rose: A depiction of wind speed and direction frequency for a given period of time.

x rays: Penetrating electromagnetic radiations with wavelengths shorter than those of visible light, usually produced by irradiating a metallic target with large numbers of high-energy electrons. In nuclear reactions, it is customary to refer to photons originating outside the nucleus as x rays and those originating in the nucleus as gamma rays, even though they are the same.

yield experiments: A measure of fusion energy/neutron production in experiments that use a mixture of deuterium and tritium isotopes as fuel.

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APPENDIX J

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ACRONYMS, ABBREVIATIONS, CHEMICAL SYMBOLS, AND UNITS OF MEASURE

Acronyms and Abbreviations

AMCCOM	U.S. Army Armament, Munitions, and Chemical Command
CFF	Contained Firing Facility
D&D	decontamination and decommissioning
DOE	Department of Energy
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
FR	*Federal Register*
FXR	Flash X-Ray
HEPA	high-efficiency particulate air
HTO	tritiated water
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
MAP	Mitigation Action Plan
MMRP	Mitigation Monitoring and Reporting Program
NEPA	*National Environmental Policy Act*
NESHAP	National Emissions Standards for Hazardous Air Pollutants
ROD	Record of Decision
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
TRU	transuranic
UC	University of California
VOCs	volatile organic compounds

Chemical Symbols

CO	carbon monoxide
HCl	hydrogen chloride
HCN	hydrogen cyanide
HF	hydrogen fluoride
NH_3	ammonia
NO_x	nitrogen oxides

Units of Measure

cm	centimeters
ft	feet
ft^2	square feet
ft^3	cubic feet
gal	gallons
ha	hectares
hr	hour
in	inches
kg	kilogram
km	kilometers

L	liters
lb	pounds
µg	micrograms
m	meters
m^2	square meters
m^3	cubic meters
mg	milligrams
$\mu g/m^3$	micrograms per cubic meter
mi	miles
rem	roentgen-equivalent-man (a measure of radiation dosage)
yd	yards
yd^3	cubic yards

APPENDIX J: CONTAINED FIRING FACILITY PROJECT-SPECIFIC ANALYSIS

J.1 INTRODUCTION

The Department of Energy (DOE) proposes to construct and operate a facility to provide containment of explosives test experiments at Lawrence Livermore National Laboratory (LLNL). These tests are currently conducted outdoors on a firing pad (also called a firing table) at the existing operational Building 801 (B801) facility, located at LLNL's Experimental Test Site (Site 300). Detonation experiments using explosives have been conducted outdoors at Site 300 since the early 1950s. The proposed Contained Firing Facility (CFF) would be a modification to the existing B801 Flash X-Ray (FXR) Facility and would consist of an enclosed Firing Chamber, a Support Facility, and a Diagnostic Equipment Facility. An Office Module, to be constructed approximately 46 meters (m) (150 feet [ft]) from the proposed Firing Chamber, is also proposed.

Two alternatives to the proposed action are addressed in this environmental assessment:

- No action (continue operation of the current B801 facility and its outdoor firing activities at planned levels).
- Build the CFF at an alternative Site 300 location (vicinity of B851).

The Record of Decision (ROD) issued January 27, 1993, for the August 1992 *Final Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories*, Livermore, DOE/Environmental Impact Statement (EIS) 0157, (1992 EIS/Environmental Impact Report [EIR]) (DOE/University of California [UC] 1992), published the Secretary of Energy's decision to continue to operate LLNL, including near-term proposed projects (those within 5 to 10 years). The proposed B801 CFF is described as one of the projected, budgeted new facilities under the proposed action, (table 3–3) in the 1992 EIS/EIR, and is further discussed in section A.2.5.3 (Proposed Construction Projects, LLNL, Site 300) and table 4.15–2 (LLNL Site 300, Overview) of the 1992 EIS/EIR. The potential impacts of construction and operation of the proposed CFF are expected to be within the scope of the impacts of normal Site 300 operations and potential Site 300 accidents as outlined in the 1992 EIS/EIR. This environmental impact analysis is tiered from the 1992 EIS/EIR and provides additional detailed information on CFF operations and its potential impacts.

This environmental impact analysis was prepared in accordance with the *National Environmental Policy Act* (NEPA) of 1969, as amended, (42 *United States Code* section 4321 et seq.) and adheres to policies and procedures for DOE compliance with the NEPA as set forth in 10 *Code of Federal Regulations*, Part 1021 (57 *Federal Register* [FR] 15122, April 24, 1992).

J.2 PURPOSE AND NEED FOR ACTION

To meet its present and future strategic stockpile stewardship responsibilities DOE needs to insure its long-term ability to continue conducting hydrodynamic testing of certain explosive and metal containing materials at its existing FXR Facility (Building 801) at LLNL's Site 300. As the most up-to-date U.S. hydrodynamic test facility, the current Building 801 FXR Facility serves a key role in providing essential hydrodynamic test data needed by DOE to assess key elements of stockpile safety and reliability in the absence of nuclear testing by the United States.

In order to assure its continued future ability to provide this needed test data at its Site 300 facility and consistent with its policy of improving environmental, safety, and health posture of its operations, DOE proposes to further reduce the environmental, safety, and health impacts of its current Site 300 explosives tests by conducting certain experiments (such as those involving depleted uranium, tritium, and beryllium) in an enclosed Firing Chamber.

Oakland
Livermore
PACIFIC OCEAN

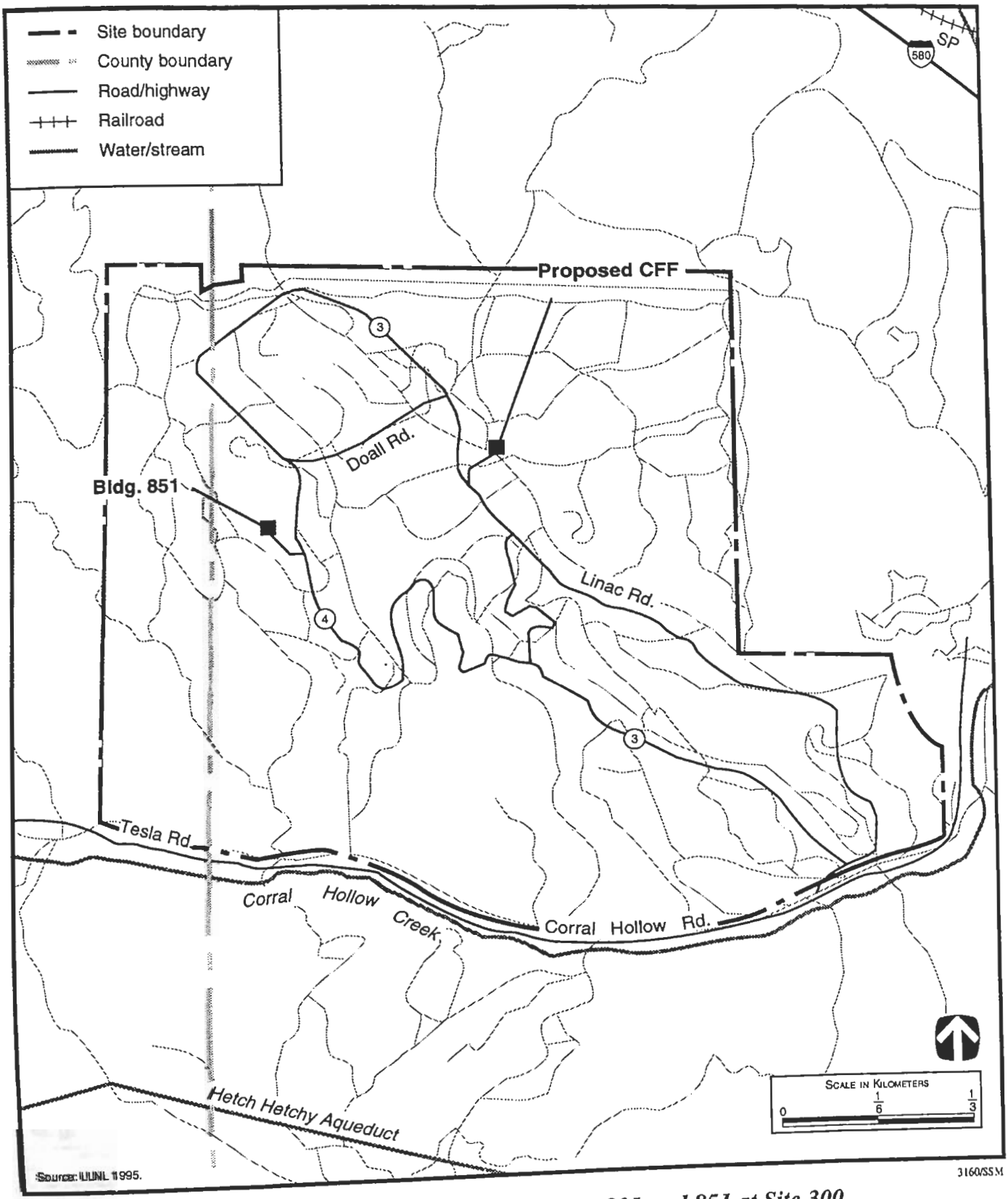

FIGURE J.3.1–2.—*Location of Buildings 801 and 851 at Site 300.*

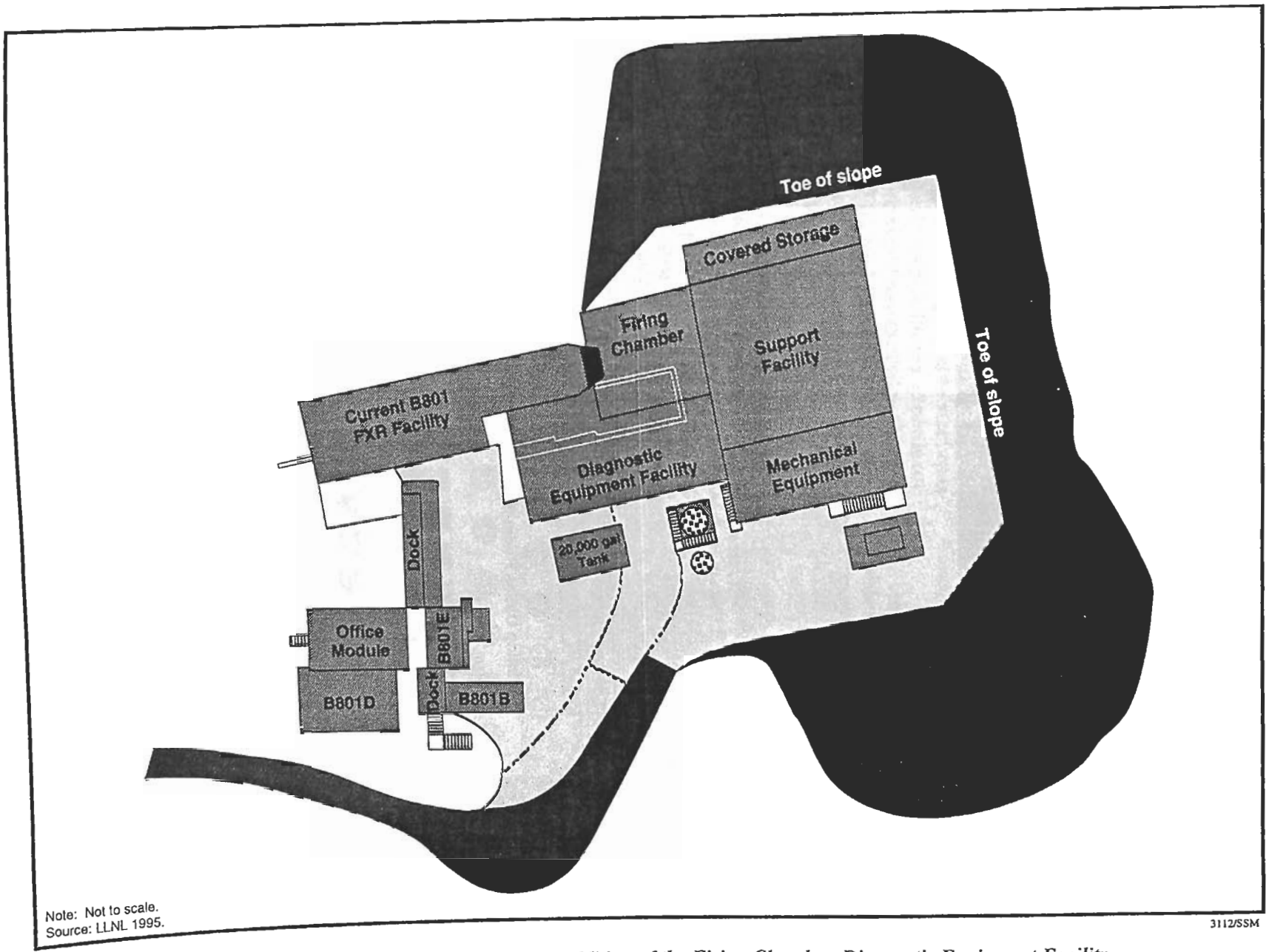

FIGURE J.3.1–3.—*Building 801 Showing Addition of the Firing Chamber, Diagnostic Equipment Facility, Support Facility, and Office Module.*

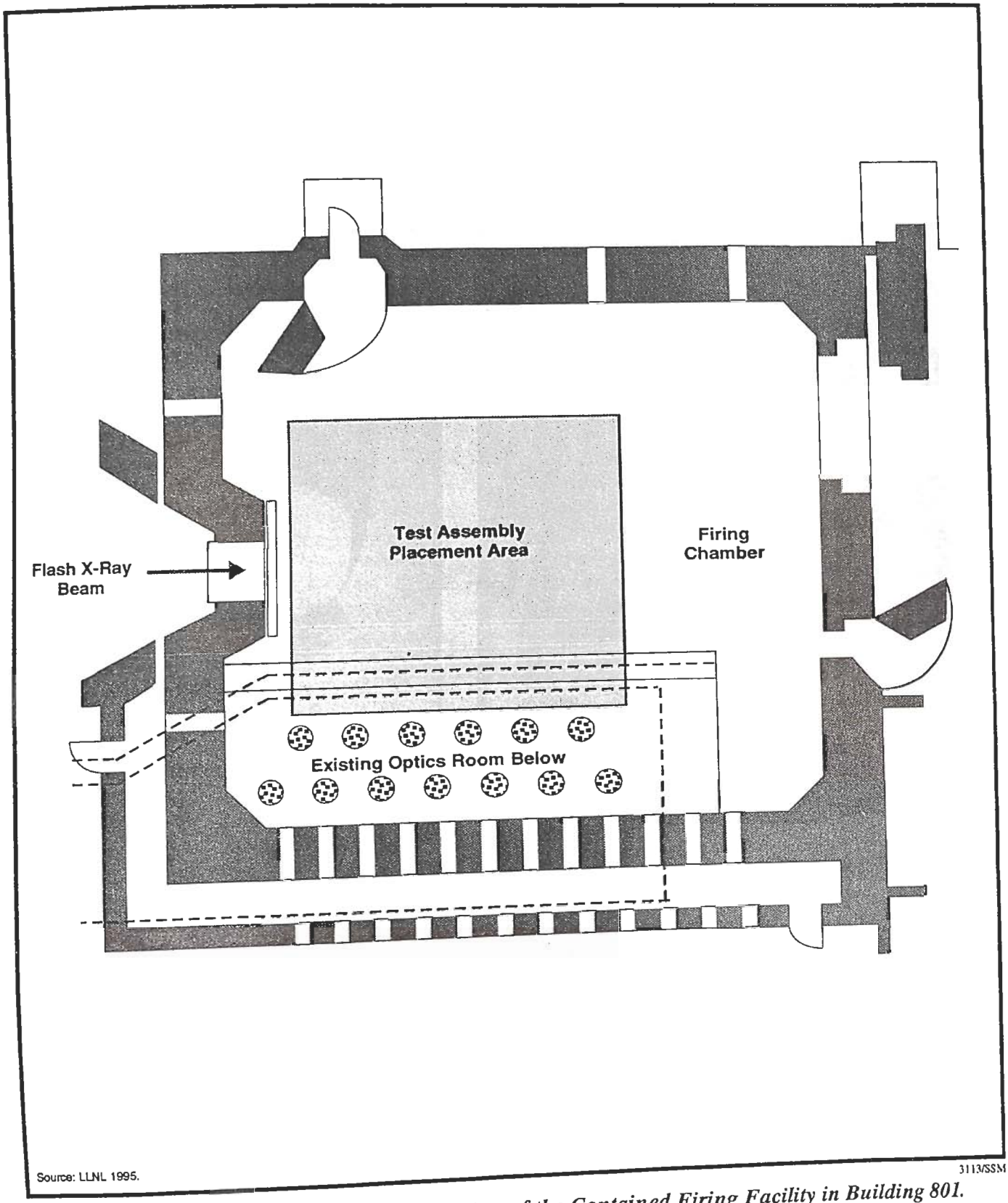

FIGURE J.3.1.1.3–1.—*Firing Chamber Portion of the Contained Firing Facility in Building 801.*

1.4-m- (4.5-ft)-thick ceiling slab and be supported on a 1.8-m- (6-ft)-thick floor slab. On the south side, an existing camera room would be integrated into and be used as part of the chamber. The 0.9-m (3-ft)-thick existing roof of the camera room would be covered by a 0.6-m- (2-ft)-thick concrete overlay to increase its structural capacity.

All interior surfaces of the chamber would be lined with 1.3 centimeters (cm) (0.5 inches [in]) steel plate. Replaceable 2.5 cm (1 in) thick steel tiles would be attached to the steel-lined walls and ceiling. Floors would also be covered with replaceable steel tiles whose thickness would vary with the experiment. Equipment would be brought into the Firing Chamber through a 3.7 m (12 ft) by 4.3 m (14 ft) blast door. Two personnel safety exit doors would be situated to provide egress during test setup. Blast doors would also be protected from detonation fragments. The chamber would have conditioned air, lighting, a water washdown system, a separate tritiated-gas stripping system, a drain leading to a holding tank, and water recycling and evaporation systems. The air supply and exhaust openings would also be protected from blast damage by shielding dampers and blast valves.

The air management system supporting the chamber would consist of a normal operation exhaust system with a post-firing air purge system, and a gas-stripping system for use after experiments involving tritium. During normal operation, the exhaust system (figure J.3.1.1.3–2) would maintain a negative pressure in the Firing Chamber relative to the Support Facility.

Following a test firing, an air purge system would exhaust air, suspended particulates, and gases from the chamber through filter and scrubber systems before the discharge of air and remaining gases to the atmosphere through a roof-mounted stack approximately 15.2 m (50 ft) above ground level. Air would be taken in through openings in the chamber wall. Ductwork would be protected from dynamic and static blast overpressure. The filtration system for use after detonations would consist of a centrifugal precipitator; a 95-percent efficient pulse-jet dust collector with fusible sprinkler head; 30-percent efficient prefilters; 99.97-percent efficient, nuclear-grade HEPA filters; a scrubber system to remove gases and vapors; and a fan. The filter housing would be a bag-out type, and would include ports for testing HEPA filter-bank efficiency and monitoring pressure drop across the filters. Any waste storage and treatment areas that may be required for processing liquid from the gas absorption wet scrubber would be designed and operated in conformance with applicable waste management procedures and DOE orders.

After tests involving tritium-containing materials, a tritium scrubber system would be activated. In addition to filtering particulate, this system would also remove at least 95 percent of any tritium. The tritium scrubbing system would consist of a standard hot catalyst/desiccant system designed to ensure oxidation and removal of airborne tritium as primarily tritiated water (HTO).

The chamber also would be designed with water washdown systems for post-test cleaning and fire protection (figure J.3.1.1.3–3). The washdown system installed in the ceiling of the chamber, consisting of an articulating nozzle, would direct water to all interior surfaces. The high-velocity spray nozzle could operate automatically or manually via remote controls with the use of video monitoring. When operated manually, personnel would use hoses from reels located outside the chamber. Residual water retained by pitted floor tiles would be removed by manual or mechanical methods. A floor drain (protected by a blast-resistant valve) would collect contaminated water and direct it to a holding tank for analysis followed by filtration and evaporation or transfer to an appropriate treatment facility.

J.3.1.1.4 Support Facility

The Support Facility would provide a staging area for preparation of the nonexplosive components of an experiment; storage of equipment and materials; and personnel locker rooms, rest rooms, and decontamination showers. A mezzanine above the personnel area would house mechanical equipment. A mechanical equipment area would be located adjacent to the staging area. The size of the Support Facility would be approximately 1,542 m^2 (16,600 ft^2).

The Support Facility would be separated into gray and clean areas. The gray areas would be areas in which contamination could occur. Egress from the gray areas would require passage through decontamination and change areas prior to entering the clean areas. The Support Facility rooms would have a negative air pressure relative to the clean areas to control the potential for migration of contamination to clean areas.

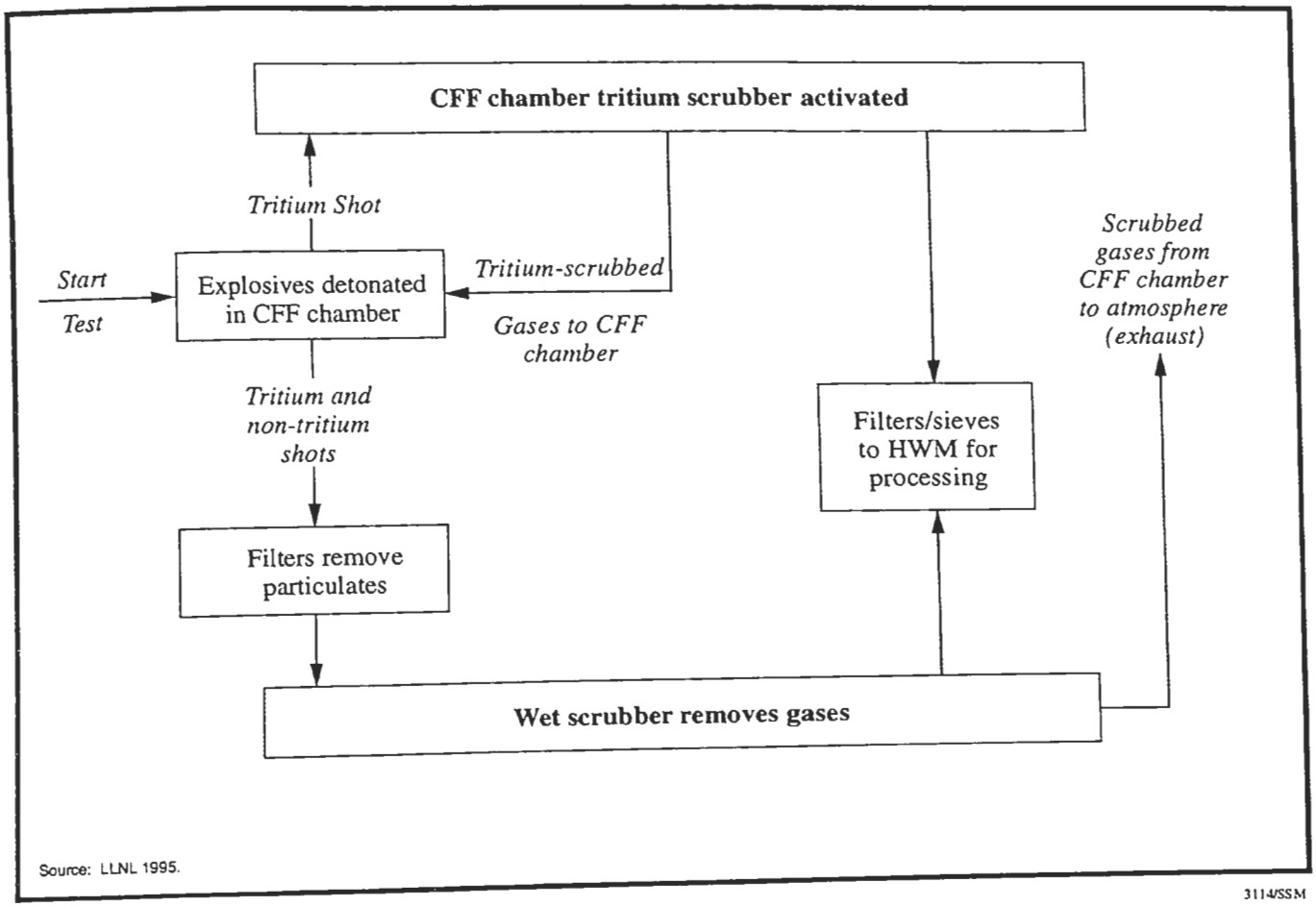

FIGURE J.3.1.1.3–2.—*Simplified Post-Test Contained Firing Facility Gas Scrubbing Schematic.*

J.3.1.1.5 Diagnostic Equipment Facility

The Diagnostic Equipment Facility would house various diagnostic equipment used to evaluate the results of explosives tests. The Diagnostic Equipment Facility would be similar in construction to the Support Facility but would be designed to protect personnel who occupy this area during the tests. The facility would be approximately 576 m^2 (6,200 ft^2). The Diagnostic Equipment Facility would be controlled as, and be considered to be, a clean area. An additional 0.6 m (2 ft) thickness of reinforced concrete wall would be placed 1.2 m (4 ft) from the Firing Chamber wall to create a utility corridor for diagnostic devices, as well as to provide an additional safety buffer wall for personnel. Pressure-rated personnel doors would be installed at either end of the corridor for access. The Diagnostic Equipment Facility would be the main personnel entrance into the new CFF complex.

J.3.1.1.6 Office Module

A premanufactured Office Module of approximately 223 m^2 (2,400 ft^2) would be constructed adjacent to the north side of the existing B801D, approximately 46 m (150 ft) southwest of the proposed Firing Chamber. This facility would provide administrative space for the B801 complex staff.

J.3.1.2 *Construction*

Site preparation would require site excavation and demolition work. The CFF design concept would require excavation of about 41,300 cubic meters (m^3) (54,000 cubic yards [yd^3]) of existing soil from adjacent hillsides. This material would be sampled and analyzed to verify that it is uncontaminated. Any identified hazardous, LLW, or mixed wastes would be appropriately packaged and labeled in accordance with all applicable regulatory, DOE, and LLNL

movement and location while certain of these setup operations are conducted.

The explosive charge would usually be the last item to be placed at the Firing Chamber. When all other equipment has been readied, the explosives assembly would be brought by truck to the chamber from its assembly point at the Site 300 process area or from an explosives storage magazine and carefully set in position, with only essential personnel in attendance. System checks in the form of dry runs would be performed to show that all electrical and mechanical systems have been properly connected and to verify that proper time delays between individual events have been programmed.

When all dry run testing is complete, the chamber would be secured, personnel assembled and accounted for (mustered) within the protected control room (bunker), and the experiment conducted.

J.3.1.3.2 Post-Test Activities

Tests Not Involving Tritium. After an experiment that does not involve tritium, the Firing Chamber would be allowed to cool. Television cameras and infrared sensors would be used to survey the chamber interior for burning debris. Fires would be quenched by a short-duration water washdown or allowed to self-extinguish. The chamber purge system would draw air through scrubber, filtration, and exhaust systems (figure J.3.1.1.3–2). Gas sampling devices would monitor the chamber gas concentrations before and after purging.

After about 10 fresh-air makeup exchanges (and after observation of the television monitor indicates that entry is permissible), qualified explosives handlers (using breathing protection, if necessary) would reenter the chamber. Any smoldering materials or unreacted explosive would be rendered safe so that others could enter. Diagnostics data would be collected and the chamber cleaned in preparation for the next experiment.

The chamber washdown system, consisting of an articulating, ceiling-mounted nozzle would be used to periodically wash detonation test residue from the chamber walls (figure J.3.1.1.3–3). A manually operated hose would be used to complete the washdown once access is permitted. The washdown water would be supplied from Site 300's domestic water supply system, supplemented by recycled washdown water. This washdown water and spent scrubber liquid would be diverted to a holding tank, filtered, and reused, evaporated, or sent to LLNL's Hazardous Waste Management Division for processing. Floor drains, floor sinks, drainage trenches, wash basins, and emergency shower and eyewash drains from portions of the Support Facility would also be gravity-fed into a separate water collection system. This wash water would be monitored, filtered, and recycled for reuse as part of the Firing Chamber washdown system.

Evaporation would be used to substantially reduce the volume of wastewater. Waste residues from this process would be treated by methods that meet applicable criteria for handling industrial wastewater (e.g., treatment and/or stabilization). Sludge containing metals and other contaminants that would be typical residue from evaporating this form of wastewater would be routinely handled by LLNL's waste management facilities.

Tests Involving Tritium. Tests involving tritium-containing components are administratively limited to 20 milligrams (mg) (200 curies) tritium each, and it is estimated that a maximum of 10 such tests per year would be performed. After an experiment, the tritium scrubber system would be activated. The system would operate in a recirculating mode until monitoring and analysis indicated that most undesirable gases had been removed. Additional tritium removal would then be accomplished by adding a few liters of water as a mist to moisturize the air and chamber surfaces to help remove additional tritium (as tritiated water, HTO). (The chamber air would then be scrubbed again to remove additional tritium.) These moisturize/scrub cycles would be repeated until most readily exchanged tritium (as HTO) had been removed and monitored chamber tritium levels were deemed acceptable for reentry. Reentry scheduling would also be dependent on the levels of any other residual radiation, the intensity of which would also be monitored during and after an experiment. The tritium (as tritiated water vapor, HTO) would be absorbed and collected onto a solid medium, such as molecular sieves, during this air-scrubbing process.

As an adjunct to the air-scrubbing removal of tritium, a more aggressive water washdown of the chamber surfaces would be done with about 1,900 liters (L) (500 gallons [gal]) of water. The volume of this

washdown water would be controlled to minimize generation of tritium-contaminated water. This would be achieved by regulating the flow into the articulating, ceiling-mounted nozzle, limiting washdown time, and/or manual washing of the chamber. Washdown water would separately be collected and may be reduced in volume, then be managed as low-level liquid (or solidified) radioactive waste. The estimated volume of the wastewater filtration sludge expected from this process would be approximately 85 L (22 gal).

It is estimated that up to 25 55-gallon (208 L) drums and 2 2.8 m^3 (100 ft^3) boxes of solid LLW would be generated for each tritium-containing test.

J.3.1.4 *Decontamination and Decommissioning (Closure)*

A useful lifetime of 30 years is assumed for CFF. Projections of the need for D&D versus conversion to different usages for CFF after that time cannot yet be made. Such proposals, when identified, would be subject to separate NEPA review, if necessary.

J.3.2 Alternatives to the Proposed Action

J.3.2.1 *No Action Alternative*

The No Action alternative would leave B801 in its current configuration and would continue the routine detonation of explosives experiments outdoors. No construction disturbance would occur with this alternative. The primary effect of adopting the No Action alternative would be an annual release of emissions from up to an estimated 100 test detonations of explosives and associated materials, equipment, and assemblies directly into the atmosphere and surrounding soils or gravel; the continued generation of solid LLW from test debris and the periodic removal and processing of firing table gravel; and the continued noise levels and blast overpressure to the surrounding area.

An indication of the explosion-related product amounts released to the environment under the No Action alternative (continued outdoor testing) can be derived from the database of materials used in past outdoor explosives experiments at Site 300. Table J.3.2.1–1 shows the estimates of annual hazardous, radioactive, and other material dispersals that could be expected each year under the No Action alternative, based on compositions of tests at B801 for calendar years 1990 to 1994. Most of this material dispersal would be in the form of solid debris that is recovered after the test or is deposited in firing table gravel. Because the experiments were conducted outdoors, the remainder has, for the most part, been dispersed to the environment (primarily as metal or oxides). The materials listed in table J.3.2.1–1 are, therefore, an indication of what would constitute the source terms for waste streams and/or emissions that would likely result from conducting approximately 100 tests per year outdoors at B801 under the No Action alternative.

As noted above, solid LLW in the form of contaminated firing pad gravels after a series of outdoor tests involving radioactive material at B801 would continue if CFF is not built and operated. (By comparison, no contaminated gravel from enclosed B801 CFF operations would be generated under the preferred alternative.) Additional solid LLW in the form of test debris (such as wood, plastic, metal, and burlap bags) is generated each year under the No Action alternative; the generation of these types of test debris would likely continue under the No Action alternative as well as under the proposed action.

The organic explosives (noted in table J.3.2.1–1) used at B801 can be expected to oxidize very efficiently upon detonation to produce gaseous carbon dioxide less than 97 percent, water, and trace amounts of nitrogen, carbon monoxide, carbon (soot), oxides of nitrogen, and assorted volatile organic compounds (VOCs) (U.S. Army Armament, Munitions, and Chemical Command [AMCCOM] 1992).

J.3.2.2 *Build the Contained Firing Facility at an Alternative Site 300 Location (B851)*

B851 is a 1,270 m^2 (13,681 ft^2) complex located in the northwest quadrant of Site 300. It features a gravel firing pad, an electron beam accelerator, and several laboratories, shop areas, and offices. B801 has a more powerful and modern accelerator (the FXR) than B851 and is therefore much more capable of performing a thorough data analysis of test results from certain tests than the facilities at B851.

Construction of CFF at the B851 site would have about the same construction-related impacts as construction at B801. Operational impacts would also be similar in terms of safety, potential accident impacts,

TABLE J.3.2.1–1.— *Estimated No Action Hazardous Materials Release to the Environment (Air, Solid Debris, and Particulate)*

Material	Estimated Dispersal per Year, kg[a,b]
Barium	0.002
Beryllium	15.3
Chromium[c]	6.9
Cobalt	0.01
Copper[d]	580
Fluoride salts	3.6
Lead	4.1
Molybdenum	1.3
Nickel[c]	8.6
Silver	1.6
Vanadium	3.6
Zinc	0.1
Lithium salts	22.6
Depleted uranium[e]	430
(Explosives)[f]	(1,662)
Tritium[g]	0.0002

[a] Projected future dispersals per year based on the estimated composition of 100 tests. The basis for these projections is the B801 shot materials database for the previous 5 years (1990 to 1994), during which the number of tests ranged from 21 to 97 per year and averaged 50 per year.

[b] Only a very small fraction of the weights of the metallic materials and salts listed in this table would be expected to be volatilized as gaseous or aerosol products.

[c] Source is primarily alloying materials on test hardware, such as nuts, bolts, etc. Most of this material is large enough to be retrieved by hand following an experiment, so that it can be disposed of in a managed waste stream, or recycled.

[d] Source is primarily electrical leads and wire. Most pieces of this material are large enough in size as to be retrieved by hand following an experiment, where it is disposed of in a managed waste stream or recycled.

[e] In rare instances, thorium may be used in place of depleted uranium.

[f] This weight of explosives would be converted to thermodynamically stable products of combustion (such as carbon dioxide and water) very efficiently upon detonation.

[g] Tritium has not been used in the most recent past few years. However, the 1992 DOE/UC EIS/EIR discusses an administrative limit of 20 milligrams (mg) of tritium, an environmental emission that can be expected under the No Action alternative. This projection is based on an estimated maximum of ten tests per year at 20 mg each.

Source: Model results.

and noise. Thus, although possibly a reasonable alternative, it offers no significant advantages and several significant disadvantages to the B801 site.

J.4 DESCRIPTION OF THE AFFECTED ENVIRONMENT

A brief description of the environment surrounding the location of the proposed facilities is presented in this section. A more detailed description can be found in the 1992 EIS/EIR (DOE/UC 1992), which is incorporated by reference.

J.4.1 Topography

Site 300 is located in the Altamont Hills and consists of southeasterly trending ridges and canyons of moderate-to-high relief. These ridges vary in elevation from slightly more than 153 m (500 ft) at the Corral Hollow Creek entrance to the site to over 518 m (1,700 ft) at the highest point. The onsite drainage pattern is well-developed and flows generally east and south toward Corral Hollow Creek.

CFF would be built as a modification to B801 and would, therefore, be nestled among hills ranging from 34 to 104 m (110 to 340 ft) above its floor elevation to the north, east, and south. The floor level would be at approximately 323 m (1,060 ft) above mean sea level.

J.4.2 Seismicity

Site 300 is located on the eastern edge of the seismically active San Francisco Bay area. A number of active faults are considered capable of causing strong ground motion at Site 300. The nearest of these faults to Site 300 is the Carnegie-Corral Hollow Fault, which crosses the southwest portion of the site (Carpenter et al., 1991). No significant recorded earthquakes have occurred on any of the local faults. The effect of seismic activity at Site 300 is likely to be confined to ground shaking with no surface displacement. Raber and Carpenter (1983) have identified the principal seismic hazard at Site 300 as being the potential for strong ground shaking caused by an earthquake on the Greenville Fault, located about 8 kilometers (km) (5 miles [mi]) west of Site 300.

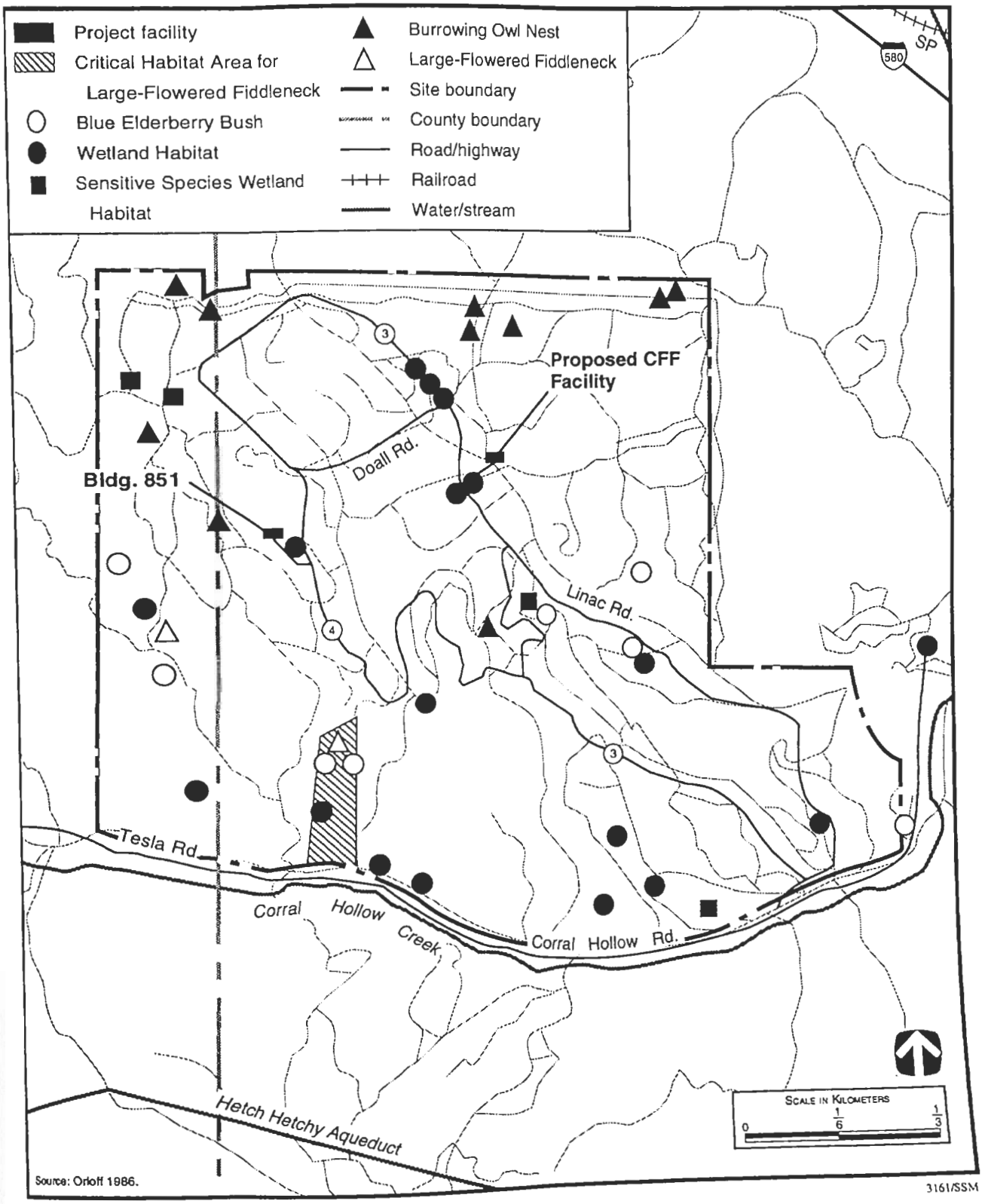

FIGURE J.4.7–1.—*Selected Sensitive, Natural Resources, Site 300.*

J.4.10 Soils

Site 300 soils have developed on marine shales and sandstones, uplifted river terraces, and fluvial deposits. They are classified as loamy Entisols (young soils with little or no horizon development). Clay-rich soils (Vertisols) are also present and have been mapped as the AloVaquero complex. Vertisols are mineral soils, characterized by a high clay content, that are subject to marked shrinking and swelling with changes in water content. The Entisols erode easily; the Vertisols exhibit low permeability and are subject to moderate erosion. Soils in the B801 area are generally classified in the AloVaquero complex.

J.4.11 Wetlands

Wetlands at Site 300 were mapped during 1991 using the unified Federal method (Federal Interagency Committee for Wetland Delineation, 1989), and a total of 2.7 hectares (ha) (6.76 acres) of wetlands were identified (DOE/UC 1992) (figure J.4.7–1). These wetlands are small and are in areas associated with natural springs or runoff from several building complexes onsite. The majority of the wetlands 1.9 ha (4.58 acres) exist at springs in the bottom of deep canyons in the southern half of the site. Other wetlands 0.76 ha (1.88 acres) were formed from building runoff, including a small *Typha latifolia* wetland formed by B801 cooling tower drainage that begins approximately 61 m (200 ft) south-southwest of B801. A small wetlands patch 0.032 ha (0.08 acre) exists approximately 213 m (700 ft) southeast of B851 and another 0.072 ha (0.18 acre) exists immediately adjacent to the B851 complex.

J.4.12 Noise

Existing chronic noise sources at Site 300 include vehicular traffic and heating, ventilating, and air conditioning equipment. Acute sources include construction activities; a small arms range; and explosives testing. Background noise levels are generally low, ranging from 56 to 66 decibels (DOE/UC 1992).

Meteorological conditions at Site 300 are monitored before each test, so that noise levels can be projected through use of a well-established computer program. Based on the results of this computer modeling, the quantities of the explosives that can be tested at the present B801 outdoor firing table without adverse noise generation as measured at six Tracy-area receptor site locations (stations) are projected. These stations monitor peak noise levels for a period of 90 seconds, starting at detonation. The results of these noise-monitoring activities demonstrate that noise levels from explosives testing at LLNL Site 300 have not exceeded 126 decibels at the city of Tracy station locations.

J.4.13 Water Use

Water consumption for domestic, infrastructure operation, and programmatic activities at Site 300 averaged approximately 120 million liters per year (31.8 million gallons per year) during the period from 1986 to 1990 (DOE/UC 1992).

J.5 Potential Effects of the Proposed Action and Alternatives

J.5.1 Impacts Related to Construction Activities

Containment of firing operations at B801 would result in minor construction-related impacts at Site 300 in the vicinity of the B801 complex. Construction noise and dust would be experienced throughout a 21-month excavation and construction period. Soils from the hill to the north of the firing pad, and the berm to the east of the firing pad would be excavated and removed to provide space for the new facility. Dust suppression and stormwater pollution prevention (runoff) mitigation technologies would be applied to reduce these impacts to insignificance. Biological surveys for special status, threatened, and endangered species would be conducted prior to any land-disturbing activities. If sensitive species are observed, appropriate mitigation measures to avoid any significant impact would be taken, as outlined in the 1992 EIS/EIR (DOE/UC 1992) and its associated Mitigation Action Plan (MAP) and Mitigation Monitoring and Reporting Program (MMRP). These measures have been routinely applied at Site 300 since 1992. The closest archaeological site is approximately 396 m (1,300 ft) away and is not expected to be affected by the proposed action. Experimental tests would be scheduled at other firing facilities (principally at B851) during construction in the B801 area, possibly increasing the workload and traffic to this area to a minor degree.

J.S.I.

slight to none because of the relatively small portion of the badger's home range (less than 1 percent) occupied by the project, the large amount of unrestricted land at Site 300, and the widely recognized transient nature of badgers. Similarly, no impacts to burrowing owl dens are expected because they have actually become established during periods of road construction south of B801 and during long periods of outdoor explosives testing at the present B801 complex. A pre-construction survey for dens of American badger and burrowing owl would be conducted within 60 days of project start. If found, active dens of the badger or owl would be avoided by construction activity through the establishment of exclusion zones around the dens. If direct impact to an active den is considered unavoidable, the California Department of Fish and Game would be consulted for permission to reduce the size of the exclusion zone or for permission to relocate the animal to other lower-impact areas within Site 300, as outlined in the MMRP and the 1992 EIS/EIR.

J.5.1.6 *Wetlands*

Soil transport from stormwater runoff during construction would be controlled so as to ensure that there is no potential for adverse impact to the wetlands patch identified approximately 61 m (200 ft) south-southwest of the B801 complex.

J.5.1.7 *Socioeconomic Factors*

Construction of CFF will take place over a 21-month period during which CFF contractor construction crew and staff day-shift population may reach a maximum peak of 20 to 30 workers during a peak 6-month period, while being less during the remaining parts of the construction period. The addition of this incremental number of onsite, day-shift contractor crew is not expected to significantly affect Site 300 infrastructure and support services or facilities or city of Tracy support services for its 34,000 population.

J.5.1.8 *Water Usage*

A maximum of 3,800,000 L (1,000,000 gal) of water would be used for dust suppression and other related activities during construction.

J.5.2 Impacts Related to Facility Operations

J.5.2.1 *Air Quality*

It is expected that emissions (such as particulate metal oxides and soot, acid gases, and VOCs) from Firing Chamber operations would be below regulatory limits because of the extensive air scrubbing, filtration, and absorption systems that would be operated in conjunction with CFF. The bulk of the resulting emissions from the air control system should then be limited to those such as carbon dioxide, nitrogen, water, and, when tritium is used in the chamber, tritiated water as well as very minor amounts of activated air gas molecules.

It is expected that the projected scrubber removal rate for the gases ammonia (NH_3), hydrogen cyanide (HCN), hydrogen fluoride (HF), and hydrogen chloride (HCl) would be 90 percent, and would be 50 percent for oxides of nitrogen (NO_x) which may be produced. Although some removal of detonation-produced carbon monoxide (CO) by air scrubbing would occur, no reduction of CO is assumed, resulting in a conservative conclusion. Based on these factors, the following approximate levels of CFF-related emissions can be expected to reach the atmosphere annually from detonating explosives during 100 tests at CFF: NH_3 < 1.8 kg (4 lb), HCN ~0.9 kg (2 lb), HF ~0.9 kg (2 lb), HCl < 1.4 kg (3 lb), and NO_x < 12 kg (27 lb). Additionally, CO emissions would be expected to be less than 15 kg (33 lb) and all VOCs and semivolatile combustion products combined should be limited to approximately 0.2 kg (0.4 lb) (based on emission factors from trinitrotoluene detonation data contained in Volume 2 of the 1992 AMCCOM report). Particulate air emissions are expected to be negligible due to the extensive use of air scrubbing and filtration systems. These emission levels should have an insignificant (negligible) adverse impact on the air quality of the area air basin. The net impact of containing these 100 CFF tests per year by use of CFF (when compared to the No Action alternative) is beneficial.

The air emission of potentially greatest (bounding) impact is HTO. On approximately 10 tests per year, up to 200 curies (20 mg) of tritium may be used on each test. It is assumed that, as a worst case, all tritium would become converted to HTO. Of the 200 curies of tritium present in the chamber, 180 curies (90

ercent) is expected to be vapor, and 20 curies (10 ercent) would condense on the steel walls, floor, quipment, and debris. After completion of air crubbing and chamber cleanup, it is expected that the 00 curies of tritium would be partitioned as follows: pproximately 175 curies would reside in solidified aste from processing the various air scrubbing and iltration systems, 18 curies (from the 20 curies of HTO condensed on walls or solids) would also reside n a separate solidified waste from a water washdown of the chamber walls and surfaces, a maximum of 5 curies might escape to the atmosphere by leakage from the chamber, and 2 curies would remain adsorbed on interior surfaces and may, therefore, become transferred to waste water used after a non-tritium-containing test which would normally follow as the next test. This 2 curies of HTO would be evaporated to the atmosphere as part of the approximately 94,600 L (25,000 gal) of such wastewater. On balance, a possible maximum of 7 curies of the original 200 curies of tritium used in the test may escape as HTO to the atmosphere over a several-day to week-long period following each of the 10 tritium-containing tests; the remainder would be captured as LLW. By comparison, the amount of tritium contained in the typical theater exit sign is about 10 curies.

All appropriate and applicable air permits would be obtained for facility construction and operation. It is expected, based on a preliminary analysis of proposed normal facility operation, that Environmental Protection Agency Region IX approval and notification of startup for operations involving radionuclides will not be required. Provisions for sampling radionuclide air effluents would be incorporated into the design of CFF, and continuous monitoring, if required, would be performed according to NESHAP requirements.

J.5.2.2 *Waste*

A beneficial impact of the proposed action is that essentially all detonation products would be captured before release of remaining, mainly innocuous gases, to the environment. Two distinct waste streams would result from totally containing the tests at B801. The first waste stream consists of the shot debris, canisters, HEPA filters, scrubber fluids, and any other component of the pollution control system that becomes contaminated. The second stream is the washdown water itself and/or components of the washdown water system. The levels of the washdown water would be processed (filtered), stored, reused throughout an extended number of firings and eventually evaporated. Components of the processing system, such as used filters and washdown water system sludge, would be characterized and handled as hazardous, radioactive, or mixed waste.

The proposed facility, with its washdown and tritium removal system, would result in the generation of LLW and/or mixed waste because of the collection of sludge produced by the washdown operations. Conservative estimates are that 25 55-gal (208-L) drums of evaporator solids, tritium adsorption media, and stabilized washdown water, and 2 2.8 m^3 (100 ft^3) boxes of shot or test debris would be generated from each test with tritium. Generation of mixed waste is not expected, but to be conservative, a projection of 0.1 m^3 (3.7 ft^3) of mixed waste per shot is assumed. The balance would be conservatively considered LLW. For tests performed without tritium, only one 2.8 m^3 (100 ft^3) box of debris (LLW) would be generated. Because CFF would eliminate the use of firing table gravels, the total amount of solid waste that would be generated represents a significant reduction from the total amount of solid waste that is now generated annually during uncontained testing at B801.

The proposed CFF represents a decrease in waste generation from current and projected levels should the CFF not be constructed and operated. The types of waste generated at CFF would have some, but manageable, impact on waste handling activities at LLNL. Table J.5.2.2–1 shows the amounts of mixed, hazardous, and radioactive waste generated in activities conducted at LLNL and compares those values with the amounts of wastes, by type, expected to be generated at CFF annually. The CFF data in this table are based on the assumption that an average of 50 tests, and possibly up to 100 tests would be conducted annually, either at CFF or at the present B801 gravel firing pad (the No Action alternative). These projected annual test rates are based on recent (1991-94) testing data at the present B801 Facility. None of the waste types expected to be generated by the CFF/FXR would be unique to LLNL and each type would be processed and managed, stored, treated, disposed, or transported appropriately as is routinely done at LLNL for the same types of wastes from other current LLNL operations.

Noise sources anticipated during and following explosives tests in a containment facility would include low-energy impulse from the test, the relief of containment vessel overpressure, and other noises associated with the operation of the air handling system used to purge the containment vessel. These noises are not expected to be perceptible to Tracy-area residents or area ranchers, and they would not exceed the occupational noise exposure limits adopted by DOE for the protection of employees.

J.5.2.4 *Ionizing Radiation*

Detonations in the Firing Chamber could involve radioactive materials such as tritium (up to 20 mg on each of 10 tests), depleted uranium, and on some tests, thorium. Additionally, certain test configurations may occasionally generate small quantities of neutrons, which may then yield neutron-activation products. Because of the modest neutron production potential, (10^{16} neutrons per test on certain tests), the very effective shielding provided by the Firing Chamber, and the low specific activity of depleted uranium, the potential radiation impacts are dominated by tritium and activation-product buildup. These potential impacts to involved workers, noninvolved workers, and members of the general public are summarized in table J.5.2.5–1. Because these results are based on very conservative assumptions used when calculating projected impacts (as described below), they are considered bounding for routine CFF operations.

Some of the assumptions used in deriving table J.5.2.5–1 estimates were:

- A maximum of 10 detonation tests per year involving a maximum of 20 mg (200 curies) of tritium each.

- A maximum level of diagnostic neutron production (10^{16}) per test, on a maximum of 10 tests per year.

- From each of 10 tests per year, up to 5 curies of released tritium as HTO from the Firing Chamber at ground level by leakage during chamber cooling and scrubbing, and an additional 2 curies of residual tritium released as HTO later during evaporation of washdown water through the facility stack that is also assumed released at ground level for p modeling.

- Up to three involve spend up to 2 days e Chamber, entering tl nation, and after chamber cleanup ha level in the chamb $5x10^{-6}$ curies/m^3; a assumed to spend fu the shot location, wh doses would be max

- Primary washdo air-scrubbing woul maximum of 193 cu low-level radioactiv

If the maximally exposed public stayed at the neares entire expected 30-year l estimated lifetime fatal ca from potential whole-bod exposure to $3.8x10^{-5}$ pers (that is, about one fatal c potential dose is about 1,0 guideline dose limit (that v cancer per 2,000). Additio workers who would be exp exposure dose (from re cleaning the Firing Cham each receive a dose of le This is less than 5 percent c limit guideline of 5 rem pe average annual dose rec attendant is about 0.5 rem, for these CFF Firing Cham

J.5.2.5 *Slope Stability*

Document review sugges slopes are stable. Uncons a few feet thick in the a shallow angle (about 5 de a recently active landslide within about 244 m (80(landslide is reported hav which reached the vicinit 15-year period prior to 19 have been mitigated by p between the flow and the

TABLE J.5.2.5–1.—*Maximum Potential Annual Radiation Exposure Impacts from Normal Contained Firing Facility Operations*

Individual or Group	Tritium	Activation	Total	Excess Cancer Fatalities (per year)[b]
Individual Potential Dose, Rem Per Year[a]				
Involved CFF-area worker	0.09	0.16	0.25	1.0×10^{-4}
Non-involved worker (50 m)[c]	5.2×10^{-3}	0	5.2×10^{-3}	2.1×10^{-6}
Total worker[d]	1.6	0.5	2.1	8.4×10^{-4}
Collective Potential Dose, Person-Rem Per Year				
Maximally exposed member of general public (site boundary, 1,340 m)	3.8×10^{-5}	0	3.8×10^{-5}	1.9×10^{-8}
Total general public[e]	0.32	0	0.32	1.6×10^{-4}

[a] See discussions, section J.5.2.4.

[b] Based on DOE dose-to-risk conversion factor of 4×10^{-4} (4 in 10,000) latent cancer fatalities per person-rem for workers and 5×10^{-4} (5 in 10,000) for the general public.

[c] Assumed to be all Site 300 noninvolved workers (approx. 260) standing 50 m from CFF resulting in an extremely conservative estimate.

[d] The total worker cumulative dose is the sum of doses to both the involved CFF workers and noninvolved workers within 50 m of the CFF.

[e] Using the EPA-approved computer code, CAP88-PC, version 1.00, the total general public cumulative dose estimate was calculated by considering the approximate population within 80 km (50 mi) of Site 300 and using annual site meteorological data.

Source: Model results.

stabilization measures would be taken in design and construction of graded slopes (see also section J.5.1.1).

J.5.2.6 *Water Use*

It is expected that washdown of the CFF Firing Chamber, after considering the contribution of planned water recycling activities, would involve the use of 950,000 L (250,000 gal) of water annually. This water consumption level, plus that for cooling towers (1,100,000 L [300,000 gal]), and domestic uses 190,000 L (50,000 gal), would add a total of approximately 2,300,000 L (600,000 gal) annually to the Site 300 water consumption rate of approximately 120 million L (31.8 million gal) over projected groundwater use (DOE/UC 1992), which is less than a 3-percent increase.

J.5.3 Accident Scenarios

The reasonably foreseeable accident scenarios that could produce the greatest potential impacts are the following:

- Case 1: Accidental detonation of a test of a 60-kg (132-lb) charge of explosives at the B801 firing table. (Applicable to No Action alternative.)

- Case 2: Accidental detonation of a 60-kg (132-lb) test that could contain up to 20 mg (200 curies) of tritium with dispersal through an unsecured blast door during final preparation. No neutron generation potential would exist, because blast doors would be closed before any accident scenario that would involve neutron generation (misfire). (Applicable to either B801 or B851 alternatives.)

One accident scenario that was considered but was not felt to be reasonably foreseeable included:

- Case 3: Same test configuration as in Case 2, but the planned detonation takes place yielding the potential for neutron generation; accidental rupture of the CFF Firing Chamber occurs (considered to be a beyond-design basis accident and therefore, not reasonably foreseeable). (Applicable to either B801 or B851 alternatives.)

In each case, the involved workers would probably be fatally injured from blast effects due to peak overpressure and debris, but there would be no injury offsite to members of the general public. No damage to current buildings offsite or in other areas of Site 300 would be expected, although window rattling might occur. Projected radiation effects from two scenarios are summarized in table J.5.4–1.

These projected radiation doses are still lower than DOE guideline limits for workers and for the general public; thus, the greatest effects would be fatalities or injuries to workers due to primary blast effects, as noted above.

J.5.4 Cumulative Impacts

The primary negative impacts resulting from the proposed action would occur as a result of construction-related activities. These activities would be short term and are not expected to result in significant increases in ambient amounts of airborne dust or noise. Approximately 45,000 kg (20,500 lb) of solid LLW from Firing Chamber air-scrubbing and washdown following contained firing operations could be generated each year. This volume of waste represents a reduction from the levels that would be projected if the same number of detonations were to take place at the current facility (No Action alternative). The proposed project is expected to greatly reduce the air emission of detonation combustion products and to reduce cumulative buildup of LLW by eliminating outdoor explosive testing on gravel firing tables (which must be handled as LLW because some of the explosive test devices would contain radioactive components). The proposed action would therefore greatly reduce the release of emittants to the air and ground.

J.5.5 Conformity

Site 300 is in an air basin area designated as non-attainment with respect to ozone. The design, construction, operation, and ultimate D&D of CFF would not result in levels of emissions of ozone precursors (oxides of nitrogen and precursor organic compounds) that would place Site 300 above conformity thresholds; and the facility would not cause or contribute to any violation of the National Ambient Air Quality Standards. The facility would be operated in conformance with all rules and regulations of the SJVUAPCD which are included as part of the state implementation plans.

J.5.6 Socioeconomic Factors and Environmental Justice

J.5.6.1 *Staffing*

The addition of another 5 to 6 full-time LLNL employees (for CFF operation) to augment the present B801/FXR operating staff (which averages 20 employees) will be an insignificant incremental impact over that of operating the current FXR Facility and its associated firing table.

J.5.6.2 *Environmental Justice*

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires that Federal agencies identify and address, as appropriate, dispro-

TABLE J.5.4–1.—*Radiation-Related Dose Effects Due to Accidents; Contained Firing Facility and Alternatives*

Scenario	Involved Worker, 30 m, rem	Uninvolved Worker, 50 m, rem	Offsite Member of Public, 1,340 m, rem	Excess Cancer Fatalities, Offsite Member of Public[a]
Case 1	0	0	0	0
Case 2	0.026	0.015	1.1×10^{-4}	5.5×10^{-8}
Case 3[b]	0.031	0.015	1.1×10^{-4}	5.5×10^{-8}

[a] See footnote b, table J.5.2.5–1, for conversion factors used.
[b] Beyond-design basis accident considered not to be reasonably foreseeable.
Source: Model results.

portionately high and adverse human health or environmental effects of their programs and activities on minority and low-income populations. DOE is developing official guidance on the implementation of the Executive Order. However, given the demographic makeup of Tracy and its surrounding agricultural areas, it is expected that there would be insignificant or no potential for differential or disproportionate impacts from the proposed action (or from its alternatives) to offsite populations that could be characterized as predominantly minority or low-income.

J.6 Persons and Agencies Contacted

No persons or agencies outside the LLNL and DOE have been contacted.

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ACRONYMS, ABBREVIATIONS, AND UNITS

Acronyms and Abbreviations

ac	alternating current
AQCR	Air Quality Control Regulation
DARHT	Dual-Axis Radiographic Hydrodynamic Test
dc	direct current
DOE	Department of Energy
EIS	environmental impact statement
EMF	electromagnetic force
HE	high explosives
LANL	Los Alamos National Laboratory
NEPA	*National Environmental Policy Act*
NESHAP	National Emissions Standards for Hazardous Air Pollutant
NHMFL	National High Magnetic Field Laboratory
NMEIB	New Mexico Environmental Improvement Board
PEIS	programmatic environmental impact statement
PM_{10}	particulate matter of aerodynamic diameter equal to or les
R&D	research and development
RCRA	*Resource Conservation and Recovery Act*
SFE	Special Facilities Equipment
TA	technical area

Units of Measure

cc	cubic centimeters
cm	centimeters
eV	electron volts
ft	foot (feet)
ft^2	square feet
ft^3	cubic feet
g	grams
G	gauss
gal	gallons
hr	hours
Hz	cycles per second
kJ	kilojoules
km	kilometers
L	liters
µs	microseconds
m	meters
m^2	square meters
m^3	cubic meters
MA	megamperes
mg	milligrams
MJ	megajoules
mi	miles
mph	miles per hour
m/s	meters per second
MVA	mega volt amperes
MW	megawatts
oz	ounces
rem	unit of radiation dose equivalent
rpm	revolutions per minute
yd^3	cubic yards
yr	years

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of the moratorium on underground nuclear testing and pursuit of a *Comprehensive Test Ban Treaty,* DOE is forming a science-based stockpile stewardship program. This program is being carried out by the weapons laboratories using a variety of technologies, including lasers and pulsed power to support the computer modeling of nuclear weapons' performance over time as the stockpile ages.

As a result of the stockpile stewardship mission, LANL is tasked with enhancing their pulsed-power capability, resulting in the ability to accurately benchmark calculations on weapon performance. An extensive amount of high-energy shots need to be performed for a variety of potential physical defects such as cracks, voids, corrosion, or other modifications to material that may be caused by aging or introduced from remanufacturing. The capability and energy of existing facilities is insufficient to reach the pressures, volumes, and energy densities needed to accurately benchmark weapon-related computational predictions as required to support the stockpile stewardship mission at LANL. In particular, existing facilities cannot support large-scale experiments in the ionized regime, an important capability for analyzing primary and secondary-physics issues, such as implosion hydrodynamics, materials properties, and interactions.

K.2 Description of Alternatives

K.2.1 Proposed Action

K.2.1.1 *Description*

The need to perform experiments with macroscopic pulsed-power targets, as well as with lasers, exists not only because of the limits of measurement diagnostics or improved ease of measurement at larger scale, but also because some of the physical phenomena that must be investigated cannot be readily scaled down to smaller sizes without affecting some parameters of importance. For example, DOE must perform experiments to develop and benchmark calculations on weapon performance for a variety of potential physical defects such as cracks, voids, corrosion, or other local modifications to material that may be caused by aging or introduced from remanufacturing. Studying the hydrodynamic effects of such perturbations in a pulsed-power experiment and comparing the results to calculations is one of the means used. Figure K.2.1.1–1 illustrates this hydrodynamic process. If the perturbations being investigated were scaled down to the volumes accessible by laser experiments, in many cases the perturbations would be of a similar size to natural material grains or pores, which would complicate or even obscure the experimental results.

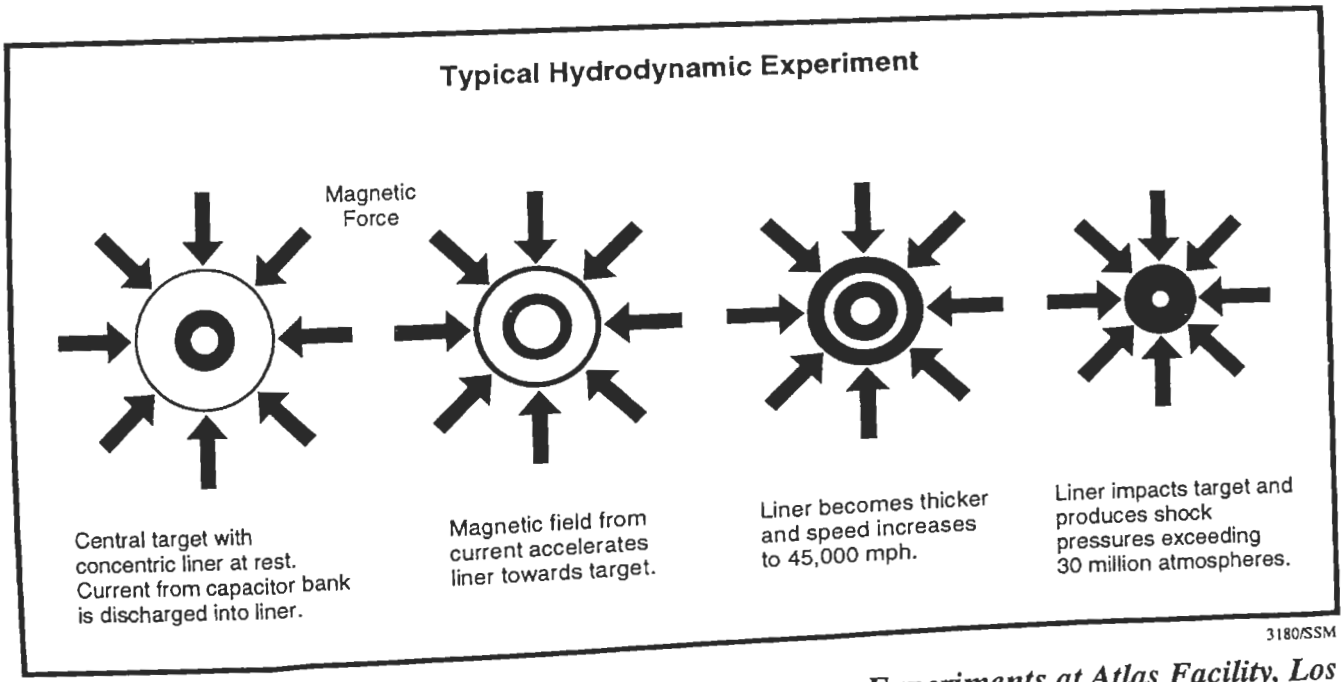


FIGURE K.2.1.1–1.—*Hydrodynamic Process of Pulsed Power Experiments at Atlas Facility, Los Alamos National Laboratory.*

However, the energy of Pegasus II is insufficient to reach the pressures and volumes needed to accurately benchmark weapon-related computational predictions. In particular, Pegasus is not adequate to drive dense hydrodynamic targets into the ionized regime, an important capability for analyzing some secondary-physics issues.

Atlas has been designed to provide enhanced pulsed-power capability specifically to address these areas. Atlas has been conceptually designed as a 36-MJ inductive energy store capacitor bank that would nominally deliver 25 to 30 megamperes (MA) (60 MA peak) to an imploding liner or plasma. For hydrodynamic experiments, Atlas would implode heavy precision liners to velocities of over 2 cm/microsecond with final kinetic energies of 2 to 5 MJ. Pressures of >5 to >30 megabars would be achieved (depending on design of the experiment). One dimensional calculations benchmarked to past HE pulsed-power results predict that Atlas will produce x-ray yields > 2 MJ with temperatures >100 electron volts (eV). In a switched mode of operation, Atlas x-ray output would approach 200 eV temperature.

For study of material properties and development of dynamic materials models, Atlas would produce pressures and strain rates in cubic centimeter (cc) scale samples at least 5 to 10 times greater than possible with the present Pegasus Facility.

Fidelity of scaled implosion hydrodynamics experiments is essential for them to be used to verify predictions of design codes. Even the simplest set of physical equations governing compressible hydrodynamics have four parameters that should be the same for fidelity. High-energy density hydrodynamic flow calculations must be validated by experiments with an energy density high enough to get materials into the appropriate state of matter, to ensure adequate fidelity of the important parameters.

Key need satisfied by the Atlas Facility would be the capability of doing large-scale hydrodynamic experiments at high temperatures to ionize the material. This is important for understanding physics phenomena associated with late stages of primary as well as secondary implosion. Atlas will be the first pulsed-power facility that will have the capability for generating the state of matter — ionized, highly correlated materials — that governs two of the most important of these similarity parameters, compressibility and Reynolds number. For metals, this requires 500 kilojoules (kJ)/cc, and for plastics 200 kJ/cc. To access this energy density regime, a typical experiment large enough to have easily resolved features needs to be driven with 2 to 5 MJ of kinetic energy. Solid-liner kinetic energies in this range cannot be achieved on presently operating pulsed-power facilities.

Atlas would provide these conditions in large experimental volumes (cc) for benchmarking and verifying models used to evaluate effects of aging (e.g., high aspect ratio cracks), or changes due to remanufacturing, on weapon performance and reliability. Atlas would make available an order of magnitude increase in dynamic pressure over Pegasus, which would greatly enhance DOE's ability to study such important phenomena as melting and hydrodynamics in primaries, early and late time spall in converging geometries, distortion in implosion systems, and effects of gaps.

The expected lifetime of the Atlas Facility is 20 years. After that time, the facility would be cleaned up and decommissioned, which would generate an estimated quantity of nonhazardous waste totaling approximately 841 cubic meters (m^3) (30,000 cubic feet [ft^3]). This waste would be recycled or disposed of at a sanitary landfill. A separate *National Environmental Policy Act* (NEPA) analysis would be conducted at that time.

K.2.1.2 *Facility*

The Atlas Facility would be located at LANL's Technical Area (TA)-35 (see figure K.2.1.2–1). TA-35 is used primarily for research and development (R&D) activities in the fields of physics, chemistry, fusion, and materials science. Construction of the facility would involve renovating existing buildings for use in performing pulsed-power experiments. The construction phase would also involve the installation of high-power electrical Special Facilities Equipment (SFE). To accommodate the facility and its support requirements, five existing buildings within TA-35 would be modified, and external concrete pads, transportable office/diagnostic space, and storage tanks would be added. These relatively minor

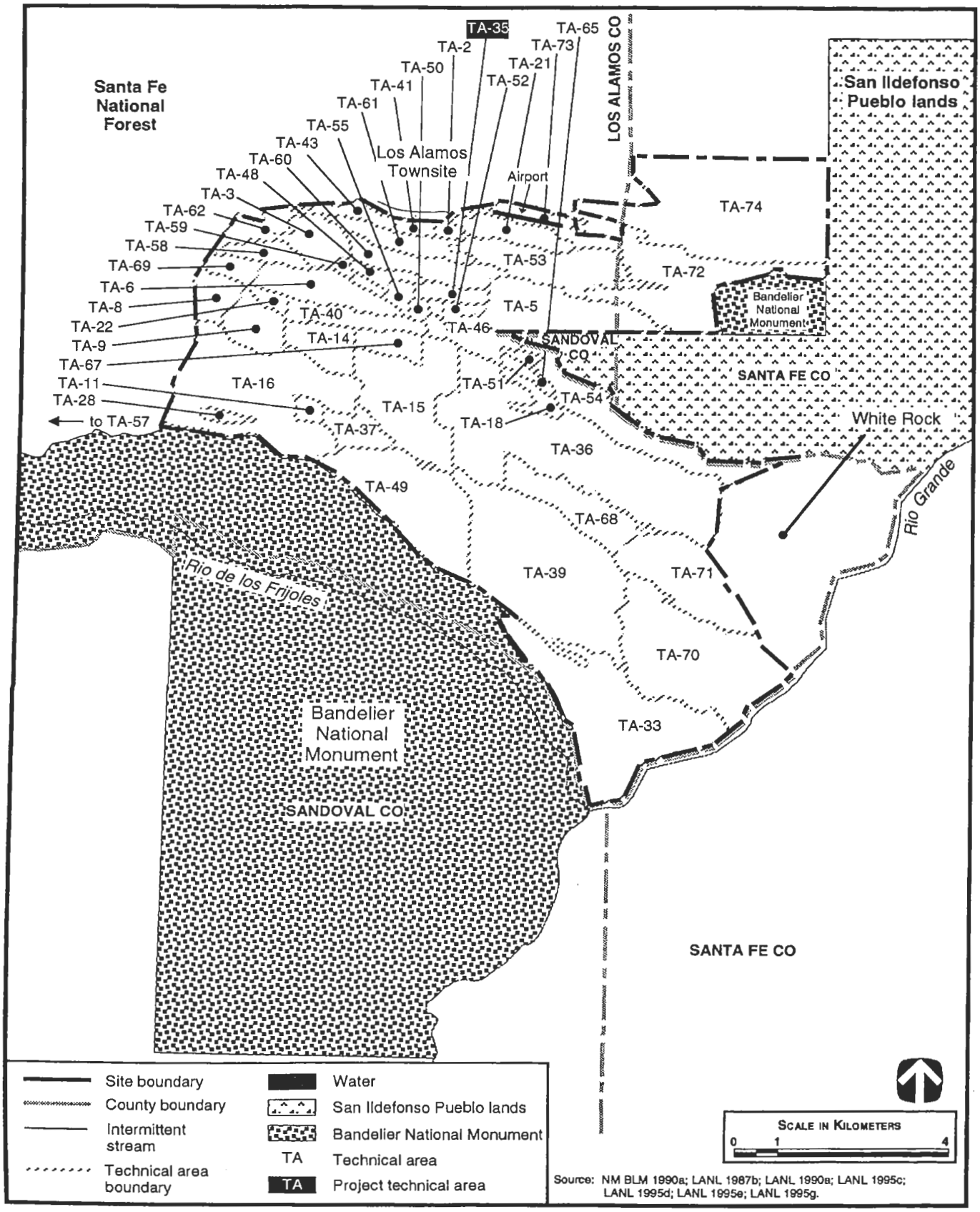


FIGURE K.2.1.2–1.—*Proposed Location of Atlas at Los Alamos National Laboratory.*

modifications have an estimated cost of $2.5 million and would be completed within 6 to 9 months of the facility construction start-date.

Atlas operations would require the following major SFE elements: 1,430 megawatt (MW) generator (existing); 80 MW alternating current to direct current (ac-to-dc) converter; 50 MJ inductive energy transfer system; 36 MJ capacitor bank; target chamber; and various control, diagnostic, and data acquisition equipment. The facilities and infrastructure requirements necessary to support this SFE include heavy lab construction with overhead material handling capability, vibration-free high-power generation, electromagnetically-shielded and security-hardened data acquisition areas, and dielectric fluid storage and transfer equipment. All SFE and supporting facilities/infrastructure meet or will be designed to meet the construction requirements for a "low hazard, non-nuclear" facility.

The Atlas Facility would use portions of Buildings 124, 125, 126, 294, and 301 at TA-35 (see figure K.2.1.2–2) in the following manner to meet these SFE facility and infrastructure requirements:

TA-35-124/125	Atlas Experimental Area, Control Room and Coordination Center
TA-35-126	Mechanical Services Building
TA-35-294	Power Supply Building
TA-35-301	Generator Building

Detailed building-use information, including building modifications, is included in the following paragraphs. Up to 35 construction workers would be involved in the building modifications and equipment installations at any given time; the workers would be a combination of relocated workers from other completed construction sites and a limited number of new hires as needed. Approximately 15.3 m^3 (20 yd^3) of noncontaminated construction waste would be generated during construction.

Buildings 35-124 and 35-125. The total space the Atlas Facility would use in these buildings is approximately 1,151 square meters (m^2) (11,770 square feet [ft^2]). Buildings 124 and 125 are proposed to house the primary Atlas Facility components because they could provide safe, secure, and convenient working and experimentation space; access to capacitor bank could be controlled and li diagnostic support platforms are availabl ducting and analyzing proposed experime buildings have the following special featu

- *Heavy-industrial, high-bay construc* Atlas requires, at a minimum, 92$ (10,000 ft^2) of high-bay building w heavy-duty gantry crane to house capacitor bank and user-support fa ties. Building 124 and 125 were desig for large-scale experimental work have high ceilings with heavy duty ga cranes that can access the entire inte space. Buildings 124 and 125 satisf the Atlas space requirements.

- *Reinforced walls and ceiling.* A requires reinforced walls and ceiling protect workers and the public agai shrapnel from possible high-energy el trical faults in the capacitor ba Buildings 124 and 125 were designe house the power amplifiers and tar chamber of a laser-fusion facility. protect the public from associat hazards, the buildings were construct with concrete walls and roofs. This ty of construction is ideal for a high-ener capacitor bank because shrapnel fr possible faults will be contained wit the building. The walls and ceiling w also contain any diagnostic x ra produced. Buildings 124 and 125 satis all the containment requirements of Atl

- *Collocation with the 1430-megavc ampere (MVA) generator.* Atlas wou utilize a multi-hundred MVA generator charge the capacitor bank rapidly. T facility housing this generator (Buildi 301) includes a spring-mount generator pad which isolates vibratic due to generator operations from s rounding experimental areas. This ra charging technique is similar to ot large physics facilities for which po from the existing electrical grid is ins cient to meet the facility techni requirements. In the case of Atlas,

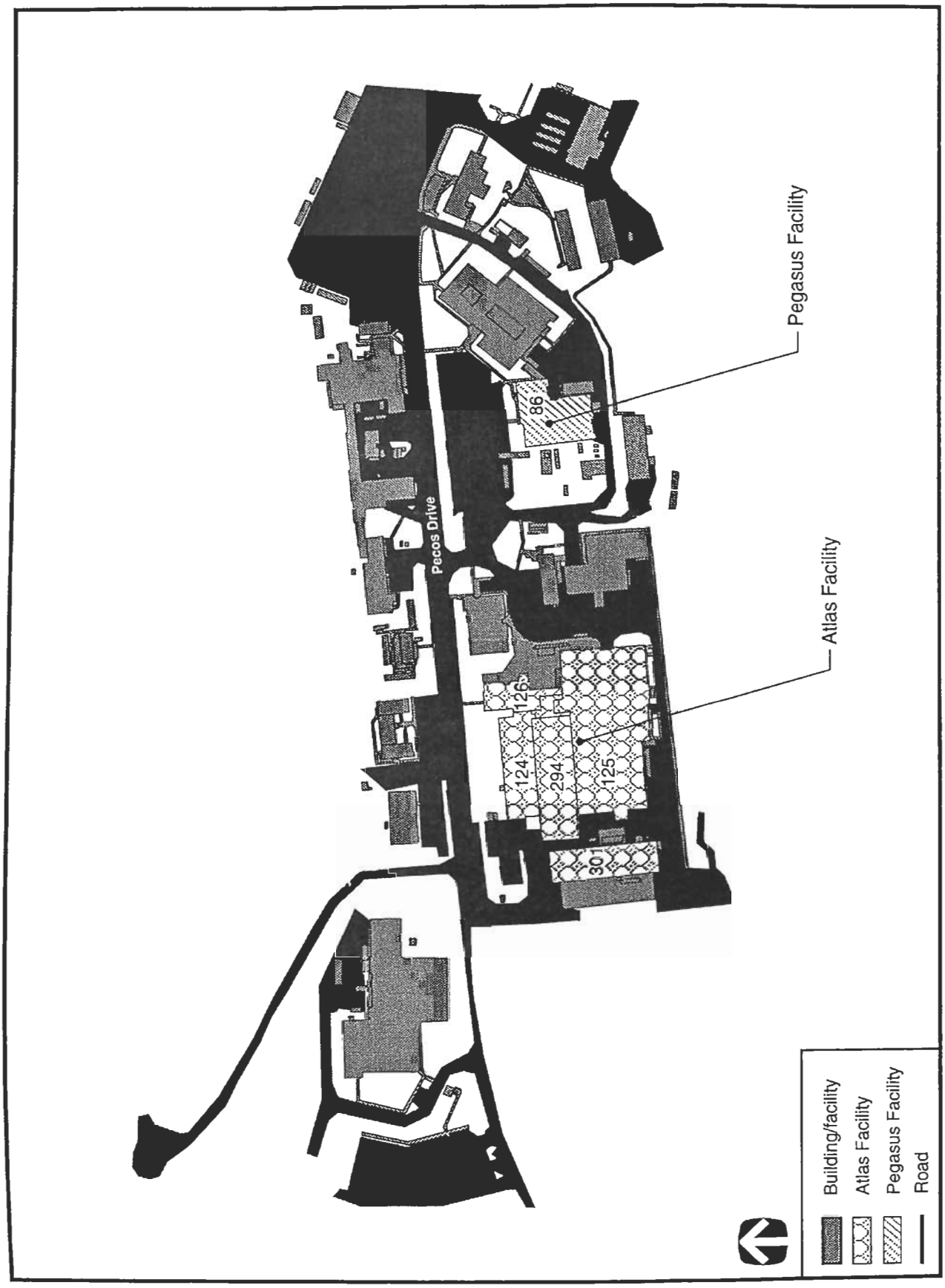


FIGURE K.2.1.2–2.—*Proposed Location of Atlas Facilities and Location of Pegasus II Facility.*

requirement stems from a common fault mode for large capacitor banks; premature electrical breakdown (prefire) of a capacitor switch. A prefire usually destroys the target and much of the rest of the experimental assembly, both of which are expensive and require days to replace. Since the probability of prefire is proportional to the time during which the switches must hold high voltage, the problem is greatly diminished by rapidly charging the capacitor bank and then quickly triggering the switches.

Due to the large number (300) of capacitor switches in Atlas and the programmatic and cost impacts of recovering from frequent prefires, Atlas will use rapid charging to satisfy its reliability requirements. Because of the extremely large energy storage required, even multi-megawatt power lines would still take 10 to 20 seconds to charge the Atlas capacitor bank. DOE has estimated that a faster charging rate will be required to provide sufficient confidence that Atlas will meet its reliability requirements. Buildings 124 and 125 are proposed to house Atlas because a 1430-MVA generator, located adjacent to these buildings in Building 301, is available and is capable of charging the capacitor bank in as little as 0.04 seconds. This configuration forms the basis of the Atlas conceptual design.

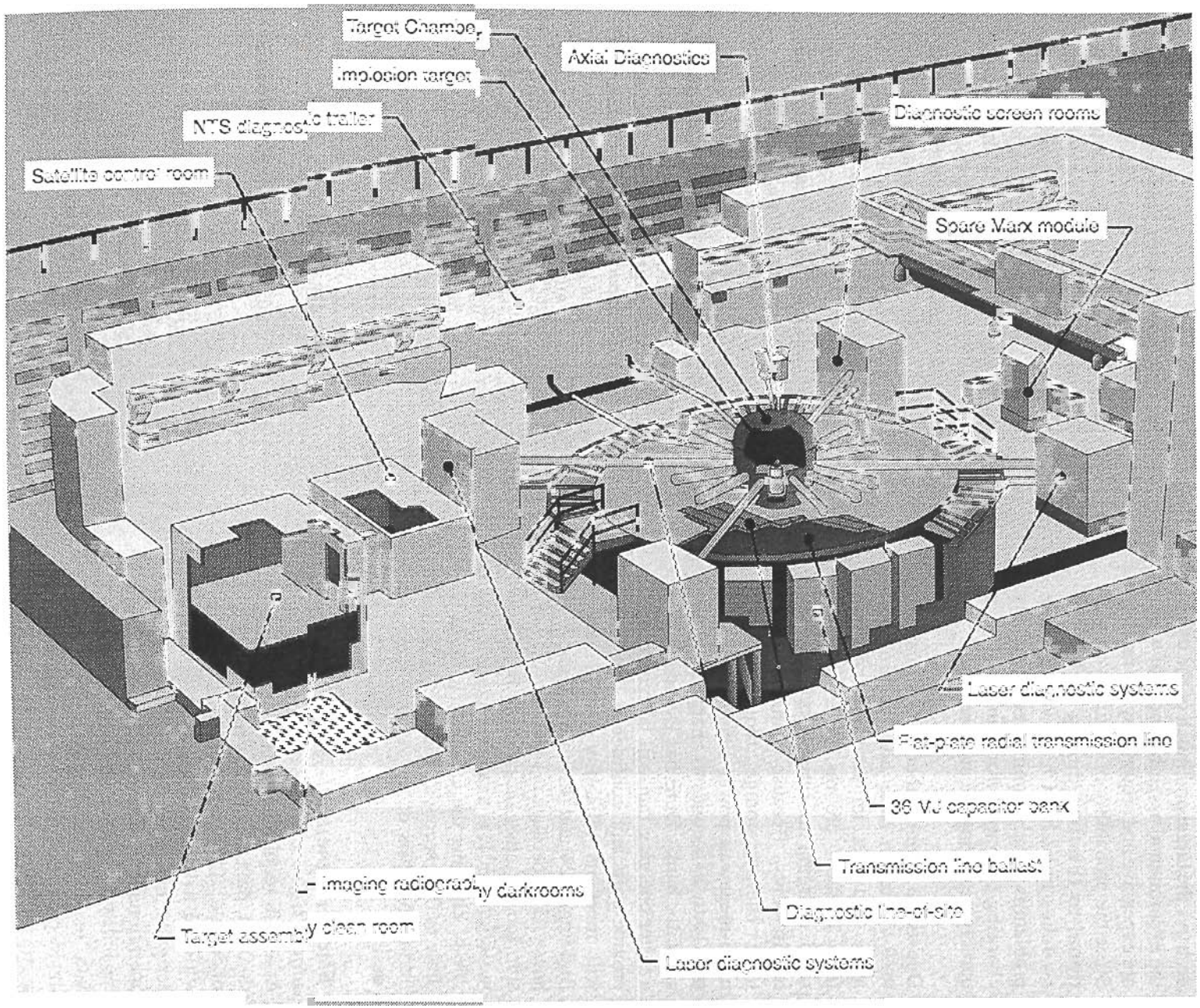
- *Electromagnetically shielded, data-acquisition room for classified data.* Atlas will require an electromagnetically shielded, data-acquisition room for classified data. The laser-fusion machine, for which Building 124 was originally designed, has many similarities to Atlas' operational requirements, including the capability to retrieve and store classified data. Inside the building is an electrically shielded data acquisition room that is also protected by a concrete wall. During classified tests, the entire building could be secured, and all classified data could be electronically routed to this room. This room satisfied the requirement for a secure site for classified data for the laser-fusion machine, and would also satisfy the Atlas requirement.

- *Electromagnetically shielded room for machine-control and unclassified data.* Atlas requires a machine-control room that is isolated from the machine and provides space for unclassified data acquisition. Just outside Building 124 in Building 125 is an 86 m^2 (925 ft^2) electrically shielded control and data acquisition room that was originally constructed to control the laser-fusion facility. This room already has conduit to Building 124 for machine-control and unclassified data acquisition lines. This room satisfies Atlas requirements for machine-control and unclassified data acquisition.

- *Oil storage.* Atlas will likely require storage capabilities for electrically insulating mineral oil. Just outside Building 125 are 3 underground oil storage tanks with a total capacity of 90,850 liters (L) (24,000 gallons [gal]). These tanks were installed to support the laser-fusion pulsed-power systems. Ownership of these tanks recently became available, and if Atlas uses oil for capacitor-bank insulation, these tanks would help satisfy Atlas oil-storage requirements.

Figure K.2.1.2–3 provides a perspective of the Atlas primary facility components, including the SFE, proposed for installation at TA-35. These consist of:

- Target chamber containing implosion target
- Imaging radiography darkrooms
- 36 MJ capacitor bank
- Target assembly clean room
- Laser diagnostic systems
- Satellite control room


Target Chamber
Axial Diagnostics
Implosion target
NTS diagnostic trailer
Diagnostic screen rooms
Satellite control room
Spare Marx module
Laser diagnostic systems
Flat-plate radial transmission line
36 MJ capacitor bank
Transmission line ballast
Imaging radiography darkrooms
Diagnostic line-of-site
Target assembly clean room
Laser diagnostic systems

- Diagnostic screen rooms
- Diagnostic trailer
- Axial diagnostics
- Spare Marx module
- Vacuum pumps
- Structural platforms and stairwells
- Flat-plate radial transmission line
- Oil storage and transfer system
- Transmission line ballast
- Chilled water, nitrogen, and compressed air systems

Structural modifications and improvements to Buildings 124 and 125 and surrounding areas required to accommodate the Atlas Facility components would include the following:

- The heating, ventilation, and air conditioning may be modified or relocated. Stairwells may require installation in the floor to permit access to and from the interior of the capacitor bank inner area. A 300 L (80 gal) liquid nitrogen storage tank and a supplemental 151,400 L (40,000 gal) non-polychlorinated biphenyl mineral oil storage tank would be stationed aboveground outside these buildings and piping connecting the tanks to the facility would be added. The oil storage tank would be bermed or similarly contained and would comply with all Spill Prevention Control and Countermeasures requirements.
- Support utilities such as compressed air, chilled water and electrical distribution systems would be added or improved to support the SFE equipment.
- A new 16.8-meter (m) by 24.4-m by 15-cm (55-feet [ft] by 80-ft by 6-inch [in])-thick concrete slab would be

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alarms currently serves the National High Magnetic Field Laboratory (NHMFL), located in Building TA-35-127. The NHMFL would continue to use the generator when it is not in use serving the Atlas Facility. Only one application would be run by the generator at any one time. No modifications are planned for this building.

K.2.1.3 *Operations*

The heart of the Atlas Facility would be a pulsed-power capacitor bank that would deliver a large amount of electrical and magnetic energy to a centimeter-scale target in a very short time (≤10 microseconds [(μs]). Each experiment would require extensive preparation of the experimental assembly and diagnostic instrumentation. The Atlas Facility would be designed to handle up to 100 experiments per year, but not more than 3 experiments per week. Approximately 15 workers would be employed at TA-35 in support of the Atlas Facility once it is operational. The workers would be a combination of relocated workers from currently operating facilities and a limited number of new hires as needed.

Atlas would support many related types of experiments. For example, in a typical experiment, a hollow cylindrical piece of metal (such as aluminum, copper, or gold) fabricated with known cracks, voids, or other defects would be placed in the target chamber. Heavy (e.g., 30 gram (g) [1.1 ounce {oz}]) targets would be used in such experiments designed to validate computer simulations of the hydrodynamic effects of such defects, which in turn support evaluation of potential defects in aging weapons. Light (e.g., 50 milligram [0.00175 oz]) targets would be imploded to produce a hot plasma source of soft (<200 eV) x rays to study radiation physics pertinent to stockpile stewardship.

During an experiment, electromagnetic energy would go sequentially from the generator to the ac-to-dc converter, through the inductor (optional), to the capacitor, and would finally be delivered to the target.

The Atlas capacitor bank would be designed to be flexible enough so that it has the capability to transfer energy in various quantities and within a spectrum of time intervals. The following is a description of what would happen during an experiment requiring maximum possible currents and generating the maximum possible magnetic fields from the facility.

When such an experiment setup was completed, power from the LANL electrical grid would be used to spin the generator to 1,800 revolutions per minute (rpm) over a period of 15 to 20 minutes (the generator may already be spinning for NHMFL experiments). When full speed is reached, a switch would close to allow electricity to flow from the generator to an 80-MW ac-to-dc converter. This converter would transform the high-voltage ac output of the generator to a low-voltage dc charging current in the inductor. The converter would provide this charging current for 3 to 5 seconds. When the peak current of 28 kiloamperes is reached, a switch would disconnect the converter from the inductor. The inductor would produce peak magnetic fields of 40,000 gauss (G) at the coil surface during this few-second interval.

When the inductor reaches 50 MJ of stored energy, various switches would close and open, and energy would be transferred to the capacitor bank, which consists of an array of Marx modules. Within 40 milliseconds, each stage in the Marx modules would acquire a voltage of 60 kilovolts. When the capacitor bank reaches full charge, switches would connect all of the modules into a series configuration, producing many times the original voltage (nominally <1 MV) at the terminals of the transmission line. At this time, the 36 MJ of energy stored in the capacitor bank would be discharged as electric current through the transmission line into a load or liner in the target chamber. The discharge would take approximately 10 μs. If the experiment requires low energy x-ray production, then Atlas may utilize a "plasma flow switch" in the electrical transmission section near the target to decrease the implosion time from several μs down to half a μs or less.

This very large current would produce a large magnetic field in the localized area around the target, causing it to implode, and possibly vaporize or melt, depending on the thickness of the metal. A light liner used inside the target would collide with itself on axis, producing a plasma and low energy x rays. A heavy liner used within the target would compress sample materials to high pressures or, when driven

into a central target, would produce extremely high shock pressures that can produce partial material ionization. Solid shrapnel and vaporized molecules would be generated but would be stopped by the walls of the target chamber. Vaporized molecules would deposit onto the walls of the target chamber.

The target chamber would be equipped with a number of ports to allow connection of diagnostic equipment and data acquisition equipment. Diagnostic equipment would include air monitoring devices, voltage probes, current probes, and magnetic field measuring instruments. Data acquisition equipment would consist of cameras, lasers, x-ray detectors, and other similar equipment. Experiments with heavy targets would yield laser holographic images and x-ray radiographs of the implosion which would be captured and recorded to determine the hydrodynamic behavior of the experiment. Experiments with light targets would measure the quantity and energy of radiation (x rays) generated during the implosion and investigate the interaction of this radiation with other parts of the experimental assembly.

After each experiment, LANL personnel would clean the target chamber of metallic debris and deformed metallic targets. Up to 150 L (42 gal) of ethanol would be used each year for cleaning. Discarded materials following each experiment would consist mostly of small amounts of aluminum, copper, very small quantities of gold, and oxides of these metals, or other similar nonradioactive heavy metals. Any metal pieces recovered would be salvaged for reuse. Personnel would also perform routine maintenance, such as replacement of worn dielectric insulation. All waste would be sampled and analyzed in accordance with LANL procedures to determine whether *Resource Conservation and Recovery Act* (RCRA)-regulated hazardous materials are present in regulated quantities. For purposes of this analysis it is assumed that a small amount (<1 m^3 annually) of liquid or solid hazardous waste would be generated by occasional experiments involving lead or other simulant materials. This waste would be staged in the onsite hazardous waste accumulation area and shipped to off-site commercial RCRA-permitted treatment, storage and disposal facilities. Uncontaminated waste (such as paper waste), expected to be about 0.15 m^3 (5 ft^3) per week, would be disposed of at the Los Alamos County Landfill.

K.2.2 Continued Operations Alternative (No Action)

K.2.2.1 *Description*

For the purpose of this analysis, Pegasus II would remain at its current energy level and current rate of experiments. The Pegasus II Facility is located at TA-35 and features a capacitor bank consisting of 8 Marx modules that store up to 4.3 MJ of electrical energy. The Pegasus II Facility is being used by personnel in the weapons physics community to perform experiments in hydrodynamics and radiation transport. It has served as a test bed and will continue to provide important data for experiments in a particular energy regime.

The No Action alternative analysis provides an environmental baseline from which to measure the potential impacts of the proposed action and other alternatives against. However, the No Action alternative does not meet DOE's purpose and need for action. Continued operation of only the Pegasus II Facility would mean that pressure and temperature regimes, critical to understanding weapon aging effects, will not be attained. For instance, in hydrodynamic experiments, Pegasus does not have sufficient power to drive shock pressures that can ionize dense materials. In radiation transport experiments, Pegasus does not have sufficient power to produce >1 MJ of x rays with temperatures >100 eV. Both of these capabilities are important to study relevant issues associated with thermonuclear secondary devices. For experiments relevant to primary physics, Pegasus has insufficient power to drive the larger-scale hydrodynamic targets required for high-fidelity diagnostic access. Operation of only Pegasus II would prevent DOE from providing adequate experimental validation of computer predictions of the effects of certain aging phenomena.

The expected lifetime of the Pegasus II Facility is 15 to 20 years; it became operational in 1987. Future decontamination and decommissioning activities associated with the Pegasus II Facility would require separate NEPA analyses.

The Pegasus II Facility is included as part of the No Action alternative for the Stockpile Stewardship and Management PEIS (DOE 1995a).

K.2.2.2 *Facility*

The Pegasus II Facility is located at TA-35, Building 86 (see figure K.2.1.2–1). The Pegasus II capacitor bank is situated in Room 100, and the control center, data collection room, and office areas are located in Rooms 101 and 205. The detonators used in firing the capacitor bank are stored in a non-propagating container in a steel safe in Room 101.

The Pegasus II Facility occupies 1,300 m^2 (14,000 ft^2) of combined laboratory and office space. The building is constructed of prefabricated metal building components (steel columns, sheet metal siding, and masonry brick) on a concrete pad. The lower level (Room 100) houses the experimental area.

No construction or remodeling of the Pegasus II Facility is anticipated under the No Action alternative.

K.2.2.3 *Operations*

The heart of the Pegasus II Facility is a 4.3 MJ capacitor bank used to deliver a pulse of electrical and magnetic energy to a target. The capacitor bank has eight modules and uses air as the dielectric between the individual capacitors. The Pegasus II Facility is used for up to 24 experiments per year. In a typical experiment, a metal cylinder is placed in the target chamber, diagnostic equipment is attached to the target chamber, and the air in the chamber is pumped out with a vacuum system to form a vacuum condition for the experiment. Operators in Room 100 prepare the power supply system, and personnel are evacuated from the room. Operators in Room 205 open and close switches to charge up the individual capacitors and allow the eight modules to be hooked up in the test configuration. HE detonator switches then fire to transfer energy from the capacitor bank. The 4.3 MJ of energy stored in the capacitor bank discharges as a 12 MA current through a transmission line to the target. The discharge rises in about 6 μs. For experiments which require production of low energy x rays, a special switch ("plasma flow switch") can be placed just before the target to decrease the discharge rise time to only a few tenths of a microsecond.

After each experiment, LANL personnel clean the target chamber of metallic debris and deformed metallic targets. About 5 L (1.3 gal) of ethanol are used per year to clean the target chamber and other parts. Discarded materials generated from each experiment consist mostly of aluminum and copper and oxides of these metals. Any metal parts are salvaged for reuse. About 0.06 m^3 (2 ft^3) of uncontaminated waste (such as paper waste) per month is disposed of at the Los Alamos County Landfill. No hazardous waste is generated.

The detonator switches use a total of 19.2 g (0.672 oz) of HE per experiment, for a total of about 461 g (16.2 oz) per year. All HE is destroyed during detonation. After the test shot is complete, switches are disposed of at the Los Alamos County Landfill.

K.2.3 Alternatives Considered but Eliminated from Further Consideration

The following alternatives were considered but eliminated from further analysis in this project-specific analysis because they fail to meet the purpose and need for DOE action. Failure to meet this purpose and need results from programmatic deficiencies identified in the Stockpile Stewardship and Management PEIS or from technical inadequacies which preclude these alternatives from being reasonable alternatives to the proposed action.

K.2.3.1 *Build Atlas at Another DOE Site*

DOE considered, but dismissed as unreasonable, the alternative of locating, constructing, and operating the Atlas Facility at a site other than LANL and other than at the Pegasus II Facility. As discussed in section 2.1.1, Atlas would expand the capabilities of the existing Pegasus II Facility through the addition of enhanced pulsed-power and other equipment sufficient to reach the temperatures necessary to ionize materials. Other sites at LANL, as well as other DOE sites which have a hydrodynamic testing infrastructure, do not have the existing special equipment provided by the Pegasus II Facility. Although it would be possible to duplicate this special equipment elsewhere, DOE considers this to be an unreasonably expensive option.

K.2.3.2 *Use An Alternate Building at LANL*

Under this alternative, DOE would construct and operate the Atlas Facility at a LANL location other than TA-35. The requirements for an alternate site at LANL are the same requirements as those described in section K.2.1.2. Siting and construction of a new building at LANL to house the Atlas Facility would require placement near the 1430-MVA generator building. Additional environmental disturbances from foundation and utility work would occur. Although other existing buildings could fulfill requirement 1, with extensive and costly modifications, none of these sites fulfill requirements 2 to 6. Therefore, this alternative has been eliminated from further consideration.

K.2.3.3 *Modify Pegasus II to Conduct Atlas Experiments*

Action under this alternative would involve modifying the existing Pegasus II Facility so that it could function at the Atlas Facility power level to meet DOE's purpose and need for action. Currently, the Pegasus II Facility supplies limited data regarding weapons physics, but the facility does not have sufficient energy capability to reach all the conditions required to adequately investigate primary and thermonuclear secondary issues. Modifying the Pegasus II Facility would require extensive expansion of the existing building housing the facility. During this expansion process, which would include construction, procurement, and verification testing, the current Pegasus II operations could not be conducted. The current Pegasus II operations are critical to DOE's existing nuclear weapons stockpile stewardship and management mission. Due to direct conflicts with the existing critical operations of Pegasus II, this alternative does not meet DOE's purpose and need for action.

K.2.3.4 *Explosive-Based Pulsed Power Technology*

As an alternative to the proposed action, DOE could rely solely on conducting tests using explosive-based pulsed power technology, such as that used by the Procyon generator at LANL. Procyon currently furnishes limited data regarding weapons physics. Although the explosive-based pulsed-power technology would apply to the type of experimental tests needed, this technology can only support a maximum of 12 to 15 experiments per year due to test preparation time constraints, scheduling of detonation, and subsequent site cleanup following detonation. The Agency need for action requires a capability of conducting up to 100 experiments per year. Because of this factor, this alternative has been eliminated from further consideration.

K.3 AFFECTED ENVIRONMENT

This section presents a summary of information regarding the general environmental setting of LANL and the immediate TA-35 site vicinity. More extensive information about the LANL environment is presented in the annual LANL Environmental Surveillance Report (LANL 1994b), as well as LANL's Site-Wide Environmental Impact Statement (DOE 1979).

K.3.1 General Site Setting

LANL and the associated residential and commercial areas of Los Alamos and White Rock are located in Los Alamos County in north-central New Mexico (figure K.3.1–1). LANL facilities cover approximately 560 hectares (1400 acres) of the Federal land managed by DOE in Los Alamos County. The LANL developed area is divided into 30 active TAs for administrative purposes (figure K.2.1.2–1). Unoccupied land area surrounds LANL buildings, providing security, safety buffer zones, and a reserve for future development.

TA-35 is located near the center of Pajarito Mesa, a southeast-trending mesa immediately north and east of Pajarito Canyon in Los Alamos County. Pajarito Road bounds the proposed Atlas Facility site less than 0.8 kilometer (km) (0.5 mile [mi]) to the south, and Pecos Drive bounds the site directly to the north. Although the general public is currently allowed free access to these roads, and Pajarito Road has heavy public traffic, access to all roads in the general site area are DOE-controlled. They can be closed for brief periods as needed. The proposed TA-35 site is surrounded by adjacent TAs -63, -50, -55, -48, -60, and -52. These TAs include facilities conducting a variety of ongoing R&D that may involve use of chemicals and radioactive materials. The site is generally considered highly developed.

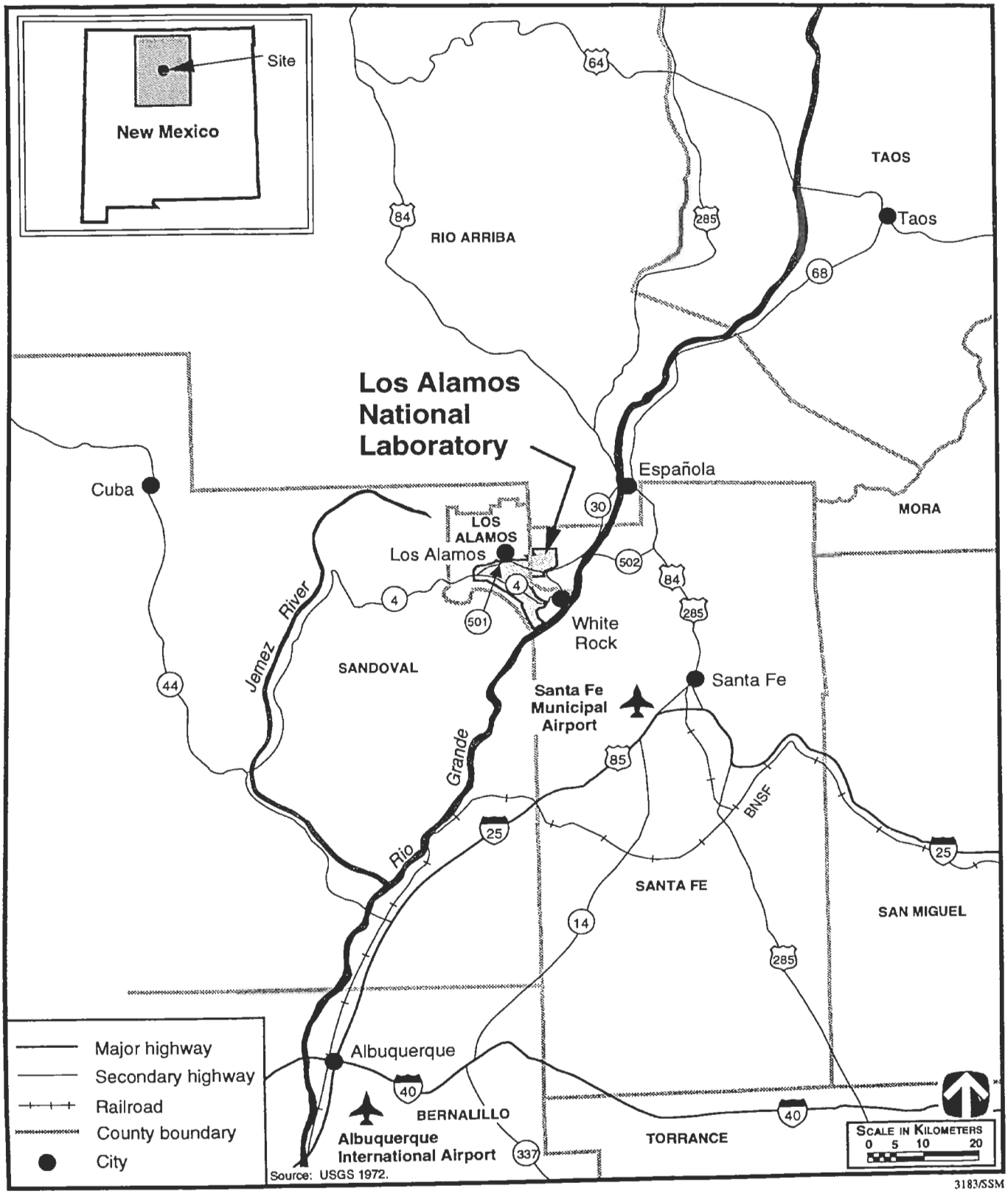

FIGURE K.3.1–1.—*Los Alamos National Laboratory, New Mexico, and Region.*

Los Alamos County has an estimated population of approximately 18,115 (U.S. Census 1994); the Los Alamos town site has an estimated population of 11,400, and White Rock has an estimated population of 6,800. There is a small, privately owned residential area, Royal Crest Trailer Park, surrounded by LANL property. Royal Crest Trailer Park is situated approximately 1.6 km (1 mi) northwest of the proposed project area with an estimated population of 500 (Morris 1994). The principal population centers are Santa Fe, Espanola, and the Pojoaque Valley located within an 80 km (50 mi) radius of LANL with an approximate population of 214,707 people. Fourteen pueblos are located within a 80 km (50 mi) radius of LANL. The populations of the four closest pueblos are as follows: the San Ildefonso Pueblo has a population of 1,499; the Santa Clara Pueblo has a population of about 3,000; the Cochiti Pueblo has a population of 1,342 people; and the Jemez Pueblo has a population of 1,750 people (Commerce 1991). LANL employs approximately 12,250 people (LANL 1994b) principally living within 80 km (50 mi) of LANL.

K.3.2 Environmental Issues Considered But Dismissed

The following environmental issues were not discussed as part of the affected environment because they either do not exist in the proposed action site vicinity (since the proposed action is in an existing building in a developed area) or neither the proposed action nor the No Action alternative would have any identified effect on these resources:

- Hydrology: surface and groundwater
- Vegetation
- Wildlife (Biotic Resources) — threatened, endangered and sensitive species, critical habitat, and migratory birds; wild horses and burros; wetlands and floodplains; wild and scenic rivers; coastal or tundra zones
- Cultural and Paleontological Resources
- Land Resources — mineral and timber resources; prime or unique farmlands
- Socioeconomics
- Water Quality — drinking water from surface or underground aquifers
- Soils and geology
- Parks, Monuments, Public Recreational Areas
- Site Infrastructure
- Visual Impacts
- Transportation

Under Executive Order 12898, Federal agencies are responsible for identifying and addressing the possibility of disproportionately high and adverse health and environmental impacts of programs and activities on minority (all people of color, exclusive of white non-Hispanics) and low-income (household incomes less than $15,000 per year) populations. Within a 16 km (10 mi) radius of the proposed Atlas site, about 14 percent of the population is of minority status. Within an 80 km (50 mi) radius, about 54 percent of the population is of a minority status. In terms of low-income populations, 8 percent of the households within a 16 km (10 mi) radius have annual incomes below $15,000. Within an 80 km (50 mi) radius of the site, 24 percent of the households have annual incomes below $15,000. Detailed environmental justice information is contained in the *Dual-Axis Radiographic Hydrodynamic Test* (DARHT) *Facility Final Environmental Impact Statement* (EIS) (DOE 1995b)[2].

TA-35 is situated on top of a mesa in a developed, disturbed area. Any impacts associated with building construction have already occurred and no new impact potential has been identified for the proposed action or the No Action alternative.

[2] The DARHT Final Environmental Impact Statement was issued on August 25, 1995. The Record of Decision for DARHT was issued on October 11, 1995.

K.3.3 Environmental Issues Considered

K.3.3.1 *Air Quality*

Prevailing winds at LANL are affected by several factors, including large-scale atmospheric wind patterns, regional weather disturbances (thunderstorms and cold fronts), complex surface terrain, and local cold-air drainage across the Pajarito Plateau. Winds in Los Alamos consist of light westerly surface winds that average 2.8 meters per second (m/s) (6.3 miles per hour [mph]). The strongest winds typically occur between March and June, when intense seasonal storms and cold fronts move through the region. During this season, sustained winds blow from the southwest to the northeast and can exceed 11 m/s (25 mph), with peak gusts exceeding 22 m/s (50 mph). Historically, no tornadoes have been reported to have touched down in Los Alamos County. Strong dust devils can produce winds up to 34.4 m/s (77 mph) at lower elevations in the area. The irregular terrain at Los Alamos affects wind motion and spreading. Localized wind gusts may not be in the same direction as average wind patterns. The wind behavior results in greater dilution of air contaminants that are released into the atmosphere.

Air quality in the LANL area is typical of arid-climate clean air. Median visibility ranges between 106 and 161 km (66 and 100 mi). The New Mexico Environment Department under the Environmental Protection Agency designated the LANL area as an air quality attainment area under the *Clean Air Act* or National Ambient Air Quality Standards in which all regulated ambient air quality standards are to be met. These standards apply to the following air emissions: total suspended particulates (TSP), particulate matter less than or equal to 10 microns in diameter (PM_{10}), sulfur dioxide, total reduced sulfur, hydrogen sulfide, carbon monoxide, and nitrogen oxides (New Mexico Environmental Improvement Board [NMEIB] 1981). Current emissions from operations around the proposed project site are within the required and existing permitted thresholds for LANL.

K.3.3.2 *Human Health*

As part of ongoing operations at LANL, several TAs, including TA-35 and those in close proximity to it, have facilities that conduct experiments involving electrical hazards and the generation of magnetic fields and x rays. Ongoing experiments and operations are conducted according to strict guidelines established by existing LANL standard operating procedures. Under these standard operating procedures, engineering and administrative controls are implemented to minimize worker and public exposure to electrical hazards, magnetic fields, and x rays. The magnitude of electrical hazards and x rays present from these experiments is regulated by Occupational Safety and Health Administration standards implemented under specific DOE orders. In addition, magnetic field threshold limit values have been developed as guidelines by the American Conference of Governmental Industrial Hygienists.

Generation and potential exposure to x rays is closely monitored under the implementation of existing health and safety requirements for maintaining worker exposure to as low as reasonably achievable standards, but not to exceed the current threshold of 5 rem per year. Magnetic fields are generated by the NHMFL at TA-35. These fields will not be additive to the fields produced during the charging of the Atlas capacitor bank because only one application can be conducted at a time. The public exposure to static magnetic fields in the TA-35 area is much less than the current pacemaker warning limit (10 G). Members of the public receive less than a 0.1 rem dose from x-ray sources generated in the TA-35 area or less than the admissible dose under DOE orders regulating public exposure to radiation.

K.3.3.3 *Waste Management Facilities*

RCRA-regulated hazardous chemical waste management is conducted at TA-54, Area L. TA-54, Area J, has a landfill dedicated to administratively controlled sanitary, non-hazardous wastes. All other sanitary waste is disposed in the Los Alamos County Landfill located near TA-3 along West Jemez Road.

K.4 Environmental Consequences

Neither the proposed action nor the No Action alternative would pose a disproportionate adverse health or environmental effect on minority or low-income populations within an 80 km (50 mi) radius of the proposed site.

K.4.1 Environmental Issues Considered

A summary of environmental issues is presented in table K.4.1–1. A discussion of the issues associated with the proposed action and the No Action alternative follows in the succeeding paragraphs.

K.4.2 Proposed Action

K.4.2.1 *Air Quality*

The air emissions expected due to operations at the Atlas Facility are presented in table K.4.2.1–1, along with the health-based New Mexico Air Quality Control Regulations (AQCR) 702-regulated levels. All expected emissions generated during normal operations would be below current regulatory levels. No permitting would be required under AQCR 702 or under the National Emission Standards for Hazardous Air Pollutants (NESHAP). No use of facility air filters or scrubbers would be required. Most of the metal targets used during experiments would vaporize and deposit onto the inside surface of the target chamber. Only minute quantities of metals would stay volatilized. Other nonradioactive heavy metals may also be used, but the metals listed in table K.4.2.1–1 are representative of any metals that would be used. The majority of the ethanol used for cleaning would evaporate. Small amounts of hazardous chemicals such as isopropyl alcohol, trichloroethylene and 1,1,2-trichloroethane may occasionally be used as cleaning solvents and would also evaporate. The quantity of air emissions as shown in table K.4.2.1–1 would not harm workers, collocated

TABLE K.4.2.1–1.—*Air Emissions from the Atlas Facility*

Constituent	Calculated Emissions[a]	AQCR 702 Limit
Aluminum	less than 1 g (0.0022 lb)	0.133 lb/hr
Copper	less than 1 g (0.0022 lb)	0.0133 lb/hr
Gold	less than 1 g (0.0022 lb)	0.42 lb/hr
Ethanol	less than 1.5×10^3 g[b] (3.3 lb)	10 lb/hr
Isopropylalcohol	less than 30 g[c]	65.3 lb/hr
Trichloroethylene	less than 30 g[c]	18.01 lb/hr
1,1,2-Trichloroethane	less than 30 g[c]	3 lb/hr

[a] Amount calculated is per experiment using that specific type of metal or cleaning solvent. Any emissions would occur after the target chamber is repressurized to ambient pressure and temperature.

[b] Scientific notation (see glossary for explanation).

[c] Total for isopropyl alcohol, trichloroethylene, and 1,1,2-trichloroethane.

Source: Model results; NMEIB 1981.

TABLE K.4.1–1.— *Environmental Issues Considered for Normal Operations/Accidents*

Issue	Proposed Action Alternative	No Action Alternative
Air Quality	Potential impacts discussed in appendix section K.4.2.1. Per experiment: minor metals (copper, aluminum, gold [less than 1 g]); and solvent (1.5×10^3 g ethanol) air emissions. Occasional small (<30 g) quantities of isopropyl alcohol, trichloroethylene and 1,1,2-trichloroethane may also be used as solvents.	Potential impacts discussed in appendix section K.4.3.1. Per experiment: minor metals (same as proposed action for copper and aluminum, no gold used), solvent (18.1 g ethanol), and high explosive (12.7 g carbon monoxide, 34.0 g nitrogen oxides, 95.2 g PM_{10}, 0.91 g volatile organic compounds, all per year) air emissions.
Human Health	No radioactive materials; potential health effects of electricity, magnetic fields, x rays discussed in appendix sections K.4.2.2 (normal operations) and K.4.4 (accidents).	No radioactive materials; potential health effects of electricity, magnetic fields, x rays discussed in appendix sections K.4.3.2 (normal operations) and K.4.4 (accidents).
Waste	Disposal of uncontaminated construction waste (15.3 m^3), other uncontaminated, nonhazardous solid waste, such as paper, dielectric insulation, etc. (7 m^3 per year), and small amounts (<1 m^3 annually) of liquid or solid hazardous waste would be generated by occasional experiments involving lead or other simulant materials. Within normal scope of LANL waste management activities, appendix section K.4.2.3.	Disposal of uncontaminated, nonhazardous solid waste, such as paper and dielectric insulation, etc. (0.7 m^3 per year), within normal scope of LANL waste management activities, appendix section K.4.3.3.

workers (those at TA-35 but not involved with the Atlas project), or members of the public. Small amounts of dust would be generated due to outdoor excavation activities. Standard dust suppression techniques, such as watering, would be used as needed.

K.4.2.2 *Human Health*

This section presents potential health hazards to site workers, collocated workers, and the general public during normal operations of the Atlas Facility experiments. The identified hazards to human health are electrical hazards, magnetic field hazards, and radiological hazards.

Electrical. Normal operations at the Atlas Facility during conduct of experiments would include electrical hazards to researchers, technicians, and other Atlas Facility personnel because the capacitors associated with Atlas would be charged to a high-voltage. The Atlas capacitor bank could deliver an instantaneous lethal current if special operating precautions are not taken. To minimize electrical risks associated with Atlas experiments, all applicable electrical codes specified by DOE Order 6430.1A (such as adequate grounding and lightening protection) would be incorporated into the Atlas capacitor bank and facility and related electrical components. In conjunction with meeting local electrical codes and DOE Order requirements, the Atlas capacitor bank would be isolated in an interlocked room where access would be controlled. During the actual charging, discharging, and energy release of the system, personnel access to the room would be denied. To aid in assuring no admittance takes place, guards would also be posted at the entrance. Other engineering safety features would be built into the Atlas Facility, such as:

- All switches would be fail-safe; i.e., either a loss of compressed air or electrical power would disengage the switches.
- A direct cut-off to the Atlas Facility systems would be available to the control room operator should the master computer malfunction. The direct cut-off would automatically return systems to their normal fail-safe position.
- Switches could not be operated until all interlocks have been made.
- If an interlock is broken during a charge cycle, shutdown would occur.

These Atlas Facility engineering controls, as well as administrative controls such as personnel training and standard operating procedures, would significantly decrease the probability of an electrical accident occurring during normal operations.

Magnetic Fields. The generator located in Building 301 would be running for 15 to 20 minutes at the beginning of each experiment. The generator would generate magnetic fields during operations of either the Atlas Facility or the NHMFL, but only one operation would be conducted at any one time; therefore, no cumulative impacts to workers would be expected due to magnetic fields resulting from generator operations. The ultimate magnetic field generated would have a frequency dependent on the final rotation speed of the generator (1800 rpm); this frequency would be approximately 60 cycles per second. Workers and members of the public are shielded from the magnetic field by the building's walls, and the generator itself is designed with adequate shielding so that a magnetic field of less than 10 G would exist near the generator. The magnetic field due to the generator would be less than 1 G at Pecos Drive, the nearest public-access roadway, about 75 m (245 ft) from Building 301.

A second source of magnetic field would come from the energy transfer into the inductors' storage coils. During the 3 to 5 seconds that it would take to transfer energy into the inductor, a dc current would be present in the coils of the inductor located on the roof of Building 124. This dc current would have an associated magnetic field of 40,000 G near the coils. There would be a few-second duration magnetic field of less than 10 G at Pecos Drive, which is approximately 33 m (110 ft) from Building 124.

All Atlas Facility workers and nearby collocated workers would be informed of the magnetic hazards associated with individual proposed experiments and those with pacemakers, etc., would be moved to a safe location. Administrative and engineering controls would be in place during experiments to keep magnetic field exposure as low as reasonably

TABLE K.4.3.1–1.—*Air Emissions from the Pegasus II Facility*

Constituent	Calculated Emissions[a]	AQCR 702/707 Limits
Aluminum	less than 1 g (0.0022 lb)	0.133 lb/hr
Copper	less than 1 g (0.0022 lb)	0.0133 lb/hr
Ethanol	18.1 g (0.04 lb)	10 lb/hr
High Explosives[b]	12.7 g (0.028 lb) carbon monoxide	200,000 lb/yr
	34.0 g (0.075 lb) nitrogen oxides	40,000 lb/yr
	95.2 g (0.21 lb) particulate matter 10 microns or smaller	25,000 lb/yr
	0.91 g (0.002 lb) volatile organic compounds	40,000 lb/yr

[a] Amount calculated is per experiment using that specific type of metal. Any emissions would occur after the target chamber is repressurized to ambient pressure and temperature.

[b] Emissions due to high explosives are calculated for one year, not per experiment.

Source: Model results; NMEIB 1981; 40 CFR 52.21.

Pegasus II Facility. Most of the metals would vaporize and deposit onto the inside surface of the target chamber. Only minute quantities of metals would stay volatilized. The majority of the ethanol used for cleaning would evaporate. The quantity of air emissions would not harm workers, collocated workers (those at TA-35 but not involved with the Pegasus II project), or members of the public.

K.4.3.2 *Human Health*

Electrical. Normal operations during conduct of experiments at the Pegasus II Facility present electrical hazards to researchers, technicians, and other Pegasus II Facility personnel because the Pegasus II capacitor bank is charged to a high voltage. The Pegasus II capacitor bank could deliver an instantaneous lethal current if special precautions are not taken during experiments. Engineering controls and administrative controls the same as or similar to those described for the proposed Atlas Facility, such as interlocked rooms, fail-safe switches, standard operating procedures, and direct cut-offs, significantly decrease the probability of an electrical accident occurring during normal operations.

Magnetic Fields. Magnetic fields are not generated during the conduct of experiments under the No Action alternative; power for charging the Pegasus II capacitor bank is obtained from the existing LANL electrical power grid and does not require the use of a separate facility power generator.

Radiological. Experiments conducted at the Pegasus II Facility produce up to 0.2 MJ of low-energy x rays, 10 percent of the level expected during the same type of experiment from the proposed Atlas Facility (2.0 MJ). Operating experience has demonstrated that these low-energy x rays do not penetrate the target chamber. Neither Pegasus II Facility workers, collocated workers, nor members of the public either onsite or offsite would be exposed to x rays from continuing to operate the Pegasus II Facility experiments.

K.4.3.3 *Waste Management Facilities*

About 0.7 m^3 (24 ft^3) of uncontaminated waste (such as paper waste and dielectric insulation) per month is disposed of at the Los Alamos County Landfill. No RCRA-regulated hazardous waste is generated.

K.4.4 Impacts Associated With Accidents

This section considers bounding case accidents that could be associated with the operation of the Atlas Facility that could affect site workers, collocated workers, the public, and the environment. Accidents with the highest consequence to workers have the likelihood of occurring once in 100 years. Accidents with the highest consequence to collocated workers, the public, and the environment have the likelihood of occurring once in 10,000 years. This information is summarized in section K.7. Other accident scenarios are contained within the Preliminary Hazard Analysis for the proposed Atlas project (LANL 1995). Accidents analyzed in this project-specific analysis are summarized in table K.4.4–1.

TABLE K.4.4–1.— *Accidents Analyzed*

Accidents	Likelihood of Event	Worst Consequence
Worker Mechanical collapse of crane; High-energy power source electrocution	Less than 1 in 100 years	Serious worker injury or death
Collocated worker Fire resulting from capacitor bank failure and release of smoke and sprinkler system water	Less than 1 in 10,000 years	Irritation or discomfort but no permanent health effects
Public Fire resulting from capacitor bank failure and release of smoke and sprinkler system water	Less than 1 in 10,000 years	Irritation or discomfort but no permanent health effects
Environment Fire resulting from capacitor bank failure and release of smoke and sprinkler system water	Less than 1 in 10,000 years	Release of smoke and effluent discharge containing sprinkler system water and mineral oil

Source: LANL 1995.

K.4.4.1 *Site Worker*

The bounding case accident for a site worker involves electrocution from a high-energy power source or mechanical collapse of the overhead crane. Of these scenarios, both have an equal likelihood of occurrence. The impact to a site worker in these scenarios could be death; however, the likelihood of occurrence is less than once in 100 years of operation.

K.4.4.2 *Collocated Worker*

The most likely accident scenario that could result in an impact to collocated workers involves exposure to emissions and effluents from a capacitor bank fire. In this scenario, a collocated worker would receive minimal exposure to smoke and sprinkler system water containing mineral oil spilled from a Marx module. The impact to a collocated worker in this scenario would be temporary irritation and discomfort; however, the likelihood of occurrence is less than once in 10,000 years of operation. In the event of a fire, all site and collocated workers would be evacuated immediately.

K.4.4.3 *Public*

The most likely accident scenario that could result in an impact to the public involves exposure to emissions and effluents from a capacitor bank fire. In this scenario, a member of the public could receive minimal exposure to smoke. The impact to a member of the public in this scenario would be less than that experienced by a collocated worker. Exposure to smoke could result in very mild and temporary irritation and discomfort. The likelihood of this accident occurring is less than once in 10,000 years of operation. In the event of a fire, all members of the public would be evacuated from the site area immediately and road closures and exclusion zones would be implemented, as appropriate. Based on the accident scenario and impact analysis in section K.7, there are no probable accidents which would result in an adverse impact to the public.

K.4.4.4 *Environment*

The bounding case accident scenario that could result in an impact to the environment involves the release of emissions and effluents from a capacitor bank fire. In this scenario, smoke and sprinkler water containing spilled mineral oil could be released to the environment. The impact to the environment in this scenario would be temporary and minimal. Smoke from a fire in this scenario would disperse quickly and the sprinkler water containing mineral oil would be contained by site soils and controlled drainage systems. Water containing mineral oil does not present a serious environmental concern given the nonhazardous nature of mineral oil, and in the event of a fire, spill prevention control measures would be implemented immediately. The likelihood of such an accident occurring under normal operating conditions is once in 10,000 years.

K.5 Agencies and Persons Consulted

No external agencies or persons were consulted for the project-specific analysis of the proposed Atlas Facility.

K.6 Permit Requirements

No external regulatory or permit requirements have been identified for the Atlas Facility.

K.7 Supplementary Information: Accidents

Tables K.7–1 and K.7–2 provide a summary of the types of hazards and scenarios that could result in impacts to the public, environment, collocated worker or the facility worker. Listed in table K.7–2 are the risk ranks resulting from the likelihood and consequence of a given scenario and hazard.

Table K.7–1.— *Hazard Sources for Atlas Preliminary Hazard Assessment Chart*

Electricity	-High voltage current -Static electricity
Radiant energy	-Electromagnetic fields
Radiation	-X rays
Mechanical structures	-Failure and collapse of critical structural assemblies -Leaks from storage tanks
Chemicals	-Toxic materials -Flammable materials -Asphyxiant gas
Implosion/ explosion	-Target chamber malfunction
Fire	-Mechanical/electrical malfunction -Target chamber malfunction

Source: LANL 1995; Model results.

Table K.7–2 shows that the highest consequence of any Atlas hazard scenario would have the greatest impact on the facility worker (Column 5, Impact on Worker). This is indicated by three hazards (radiation, mechanical structures, and fire) showing a risk ranking factor of two. The other impact receptors (e.g., collocated worker or environment) all have maximum risk ranks of 3 which means that risks are acceptable with sufficient controls and safeguards in place. Information charts on the following pages of this project-specific analysis have been provided to present the methodologies used to determine risk categories, probabilities, consequences, and requirements for risk mitigation during the typical preliminary hazard assessment process. The final preliminary hazard assessment risk reduction recommendations would be incorporated into the project design or in the project standard operating procedures.

Further information may be found in the preliminary hazard assessment for Atlas (LANL 1995).

K.8 Glossary

Angstrom (Å): Unit of length equal to $1x10^{-10}$ meter.

Dielectric: A nonconductor of electric current.

Electrolyte recirculation system: A water circulation system with salt additives which is used for controlling resistance near the capacitors.

Electron volt (eV): The energy equivalent ($1.602x10^{-19}$ Joules) of an electron passing through a voltage differential of 1 volt.

Environmental impact statement: A document required by the *National Environmental Policy Act* (NEPA) of 1969, as amended, for proposed major Federal actions involving potentially significant environmental impacts.

Foil implosion: To burst inward; i.e., the effect of applying large doses of electrical current to a thin walled cylinder.

Gauss (G): Unit of magnetic induction in the electromagnetic and Gaussian systems of units. Equal to 1 maxwell (measure of magnetic flux through an area) per square centimeter.

High-energy pulsed-power: A technique used in compressing electrical energy and storing it at high levels and then releasing it to a target in a very short time period.

High-energy x ray: An x ray in the 0.03 to 1 Angstrom wavelength range (e.g., medical x rays).

TABLE K.7–2.—*Summary of Hazards and Impacts with Risk Ranks from the Atlas Preliminary Hazard Assessment* **[Page 1 of 2]**

Hazard	Scenario	Impact on Public (Risk Rank)	Impact on Collocated Worker (Risk Rank)	Impact on Worker (Risk Rank)	Impact on Environment (Risk Rank)	Highest Consequence (Risk Rank)
Electricity	Access Breach	No	No	Yes (3)	No	Potential fatality
Radiant energy (EMF)	Inadvertent access of personnel to roof during charging	No	No	Yes (3)	No	Potential exposure of personnel to EMF
Radiation (x rays)	Implosion of experiment	No	Yes (4)	Yes (2)	No	Potential exposure of facility/ collocated workers
Mechanical structures	Failure and collapse of critical structures	No	No	Yes (2)	No	Potential worker injury/fatality
Mechanical structures	Leaks from storage tanks	No	No	No	Yes (3)	Release of untreated fire suppression water
Chemicals	Marx tank oil leak	Yes (3)	Yes (3)	Yes (3)	Yes (3)	Mineral oil is leaked to the facility and possibly to the environment
Chemicals Asphyxiant	Sulfur hexafluoride resupply hose leaks	No	No	No	Yes (3)	Sulfur trifluoride vaporizes and escapes; Potential exposure of facility/co-located workers
Explosion	Capacitor explodes	No	No	Yes (3)	No	Debris and mineral oil released to facility, possible worker injury
Implosion	Target chamber malfunction	No	No	No	No	Loss of vacuum and operational capability
Fire	Generator fire during power generation	No	No	Yes (3)	No	Worker injury from inhalation of fire combustion products
Fire	Marx generator capacitor banks fail	Yes (3)	Yes (3)	Yes (2)	Yes (3)	Fire in capacitor banks, potential injury to facility worker

Consequence Likelihood Categories

I (1 to 0.1)	Normal Operations: Frequency as often as once in 10 operating years or at least once in 10 similar facilities operated for 1 year.
II (0.1 to 0.01)	Anticipated Events: Frequency between 1 in 10 years and 1 in 100 years or at least once in 100 similar operating facilities operated for 1 year.
III (10^{-2} to 10^{-4})	Unlikely: Frequency between 1 in 100 years and 1 in 10,000 years or at least once in 10,000 similar facilities operated for 1 year.
IV (10^{-4} to 10^{-6})	Very Unlikely: Frequency between 1 in 10,000 years and once in 1 million years or at least once in a million similar facilities operated for 1 year.
V	Improbable: Frequency of less than once in a million years.

Note: EMF - electromagnetic force.

Source: LANL 1995.

TABLE K.7–2.—*Summary of Hazards and Impacts with Risk Ranks from the Atlas Preliminary Hazard Assessment* [Page 2 of 2]

Consequence Severity Categories, Maximum Possible Consequence				
Category	**Public**	**Collocated Worker**	**Worker**	**Environment**
A	Immediate health effects	Immediate health effects	Loss of life.	Substantial offsite contamination
B	Long-term health effects	Long-term health effects	Severe injury or disability.	Substantial contamination of originating facility/activity, minor onsite contamination; no offsite contamination.
C	Irritation or discomfort but no permanent health effects	Irritation or discomfort but no permanent health effects	Lost-time injury but no disability	Minor or no contamination of originating facility/activity; no offsite contamination
D	No substantial offsite release	No substantial offsite effect	Minor or no injury and no disability	Minor or no contamination of originating facility/activity; no offsite contamination

Note: Offsite: Public, private, or Indian lands that are not part of Laboratory property; Onsite: Laboratory property but not necessarily the originating technical area; Facility: Originating technical area of the Laboratory.

Risk Ranking Matrix					
	Likelihood of Consequence				
Severity of Consequence	**I**	**II**	**III**	**IV**	**V**
A	1	1	2	3	3
B	1	2	2[a]	3	4
C	2	3	3	4	4
D	3	4	4	4	4

[a] Assign risk rank of 3 if severity category rank of B is based upon worker injuries and offsite consequence severity is less than B.

Risk Rank	**Recommendation**
1	Unacceptable: Should be mitigated to risk rank 3 or lower as soon as possible.
2	Unacceptable: Should be mitigated to risk rank 3 or lower within a reasonable time period.
3	Acceptable with Controls: Verify that procedures, controls, and safeguards are in place.
4	Acceptable as is: No action is necessary.

High explosives: Any chemical compound or mechanical mixture that, when subjected to heat, impact, friction, shock, or other suitable initiation stimulus, undergoes a very rapid chemical change with the evolution of large volumes of highly heated gases that exert pressures in the surrounding medium; the term applies to materials that detonate.

Joule: Unit of energy equivalent to one watt-second.

Low-energy x ray: An x ray in the 1 to 10 Angstrom wavelength range. Low-energy x rays do not have enough energy to penetrate a sheet of paper.

Marx modules: Assemblage of electric capacitors charged in parallel and discharged in a series are said to be of a "Marx Configuration."

Megajoule (MJ): One million joules which is a measure of energy or work in the meter-kilogram-second system of units, equal to 1 Newton.

Micron: A unit of length equal to one-millionth of a meter; one meter equals 3.2 feet.

National Emission Standards for Hazardous Air Pollutants: Hazardous air pollution standards established through the *Clean Air Act*, as amended.

Plasma flow switch: An electrical switch used to open a circuit through the use of ionized gas (plasma).

Prevention of Significant Deterioration: Refers to provisions in the *Clean Air Act*, as amended, and state air quality regulations, to ensure that an area in attainment with the National Ambient Air Quality Standards will stay in attainment.

Rem: Roentgen equivalent man; unit for measuring radiation dose equivalence. The rem takes into account the energy absorbed (dose) and the biological effect on the body (quality factor) due to the different types of radiation.

***Resource Conservation and Recovery Act* of 1976:** Establishes a comprehensive "cradle-to-grave" approach to the regulation of hazardous waste. Also establishes a framework for instituting corrective action for releases of hazardous wastes.

Reynolds Number: A dimensionless numerical value relating fluid density and viscosity to particle size and relative velocity.

Roentgen: A unit of exposure to ionizing x- or gamma radiation equal to or producing one electrostatic unit of charge per cubic centimeter of air.

Science-based stockpile stewardship: DOE program to develop a new approach, based on scientific understanding and expert judgment, to ensure continued confidence in safety, performance, and reliability of the nuclear weapons stockpile.

SOP: Standard operating procedures; written and authorized procedures for conducting an activity.

Special facilities equipment (SFE): An assemblage of high power electrical equipment and systems to support Atlas (i.e., target chamber, vacuum equipment, etc.).

Swale: A low-lying stretch of land where water could collect or puddle.

Threshold limit value: Refers to airborne concentrations of substances and represents conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects.

K.9 References

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