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1994 SITE DEVELOPMENT PLAN

"A Plan with Vision"

MASTER

LAWRENCE

LIVERMORE

NATIONAL

LABORATORY

UCRL-LR-110253-94

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The renderings shown on the front cover and on the facing page were submitted by Kaplan/McLaughlin/Diaz, Architects and Planners, in May 1991, as part of the White Space Study for the Lawrence Livermore National Laboratory. They are presented here as visions to strive towards as the Laboratory moves into the 21st century.

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1994 SITE DEVELOPMENT PLAN

LAWRENCE LIVERMORE NATIONAL LABORATORY

FOREWORD

The 1994 Lawrence Livermore National Laboratory Site Development Plan has been developed during a period of great change and uncertainty. Our goal is to make possible the best use of the Laboratory's resources to meet shifting national priorities in the post-Cold War world.

Site Planning is an important component of the overall Laboratory strategic planning process. This plan focuses on opportunities for the Laboratory as well as on key site development issues including facility construction, redevelopment and reuse, site accessibility, and security.

A major challenge is to achieve sufficient stability in the site planning and execution so that the processes of construction can occur efficiently while at the same time providing sufficient flexibility in site facilities so that a range of changing national needs can be accommodated. We are closely coupled to the DOE strategic planning process to meet this challenge.

A handwritten signature in black ink, appearing to read "J. H. Nuckolls".

John H. Nuckolls, Director

I. Laboratory Overview	2
Mission	
Vision	
Population	
Regional Information	
II. Program Projections.....	3
Mission Projections	
Major Programmatic Goals	
Major Facility Initiatives	
Mission Resource Projections	
Laboratory Development Goals	
III. The Livermore Site.....	6
Overview	
Special Planning Considerations	
The Master Plan	
Project Summary.....	14
IV. Site 300 Experimental Test Site.....	16
Overview	
Special Planning Considerations	
The Master Plan	
Project Summary.....	22

LABORATORY OVERVIEW

Mission

The Lawrence Livermore National Laboratory (LLNL) serves as a national resource in science and engineering, focused on national security, energy, the environment, biomedicine, economic competitiveness, and science and mathematics education, with special responsibility for nuclear weapons. The Laboratory's mission is dynamic and has been broadened over the years to meet new national needs.

Vision

The Laboratory will excel in meeting vital national needs in its mission areas and in creating major national opportunities. It has a special responsibility in the area of nuclear weapons for the U.S. Department of Energy (DOE) Defense Programs.

Reducing the nuclear danger is the centerpiece of DOE's and LLNL's national defense vision. This is the organizing principle and cornerstone of the strategic plan in the Laboratory's defense sector. Key elements of the nuclear danger include: use of nuclear weapons against the U.S. and other nations; proliferation; and unsafe weapons, processes, and facilities.

The Laboratory will also excel in contributing to the welfare of the nation in nondefense mission areas: energy, environment, biomedicine, economic competitiveness, and mathematics and science education. Through expanding interactions with California's business and government, LLNL will be recognized as a vital institution for both California and the nation.

Population

As of January 1, 1994, there were a total of 10,145 persons working at the Laboratory. There are 9673 persons at the Livermore Site, 210 persons at the Experimental Test Site (Site 300), and 262 persons at off-site leased facilities. Of those at Livermore, 7938 are LLNL personnel, and 1735 are non-LLNL personnel, including 236 DOE and other Federal staff.

Regional Information

The LLNL site is about 80 highway km (50 miles) southeast of San Francisco. Site 300 lies an additional 27 km (17 miles) to the east (see Figures 1 and 14). A nearby interstate highway to the north, I-580, connects the site to the Bay Area and the California Central Valley.

The City of Livermore, with a population of over 58,000, has been steadily expanding toward the Laboratory for the past 20 years. A recent survey of the local community confirms that the Laboratory is a welcome neighbor, adding over a half billion dollars annually to the regional economy.

The San Francisco Bay area provides an exceptional range of opportunities and resources for scientists and engineers. The Laboratory's proximity to major universities and the research and development community of Silicon Valley provides a diversity of workforce resources. Sandia National Laboratories/California (SNL) is located immediately south of LLNL, and both the Stanford Linear Accelerator Center (SLAC) and Lawrence Berkeley Laboratory (LBL) are nearby.

Figure 1. The LLNL LIVERMORE SITE and EXPERIMENTAL TEST SITE (SITE 300) ARE LOCATED WITHIN THE SAN FRANCISCO BAY AREA IN CLOSE PROXIMITY TO OTHER RESEARCH LABORATORIES.

PROGRAM PROJECTIONS

Mission Projections

The U.S. defense effort is decreasing from Cold War levels, but the importance of economic competitiveness and industrial strength for sustainable national security is increasing.

In response, the DOE and its laboratories are changing their focus and methods of operation to accommodate this shift in emphasis. At the announcement of the initial changes, Energy Secretary Hazel O'Leary said, "For the past 15 years, the Department's major function has been to defend our national security. We have been successful in that endeavor. Now we must achieve as much in new missions that mirror the priorities of a changed world."

Laboratory Director John Nuckolls projects a significant shift in work efforts over the next five years. According to Director Nuckolls, work related to national defense and national security will account for 50% of the Laboratory effort, work associated with the civilian sector will account for some 30%, and commercial projects will represent 20% of the work (see Figure 2).

Changes within the defense sector are profound. There is no requirement for new nuclear weapons, however, there remain defense responsibilities that are extremely important to the national security. The dismantlement of U.S. and former Soviet weapon stockpiles is a high priority and should be accelerated. The acquisition of these nuclear weapons by other countries must be prevented. Effective methods for the detection and disablement of nuclear weapons are needed. Nuclear proliferation must be slowed and, if possible, reversed through improved intelligence and enforceable international agreements.

Civilian sector programs will focus on developing fusion energy for the long term and renewable

energy sources for the shorter term. More effective methods for environmental protection and cleanup will also be pursued, as will breakthroughs in genetics and biotechnology. Contributions to the nationwide effort to improve mathematics and science education will be increased.

Commercial projects will include: cooperative research and development projects; development of technologies critical to U.S. industry; assistance to startup and small businesses; and agreements to license specific Livermore-developed technologies to individual companies. The Atomic Vapor Laser Isotope Separation (AVLIS) is an example of a large commercial project. A substantial investment of LLNL resources has been made in the AVLIS technology. This technology has been fully developed and is ready for transfer to a suitable industrial organization. The Energy Policy Act of 1992 established the United States Enrichment Corporation (USEC). Under the provisions of the legislation, USEC has the option

to acquire the AVLIS technology, including the facilities at LLNL.

Work such as this and other commercial activities will be as crucial to the nation's economic security in the coming decades as defense work has been for the past 40 years. The U.S. must maintain a position of leadership in the global marketplace if it is to maintain its political leadership.

Major Programmatic Goals

Major LLNL programmatic goals include:

- Developing marketable technologies in collaboration with U.S. industry and making significant contributions to the economic strength of the nation.
- Providing the scientific and technological base for critical national defense capabilities through the operation of two proposed critical research facilities, the National Ignition Facility and the Contained Firing Facility.
- Demonstrating technologies for the long-range detection of nuclear, biological, and chemical

FIGURE 2. By the year 2000, work related to national defense and national security is projected to account for 50% of the LLNL effort. Work associated with the civilian sector will account for 30%, and commercial projects will represent 20% of the work.

weapons and methods for the disablement of terrorist weapons.

- Improving energy efficiency and developing new energy sources that are clean, abundant, safe, and economical.
 - Developing the science and technology necessary for assessing and predicting environmental response to pollution, cleaning up past contamination, and for moving toward an ecologically and economically healthy future.
 - Understanding human life, health, and pathology at the genetic level.
- Additional technical goals and objectives of increasing importance to LLNL include:
- Serving as a source of computation/information science and technology to meet a broad range of rapidly evolving national needs.
 - Enhancing science, engineering, and mathematics education.
 - Supporting the missions of other national agencies in the areas of environment, health, energy, defense, space, education, and economic competitiveness.

MAJOR FACILITY INITIATIVES

Among the keys to the transition from past to future Laboratory missions are the availability of critical research facilities and cooperation among the participating institutions. Five research facilities proposed for LLNL are described below.

The **National Ignition Facility (NIF)** offers a key research capability for the National Inertial Confinement Fusion (ICF) Energy program and is LLNL's highest priority (see Figure 3). The NIF is a critical part of the nation's Stockpile Stewardship Program. This facility will satisfy three ICF program missions: (1) to play an essential role in accessing physics regimes of interest in nuclear weapon design and to provide nuclear weapons-related physics data, particularly in the area of secondary design; (2) to provide aboveground simulation for nuclear weapon effects on strategic, tactical, and space assets (including sensors and command and control equipment); and (3) to develop inertial fusion energy for civilian power production. These ICF appli-

cations require the achievement of ignition and propagating thermonuclear fusion burn.

The **Site 300 Contained Firing Facility** is also one of LLNL's highest priority programmatic projects (see Figure 18). This facility will provide a totally enclosed firing chamber for the firing table of the Flash X-Ray (FXR) Facility at Site 300. This project will be designed to eliminate emissions to the environment, minimize quantity of waste generated, and provide the continuing ability to test explosives in compliance with changing environmental regulations.

The proposed **Mixed Waste Management Facility (MWMF)** is a key element in the deployment of effective and environmentally acceptable treatment processes for mixed waste. It will provide the "bridge" between bench-scale demonstrated technologies and full scale treatment facilities. The facility will support the National Mixed Low-Level Waste Program by providing a blueprint for design and, eventually, full scale deployment.

Figure 3. The proposed National Ignition Facility offers a key research capability and is LLNL's highest priority project.

In biology, the key facility is the **Genomics Research Laboratory**, which is essential for the continued success of the rapidly growing human genome research program and initiatives. This facility will house the LLNL Human Genome Center and will provide the necessary facilities to meet research objectives for the human genome program. This laboratory facility will support collaborative research with both the Laboratory's university colleagues and industrial collaborators.

The **Verification, International Security, and Technology Assessment (VISTA) Center** will be combined with Building 261 as a new integrated facility to house LLNL's Nonproliferation, Arms Control, and International Security Program.

These five projects represent the most critical line-item facility projects required for LLNL. They are subject to more detailed discussion in the Capital Assets Management Process (CAMP) document. Table 2 and Figure 19 provide comprehensive listings of all funded and proposed construction projects for the Livermore Site and Site 300, respectively. All proposed facility projects are located on their respective Master Plan maps (see Figures 13 and 19).

MISSION RESOURCE PROJECTIONS

Over the next five years, yearly operating funds are expected to remain at \$1 billion, plus or minus 30%, with significant growth projected in the non-defense areas (see Figure 4). In particular, funding growth is anticipated in the areas of technology transfer/industrial partnerships, nonproliferation/counterproliferation, environmental research and development, biomedicine/biotechnology, and energy.

The Laboratory work force will most likely continue to fluctuate, from 7,222 Full-Time Equivalent (FTE) employees today to around 7,500 FTEs by the year 2000. The

recent voluntary retirement program, VERIP III, provided an excellent opportunity to eliminate and re-engineer jobs and streamline the Laboratory management structure. As the Laboratory changes over the next several years, it is inevitable that job requirements will continue to change, some of them radically.

LABORATORY DEVELOPMENT GOALS

Changing security requirements, continuing urban encroachment, and the flexibility required to meet the new national focus are issues affecting land use, physical security, and traffic circulation.

The following site development goals address these critical issues. The goals are the basis for further discussion in the following chapters:

- Consolidate and collocate functional groups into flexible facilities to foster communications and collaboration.
- Ease access to the Laboratory, while maintaining appropriate levels of security, to better facil-

itate collaborative research with universities, industry, and other government agencies.

- Replace temporary, outdated and substandard facilities with permanent, energy-efficient structures.
- Ensure utility systems can provide present and future program support reliably and economically.
- Expand the road and pathway systems to provide safe, efficient circulation conducive to effective security and emergency response.
- Ensure all site improvements are architecturally compatible with immediate surroundings and appropriate for a research park setting.
- Enhance the physical image of the Laboratory commensurate with its standing as a nationally recognized center for basic and applied research and development.

FIGURE 4. Although funding levels for CORE NUCLEAR WEAPONS ACTIVITIES ARE PROJECTED TO DECLINE, GROWTH IN FUNDING FOR OTHER LABORATORY ACTIVITIES IS ANTICIPATED.

THE LIVERMORE SITE

OVERVIEW

Land use at the Livermore Site is the result of 50 years of physical development, determined first by the requirements of a Naval Air Station and later guided by the Atomic Energy Commission, the Energy Research and Development Administration, and the DOE Long-Range Site Development Plans.

In the early years of the Laboratory, most employees were housed in converted barracks and other Navy facilities. Some of these buildings are still in use today. As the Laboratory grew, new facilities were built adjacent to the previously developed area.

Site development decisions were influenced by the existing grid of roads and utilities. This led to overdevelopment in the southwest quadrant, creating high population densities and constrained building sites that severely limited traffic flow and expansion of key facilities. In 1968, the loop road system, established by the Long-Range Site Development Plan, created a free

circulation pattern, and a greater variety of parcel shapes and sizes throughout the site. The grid pattern in the southwest quadrant of the site was modified and integrated with the loop road system.

EXISTING LAND USE

The valley surrounding the 332 hectare (821 acre) Livermore Site has a mix of agricultural, residential, and light industrial uses. There are recent residential developments to the west of the site. Light industrial and office developments continue to grow at the north boundary.

The Sandia National Laboratories/California is located immediately south of the Livermore Site. The Department of Applied Science of the University of California, Davis, occupies a facility on 4 hectares (10 acres) of leased land near the Livermore Site's east entry gate.

Laboratory land has been categorized and documented based on its predominant use. The Existing Land Use Map, shown on the facing page, displays the general use of both Laboratory and adjacent lands and

defines the categories associated with Laboratory land use. Understanding how the land is presently used will enable wiser facility siting decisions in the years ahead.

EXISTING FACILITIES

There are 166 permanent buildings and 348 temporary structures at the Livermore Site, totaling approximately 510,000 m² (5.5 million ft²) of gross floor space. The entire facility has a plant replacement value of approximately \$3.2 billion and includes many unique experimental facilities.

Approximately 21% of all facilities exceed their design life expectancy, and 42% are rated in substandard condition categories. These high-maintenance, outdated facilities must be rehabilitated or replaced. Temporary trailers and World War II-era buildings constitute about 19% of currently occupied space. Approximately 36% of the office population is housed in these trailers or other substandard facilities (see Figure 5).

The overall land-to-building ratio remains near 6:1 for the Livermore Site — a very desirable ratio for a research and development facility complex. However, this ratio varies considerably throughout the site.

INFRASTRUCTURE

The utilities serving LLNL are currently capable of meeting the demand. On-site utilities include electrical power, natural gas, domestic water, low conductivity water (LCW), demineralized water, sanitary and storm sewer, compressed air, life safety alarms, and a state-of-the-art voice/data system.

The two primary energy sources at LLNL are natural gas, with a backup propane system, and electricity. Natural gas is transmitted by Pacific Gas and Electric (PG&E), with an average usage at 55% of the current capacity. Electrical usage is currently at 58% of capacity.

Figure 5. Approximately 48% of the Laboratory population resides in permanent buildings, while 49% is housed in temporary or substandard facilities.

LAND USE LEGEND

LLNL

- **Research & Development:** Office facilities, light and heavy laboratories, and light industrial facilities in direct support of programmatic endeavors.
- **Scientific Research/Computational Science:** Scientific research office facilities and computational laboratories for multi-program support.
- **Administration/Technical Support:** Office facilities used primarily to house the Laboratory professional and technical support staff.
- **Undeveloped Land:** Undeveloped properties, including floodplains and buffer zones, open space, and active/passive outdoor recreational areas.
- **Institutional:** Public and quasi-public facilities, including clinics, cafeterias, conference centers, visitor centers, and badge offices.
- **Industrial:** Warehouses, open storage, maintenance shops, and waste management corporation yards.
- **Easements & Utility Rights-of-Way (ROWS)**

Surrounding Area

- **Agricultural**
- **Industrial**
- **Residential**

FIGURE 6. EXISTING LAND USE MAP. LAND AT THE LIVERMORE SITE IS CATEGORIZED BASED ON PREDOMINANT USE. THE MAJORITY OF THE SITE IS FULLY DEVELOPED.

the site and the associated relocation of activities from overdeveloped areas will allow the desired population redistribution. These actions will aid in the realization of several Laboratory site development goals, discussed on page 5.

Physical Security

The increasing emphasis on collaboration with outside industry and technology transfer means that LLNL employees will host more unclassified visitors, including foreign nationals. The changing mission of LLNL, with its emphasis on unclassified activities, requires a reassessment of the physical security configuration. The objective is to allow easier access for visitors while maintaining effective physical and technical security where necessary.

Minimizing the number of physical barriers to areas which could be designated for unclassified activities is both desired and necessary. Physical barriers in the southwest classified core area may be minimized by moving security fence lines closer to classified facilities and, in some cases, using building walls themselves as the classified area perimeters. This reconfiguration will require changes in access control. Each facility will need some form of access control appropriate to the level of classification or sensitivity of its mission.

Consolidation of classified functions into the secured, permanent buildings will be pursued. End-user encryption will be one of the methods explored to accommodate the required classified computer communication networks linking secured buildings.

The most sensitive portion of the Limited Area core, the Superblock and its contiguous areas, will become the "new green core" (see Figure 8). This will minimize the acreage dedicated to the classified core while meeting DOE guidelines for the protection of Special Nuclear Material (SNM).

Redevelopment

Requirements for facilities and land continue to evolve. There is suitable

and adequate land available for all projected facility requirements provided that areas can be redeveloped. The most obvious potential redevelopment areas are those now sup-

porting temporary trailer complexes and World War II-era buildings.

Redevelopment sites at LLNL offer an opportunity to reuse the existing infrastructure. Proximity to

LEGEND

- Existing Classified Core Area
- Future Classified Core Area
- Proposed Stand-alone Limited Security Facilities
- Substandard Facilities Targeted for Removal

NOTES:

1. Ongoing Security Study to determine classified functional consolidations.
2. Proposed facilities are not shown. See Master Plan, Figure 13.
3. Classified core contraction to be accomplished in phases.

FIGURE 8. Classified CORE CONTRACTION PLAN. Reducing the area dedicated to classified work gives easier access for unclassified research collaborations.

THE LIVERMORE SITE

service facilities and functional program areas make this an exceedingly attractive option. These factors must be weighed together with existing population density, as previously discussed, in determining proposed facility sitings.

Completion of the Defense Programs Research Facility (DPRF) and the Nuclear Test Technology Complex (NTTC) in the southwest quadrant will result in mass personnel migrations of up to 15 to 20% of the Laboratory population, thereby offering a number of demolition and redevelopment opportunities. Similarly, completion of the Atmospheric Emergency Response Facility (AERF), now fully designed, will allow for the elimination of six substandard trailer complexes.

Permanent facilities will remain the preferred method of housing personnel. Replacing temporary facilities and providing for institutional needs must be emphasized as facilities age.

Off-Site Leased Facilities

The Laboratory is evaluating the feasibility of leasing more space

beyond the borders of the Livermore Site to reduce near-term acquisition and maintenance costs. Modest off-site leased facilities have supplemented on-site space for more than a decade. As more collaborative efforts are pursued in the future with outside agencies, additional leasing will present a viable housing alternative.

Today, the Livermore Site is faced with aging trailers, insufficient permanent facilities, and long acquisition periods for line-item facilities. It is projected that off-site leasing, as well as new and different types of off-site workspace and property acquisition, will gain widespread favor as an acceptable way to house both programs and personnel and to facilitate interaction with outside entities.

INFRASTRUCTURE

Completion of a looped utility network remains an important site development objective. Looped utilities will provide increased reliability and efficiency, while allowing the opportunity to isolate repair and maintenance activities. Figure 9

shows existing and proposed mechanical utility bundles and domestic water lines.

The electric utility system is presently being designed to allow the bulk power suppliers, PG&E and Western, to operate their systems in parallel at the Main U-424 Substation. This will minimize the effect of outages from either the PG&E or Western lines at the Livermore Site. Six new relay-activated circuit breaker switchgear installations (Load Grid Switchgear), with feeds from both Western Livermore Substation and the Main U-424 Substation, will be installed as shown in Figure 10. A new duct bank is also included for the express feeders to these new switchgear installations.

The 5-to-20-year plan will achieve the following: (1) modification of existing distribution feeders and installation of new distribution feeders to allow for "loop style" connections; (2) increased 115/13.8kV substation capacity; (3) reduced system fault duty; (4) conversion of the remaining overhead distribution to underground lines;

FIGURE 9. MECHANICAL UTILITIES PROVIDE SERVICE TO ALL FACILITIES. PROPOSED UTILITY EXTENSIONS WILL CREATE LOOPED NETWORKS FOR INCREASED RELIABILITY AND EFFICIENCY.

and (5) upgrading the Supervisory Control and Data Acquisition (SCADA) system to better control the distribution system.

Other actions to improve the operation and maintainability of LLNL utilities systems include:

- Installing a centralized mechanical utility control and monitoring center to ensure quality, reliability, and cost-effective service.
- Upgrading the domestic water system, including replacing the existing storage tanks at Sandia National Laboratory with larger, seismically upgraded models.
- Upgrading the propane-air blending equipment at the propane plant.

Utility usage and projections are presented in Table 1.

Telecommunication capabilities planned for the near future include video conferencing, distance learning, electronic library, and electronic commerce. These capabilities will provide LLNL with important productivity enhancements for business and programmatic needs. It is projected that ISDN will evolve to become the only available worldwide digital public network supporting full-motion video, image, slow-to-high-speed data networks, and voice services. Utilizing the ISDN platform, LLNL is well positioned to take advantage of and provide leadership in shaping the National Information Infrastructure.

ENVIRONMENTAL CONSTRAINTS

The Livermore Site was a Naval Air Training Station before becoming a DOE nuclear weapons design facility in 1952. Hazardous materials have been used at the site for over 50 years.

Low-level chemical and radioactive contamination was discovered in both the soil and ground water at the Livermore Site in 1983. The Environmental Restoration Division (ERD) of the Environmental Protection Department continues to characterize the soil. The ERD also reme-

diates the areas that historically have been contaminated above regulatory limits. All proposed excavation sites must be evaluated for possible soil contamination. Sites that are potentially contaminated must be sampled and analysis results must be evaluated before excavation may begin (see Figure 11).

Four treatment facilities (TFA, TFB, TFC, and TFF) have been built to date to deal with contaminated ground water. Five additional treatment facilities are being planned to remediate the contaminated ground water (see Figure 11).

Contaminated ground water is pumped from the subsurface via extraction wells and piped to the nearest treatment facility. After treatment, the water may be reinjected into the ground, released to the storm drainage system, or discharged to an infiltration pond on adjacent Sandia property. This is a long-term cleanup effort, estimated to continue for several decades. Future treatment facilities are being carefully sited to maximize remediation efficiency and minimize associated piping and adverse visual affects.

FIGURE 10. The 13.8 kV underground duct bank system will provide the redundancy necessary to eliminate power outages at the Livermore site.

THE LIVERMORE SITE

Floodplains, although limited at LLNL, also pose a development constraint. A floodplain is defined as the valley floor adjacent to a streambed or arroyo channel that

may be inundated during high water. All development should be avoided within the 100-year floodplain, and storage of hazardous constituents may not occur within the 500-year floodplain (see Figure 11).

THE MASTER PLAN

Figure 12 presents a conceptual graphic depiction of many of the site-wide opportunities and respective programmatic projections for the Livermore Site. Proposed major line-item facilities are shown on this diagram, as are areas presenting redevelopment opportunity, collaboration potential, and public service interface.

The Master Plan, depicted in Figure 13, is meant to serve as the foundation for more detailed implementation plans to build upon. This Master Plan establishes future land uses, presents expansion of the traffic circulation system, and locates all proposed facilities documented in the CAMP. A complete listing of all funded and proposed line-item construction projects for the Livermore Site is shown in Table 2.

Projected land uses shown on this map are significantly different from

Utility system	Current usage	Year 2000 projected usage	Current Capability
Electricity	58 MW	74 MW	100 MW
Natural Gas	13,700 TPD	14,900 TPD	24,480 TPD
Domestic Water	700,000 GPD	725,000 GPD	2,880,000 GPD
LCW ⁽¹⁾	79.2 MW ⁽²⁾	86.5 MW	88 MW ⁽³⁾
Demineralized Water	17,280 GPD	17,900 GPD	72,000 GPD ⁽⁴⁾
Sanitary Sewer	330,000 GPD	343,000 GPD	1,684,800 GPD
Compressed Air	2400 SCFM	2600 SCFM	4090 SCFM ⁽⁵⁾

Unit	
MW = Mega Watts (1,000,000 Watts)	
TPD = Therms Per Day (1 Therm = 1,000,000 BTU)	
GPD = Gallons Per Day	
SCFM = Standard Cubic Feet Per Minute	
Note: National Ignition Facility accounts for a significant increase in projected utility usage	

(1) Low Conductivity Cooling Water	
(2) Peak low load—47 MW avg.	
(3) Includes FY94 5.5 MW expansion	
(4) An additional 72,000 GPD is avail. on stand-by	
(5) 4090 SCFM electric driven, 3240 SCFM diesel back-up

Figure 11. Low-level soil and ground water contamination exist at the Livermore site. Ongoing remediation efforts pose a constraint to future development.

existing land uses depicted in Figure 6. These changes result mostly from planned efforts to collocate and consolidate related functions, and from programmatic and institutional projections hinging on collaborative agreements with industry.

The Master Plan will help guide progress toward the Laboratory development goals identified on page 5. Phased contraction of the southwest limited security core, redistribution of personnel from the southwestern corner, redevelopment

ment of areas now occupied by temporary or substandard facilities, and collocation of related functions are issues that must be carefully evaluated as workforce migrations are intelligently pursued at the Livermore Site.

Figure 12. Future opportunities for programmatic growth, redevelopment, and collaboration exist at the Livermore site.

Project Key	Project	Fiscal Year	\$M TEC	Project Key	Project	Fiscal Year	\$M TEC
Funded Projects:							
1	Nuclear Test Technology Complex (NTTC)	88	64.6		Protection of Real Property (roofs) Phase IV	99	8.0
2	Defense Programs Research Facility (DPRF)	91	72.6		Elec. Power Syst. Replacement/Upgrade II	99	41.4
3	Decontam./Waste Treatment Facility (DWTF)	89	57.4	24	Central Cafeteria & Conference Center	00	9.9
4	Mixed Waste Management Facility (MWMF)	93	17.4		Backlog Reduction - Roofing	00	19.7
	Electrical Power Replace./Upgrade I	91	31.0		Backlog Reduction - Building Utilities	00	31.0
	Fiber Optics Comm. Backbone	91	4.6		Projected Utility Projects	00	29.8
	Infrastructure Modernization	92	13.8	25	Chemistry Office Building	01	16.4
	Sanitary Sewer Rehabilitation	92	7.1	26	Replace Deteriorating Offices (B213, B319, T2175, T2177)	01	15.5
	Tank Upgrades Project	92	12.2	27	Plutonium Facility Upgrade	01	27.3
5	Atmospheric Emerg. Resp. Facility (AERF)	93	11.3	28	Laboratory Administration Center	02	2.9
Proposed Projects:				29	Laboratory Business Center	03	45.0
6	Genomics Research Laboratory	96	21.4	30	Nano Scale Material Facility	03	10.9
	In-House Energy Management	96	100.0	31	B151 Plant and Seismic Upgrade	03	21.2
7	Verif., Int'l. Security & Tech. Assessment Ctr.	96	27.0	32	B321 General Upgrade	03	11.0
8	National Ignition Facility	96	834.4	33	B141 General Upgrade	03	5.7
	Protection of Real Property (roofs) Phase I	96	8.3	34	B231 General Upgrade	03	10.5
	Chlorofluorocarbons (CFC) Chiller Conversion	96	18.2	35	Replace/Refurbish Hazard Control Facility	03	16.8
	Road Reconstruction	96	7.3		Building Electrical System Code Upgrade	03	30.4
9	Addition to B543	97	16.5	36	B151 Effluent Systems Upgrade	03	17.7
	Protection of Real Property (roofs) Phase II	97	8.6	37	B241 Renovation/Replacement	03	22.5
	Tank Upgrades Project II	97	7.1	38	LLIX Admin. Housing	05	3.3
	Sanitary Sewer Rehabilitation II	97	3.0	39	B551W Addition for TID	05	8.0
10	Earth Science Building	97	12.0	40	B181 Addition (replace 1700 block trailers)	05	7.1
11	B212 Replacement Laboratory	98	75.0		Building Envelope Repair	05	9.3
12	Nonproliferation Annex (NPA)	98	10.0		Civil Maintenance - Sitewide	05	5.2
	Protection of Real Prop. (roofs) Phase III	98	8.0		VHS Unclassified Data Communication	06	10.3
13	Technology Transfer Complex	98	19.0		VHS Classified Data Communication	07	25.8
14	NW Low Conductivity Water (LCW) Station	98	5.9	41	Generic Office Bldg #1 (replace Iron Crosses)	07	17.8
*	Fire Safety Training Facility	98	6.1		Upgrade Smoke Detection	08	5.7
15	Library Facility	98	2.1		Backlog Reduction - Flooring	08	12.4
16	Hazards Control Fire Science Facility	98	6.5	42	Generic Office Bldg #2 (Replace 5900 block trailers)	09	21.3
17	Public Affairs Center	98	6.2	43	B235 Upgrade	10	30.5
18	Block 220 Chem. & Materials Sci. Refurbish.	98	16.2	44	Generic Office Bldg #3 (Replace 1800 block trailers)	11	21.3
19	Environ., Safety and Health Facility (ES&H)	99	41.6				
20	B222 Chem. Bldg. Decon./Demolition	99	22.6		Sitewide projects		
21	B123 General Upgrade (Conf. Ctr. Upgrade)	99	5.4		* Off-site project proposal		
22	Energy Program Office Building	99	18.0		Notes: 1) Coordinated with Capital Assets Management Process (CAMP), as of 4/6/94		
23	B191 Hazardous Firing	99	21.0		2) Projects keyed to Master Plan, Figure 13		
					3) TEC is Total Estimated Cost

LLNL Research & Development: Office facilities, light and heavy laboratories, and light industrial facilities in direct support of programmatic endeavors. Scientific Research/Computational Science: Scientific research office facilities and computational laboratories for multi-program support. Administration/Technical Support: Office facilities used primarily to house the Laboratory professional and technical support staff. Undeveloped Land: Undeveloped properties, including floodplains and buffer zones, open space, and active/passive outdoor recreational areas. Institutional: Public and quasi-public facilities, including clinics, cafeterias, conference centers, visitor centers, and badge offices. Research & Development/ Institutional: Mixed-use facilities providing collaborative research opportunities with other institutions and industry. Industrial: Warehouses, open storage, maintenance shops, and waste management corporation yards. Easements & Utility Rights-of-Way (ROWS) Proposed Roadway Extensions	Surrounding Area Urban Reserve Industrial Major Public Residential

FIGURE 13. MASTER PLAN. FUTURE LAND USE AT THE LIVERMORE SITE REFLECTS LABORATORY MISSION PROJECTIONS AND SITE DEVELOPMENT GOALS.

SITE 300 EXPERIMENTAL TEST SITE

OVERVIEW

Development of the Site 300 Experimental Test Site began in 1955. Today, Site 300 provides the staff and facilities to conduct non-nuclear experimental tests that are cost effective and technically sound.

Site 300 offers a wide range of diagnostic and testing opportunities as well as processing capabilities. These are available for Laboratory experimenters, other federal organizations, and industry, offering unique facilities and sophisticated technical capabilities.

The world-class hydrodiagnostic test capabilities of Site 300 support the Laboratory mission. In particular, Site 300 supports the Laboratory position as lead laboratory for high explosives in the DOE system. As fewer resources are devoted to weapons research, development, and testing it will become more important to take maximum advantage of the existing facilities and core nuclear weapons capability.

If the current nuclear testing moratorium is continued or a comprehensive test ban treaty is signed,

the Site 300 hydrodynamic testing facilities will play an even more important role than in the past. Integrated testing of stockpile designs will be conducted using radiography and the extensive hydrodiagnostics developed for weapons design. Efforts will be made to improve computational abilities in the areas of maintaining and improving weapons safety to respond to stockpile issues. As the stockpile ages, the hydrodiagnostic test facilities will be used to assess effects of deterioration and the need for remanufacture. These efforts could increase Site 300's hydrodiagnostic testing workload in the near term.

SITE DESCRIPTION

The site is 2790 hectares (6893 acres), or about 28 km² (11 square miles), located 27 km (17 miles) east of Livermore (see Figure 14). It consists of two remote firing areas, a chemistry processing area, a General Services Area (GSA), and several unique facilities used to conduct a wide range of tests and experiments. Access to the site is facilitated by nearby Interstate

Highway 580 connecting the site to the San Francisco Bay Area and California's principal north-south interstate route, Interstate Highway 5. Located in both Alameda and San Joaquin Counties, the site lies within the rolling hills separating the San Joaquin Valley from the San Francisco Bay Area. The terrain of the site varies from plateaus to steep canyons, with on-site elevations ranging from 160 m (525 ft) to 533 m (1750 ft).

EXISTING LAND USE

The area surrounding Site 300 is sparsely populated. The majority of the land supports sheep and cattle ranching operations, windmill farms, and an off-road vehicle recreation area. Although not officially designated, San Joaquin County has approved, through Special Use Permits, other explosive test facilities similar to Site 300 in the area. Physics International is located along a portion of the Site 300 eastern boundary, and SRI International lies to the south (see Figure 15).

A proposal was made, in 1993, to develop housing along certain

Figure 14. Site 300 is situated 27 km (17 miles) to the east of the Livermore site. Access is facilitated by nearby highway I-580.

FIGURE 15. EXISTING LAND USE MAP. Land at site 300 is categorized based on predominant use. The majority of existing land remains undeveloped because of steep terrain and required safety zones.

SITE 300 EXPERIMENTAL TEST SITE

limited areas of the northern and eastern boundary of the site. This proposal was withdrawn. Other proposals in this area have had a similar history. Providing water and sewer, and other city services, has been the principal obstacle to development, together with the existence of endangered species habitat and corridors in the area.

The principal land use at Site 300 is research and development. Figure 15 shows the major areas of use by category. These categories are determined by the predominant use within an area. The majority of the area at Site 300 is not developed and is currently available for experimentation and testing purposes. Many of the current uses represent facilities that have been physically separated

because of the explosives safety arcs required by DOE rules. Within these arcs, many experiments have continued with minor schedule changes while intermittent explosive testing was conducted. This dual use of the area makes Site 300 both efficient and effective by accommodating multiple researchers in a location close to the Livermore Site.

Existing Facilities

Site 300 facilities include a total of 31,708 m² (341,317 ft²) of gross floor space. Temporary facilities constitute only 4% of this total. The facilities are generally in good condition. Projects to provide an adequate water supply and seismic protection have been completed or are in progress. Site 300 has land and existing facilities available for several types of experiments.

Some current work includes:

- The Flash X-Ray Facility, providing experimental verification and analysis of hydrodynamic testing. This is the most technically advanced facility of its type in the world.
- The Advanced Test Accelerator (ATA) provides for the development and study of the use of electron injectors as a radio frequency power source for high-energy linear colliders.
- The Super High Altitude Research Project (SHARP) site is the location of experimentation with gas gun technology to launch payloads into space and to explore the gun's potential military and industrial applications.
- Formulation, pressing, machining, and assembly of explosive components using remote processes are done in the process area.

Physical Security

A new physical security configuration has been implemented over the past year. The new configuration produced a great reduction in Limited Security Areas at Site 300. The new configuration created Limited Area "islands," leaving the rest of the site a Controlled Area during normal working hours (see Figure 16). Almost all of the site can thus become accessible to a far greater number of potential users.

INFRASTRUCTURE

Existing on-site infrastructure systems support a large investment in land and specialized facilities with sophisticated diagnostic capabilities.

The domestic water system is the only site-wide mechanical utility at Site 300. Water is currently pumped from one on-site well into ten storage tanks. The water system improvement project, now under construction, will change the primary source of water to the City of San Francisco's Hetch Hetchy underground aqueduct. It will also upgrade some existing waterlines and add a

Figure 16. A recent security reconfiguration at Site 300 created several Limited Area "islands". Far greater accessibility to the majority of the site is now possible.

870,642 L (230,000 gal) water tank for additional water storage.

A central air plant provides compressed air at 8.5 bar (125 psi) to the explosive process area. Buildings not serviced by the central air plant at Site 300 have independent compressed air units to meet their needs.

Sanitary sewage generated within the GSA is piped into an asphalt-lined oxidation pond east of the GSA at an average rate of about 12,113 L (3,200 gal) per day. Studies are currently underway to upgrade this facility to satisfy future institutional and regulatory requirements. Sanitary sewage generated outside the GSA is disposed of through septic systems at individual building locations.

Electrical power is supplied by PG&E transmission lines and is metered by PG&E and Western. The two 20-MVA substations at Site 300 are linked via a 12 kV overhead tie-line. They receive 115 kV power and have normal distribution voltage of 12 kV, with a 3-MVA system peak. Buried copper communication wire links the Livermore Site with Site 300. Utility usage is described in Table 3.

There are currently 40 km (25 miles) of paved and 129 km (80 miles) of unpaved roads at Site 300. The current daily volume of vehicles at the main gate is over 700 vehicles. Only government vehicles are allowed past the GSA.

SPECIAL PLANNING CONSIDERATIONS

Successful site planning requires foresight and flexibility. Facilities, and the land to support them, must be provided to accommodate changing program requirements within the limits of budget constraints, tight schedules, development standards, and concerns related to environment, safety and health (ES&H). This is particularly true in the areas of testing and experimentation.

Utility system	Current usage	Year 2000 projected usage	Current Capability
Electricity	2.7 MW	2.8 MW	20 MW
Domestic Water	65,000 GPD	70,900 GPD	756,000 GPD
Sanitary Sewer	3,200 GPD ^(*)	3,500 GPD ^(*)	7,000 GPD ^(*)
Compress Air	175 SCFM	190 SCFM	225 SCFM

Unit

MW = Mega Watts (1,000,000 Watts)

GPD = Gallons Per Day

SCFM = Standard Cubic Feet Per Minute

Note:

(*) General Services Area (GSA) only

The following assumptions are made with respect to future land use at Site 300:

- Site 300 is an ideal place for testing and large-scale experimentation.
- Technology transfer opportunities, among other concerns, are creating a need for "Open Areas" or non-restricted space at LLNL.
- Site 300 is an Environmental Protection Agency (EPA) Superfund site, a designation that will not be changed for some time.

OPPORTUNITIES AND CONSTRAINTS
The sites most suitable for future development at Site 300 have:

- Good road access
- Less than 15 percent slopes
- Ample utilities and services
- Sufficient area to provide a wide range of options
- Adequate space for future expansion

Figure 17 shows areas of opportunities for, and constraints on, future land development. This map is not a comprehensive representation because of its large scale. The map shows the areas most suitable for development in slope or gradient ranges from 0 to 15 percent. Slopes over 15 percent are generally considered too costly to justify site preparation; however, many exceptions to this rule of thumb may be found within the DOE complex. The actual implications for development are shown on the Master Plan (see Figure 19).

All Site 300 explosives facilities have explosives-safety clear zones around them. All construction, modifications, or change in use of facilities or utilities within these clear zones must be reviewed for compliance with DOE safety requirements. Temporary as well as permanent construction or modification is also subject to review. However, areas within some existing safety zones may be used for temporary, non-explosives experimentation and testing. This is subject to the restrictions of nearby explosive operations.

ENVIRONMENTAL CONSIDERATIONS
Testing of both the non-nuclear portion of atomic weapons and of conventional weapons at Site 300 must also be done in a manner sensitive to environmental concerns.

The Site 300 Environmental Restoration Project includes ongoing remedial investigations, feasibility studies, and remedial actions. This restoration is conducted under the joint oversight of the Federal EPA, California Central Valley Regional Water Quality Control Board, and the California Department of Toxic Substances Control under the authority of a Federal Facility Agreement.

Site 300 includes habitat for two federal and state listed endangered species: the San Joaquin Kit Fox, not actually present on the site, and a plant, the large flowered fiddle-neck. The site also accommodates representatives of state species of special concern, including the

SITE 300 EXPERIMENTAL TEST SITE

American badger and burrowing owl. In addition, a single larvae of a species proposed for consideration as a Federal-defined endangered species, the California red-legged frog, was found in 1991.

Evaluation of culturally significant sites at Site 300 is proceeding. National Environmental Policy Act (NEPA) assessments may be required prior to project site development.

Facility Upgrades

The capability to meet additional diagnostic requirements at the high-explosives firing facilities must be expanded. Phase I of the Revitalization Program has made significant progress towards pro-

viding future experimentation capability at Site 300.

Facility and infrastructure upgrades such as fire suppression, communication, and electrical power distribution systems must be pursued to provide modern and safe facilities capable of handling emergency events. The process area will eventually require replacement of obsolete machining equipment to meet both new demands and increased regulatory requirements. This would make excellent use of existing specialized facilities that could assist in the effort to change the current stockpile of weapons.

One objective of the explosives testing program is to conduct future

firing activities at Site 300 in a contained facility. Active research and development programs coupled with a heightened sensitivity to environmental issues make upgrading to a Contained Firing Facility highly desirable (see Figure 18). Much larger areas of land were required when land use was previously based on open-air firing. The Contained Firing Facility will allow substantial development in an area previously restricted by a safety zone. This proposal actually decreases the amount of land needed to do the same work, in a more environmentally sensitive manner.

Figure 17. Although environmental constraints exist on some of the potential development areas, significant areas offer opportunities for development in the future.

THE MASTER PLAN

Site 300 offers a significant area of opportunity based on its vast potential for future uses. Development goals for Site 300 are to:

- Preserve and extend the capability to safely test explosives while minimizing the effect on the environment.
- Build facilities that enhance employee performance and safety.
- Foster and promote the viability of Site 300 as an experimental test location.

Site 300 is both a valuable asset of, and an irreplaceable resource for, LLNL. Its proximity to the Livermore site will continue to be a key element in successful research and development through testing, such as the LLNL projects ATA and SHARP. The site will continue to be

a test bed for environmental remediation technologies.

Large areas of the site could be developed for all phases of experimentation, research, development, and testing. The Master Plan (Figure 19) shows four unique areas with significant development potential. Brief descriptions of each area are provided below.

- Eastern General Services Area (GSA): This area consists of two 6 to 8 hectare parcels (15 to 20 acres) that have excellent access from both within the Site 300 road network and Corral Hollow Road. They offer the best opportunity for expansion of the existing General Services Area function.
- Northern Boundary: Although presently restricted by an explosives safety zone, this area will be available for development

when the Contained Firing Facility is built.

- Northern Valley: This area contains a variety of sites along existing roads with good access to utilities.
- West Central: This area is served by a road and utility infrastructure and is the closest of the remote sites to the main entrance and General Services Area.

These four areas represent future development potential for LLNL at Site 300. The opportunity currently exists to accommodate facilities required for future experimentation and mission changes, as necessary. Construction projects presently funded and proposed for Site 300 are both shown and summarized on the Master Plan, Figure 19.

FIGURE 18. THE CONTAINED FIRING FACILITY IS ONE OF LLNL'S HIGHEST PRIORITY PROGRAMMATIC PROJECTS. IT WILL BE DESIGNED TO PROVIDE A TOTALLY ENCLOSED FIRING CHAMBER FOR THE FLASH X-RAY FACILITY.

SITE 300 EXPERIMENTAL TEST SITE

LAND USE LEGEND

	Potential Development Areas
	Research & Development
	Administration/Technical Support
	Undeveloped Land
	Institutional
	Industrial

10 Acre Parcel Equivalent

Line-Item Construction Plan Project Summary

Project Key	Project	Fiscal Year	\$M TEC
Funded Projects:			
	Site 300 Facilities Revit. Proj., Phase I	90	27.1
Proposed Projects:			
A	Site 300 Contained Firing Facility	96	47.9
B	Fire Station and Medical Facility	96	5.1
C	High Explosive Mach. Facility (HEMF)	99	22.5
	Site 300 Facilities Revit. Proj., Phase II	01	37.7

Notes: 1) Coordinated with Capital Assets Management Process (CAMP), as of 4/6/94
2) TEC is Total Estimated Cost

Figure 19. MASTER plan. Future land use at Site 300 reflects four significant potential development areas and three project locations.

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