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**PRELIMINARY REPORT ON
THE PAST AND PRESENT USES, STORAGE, AND DISPOSAL
OF HAZARDOUS MATERIALS AND WASTES
AT THE LAWRENCE LIVERMORE NATIONAL LABORATORY**

December 1985

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FOREWORD

This report contains the findings of a records search performed to survey the past and present use, storage, and disposal of hazardous materials and wastes at the Lawrence Livermore National Laboratory (LLNL) site.

The first draft of this report was prepared by staff of LLNL's Environmental Protection Program (EPP) in response to a request from the California Department of Health Services (DOHS) and submitted to them in March 1985.

This report is also intended to provide a point of departure for further planning of environmental protection activities at the site. It is an EPP document maintained in a format to allow for easy updating of information.

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Most of the information in this report was supplied by cooperative employees from many different LLNL programs, especially from the Plant Engineering Department and the Hazards Control Department.

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L INTRODUCTION

This report contains the findings of a records search performed to survey the past and present use, storage, and disposal of hazardous materials and wastes at the Lawrence Livermore National Laboratory (LLNL) site. The information in this report is intended to provide a point of departure for further planning of environmental protection activities at the site. The research for this report was conducted using the following resources: (1) the LLNL archives and library, (2) documents from the U.S. Navy, (3) old LLNL Plant Engineering blueprint files, (4) published articles and reports, (5) Environmental Protection Program records, (6) employee interviews, and (7) available aerial photographs.

Sections I and II of this report provide an introduction to the LLNL site and its environmental characteristics.

Several tenants have occupied the site prior to the establishment of LLNL, currently operated by the University of California for the U. S. Department of Energy. Section III of this report contains information on environmentally related operations of early site users: 1) the U.S. Navy and 2) California Research and Development.

Section IV of this report contains information on the handling of hazardous materials and wastes by LLNL programs. The information is presented in 12 sub-sections, one for each currently operating LLNL program. General site areas, i.e., garbage trenches, the traffic circle landfill, the taxi strip, and old ammunition bunkers are discussed in Section V.

Conclusions are summarized in Section VI. References are provided in Section VII.

Maps and overlays of the site, which are located after the text, are provided to track physical and operational changes through time. Included are graphics presenting:

- maps of the site through time (years 1942, 1952, 1960, 1965, 1970, 1975, 1980, and 1985); building operations are presented in Appendix B
- the sanitary sewer layout for 1952, 1968, 1976, and 1984.

- the storm drain layout for 1952, 1962, 1976, and 1984
- Toxic Waste Control pickup locations for 1984
- underground tank locations for 1984
- drum rack locations for 1984.

Besides the graphics bound with this report, large-scale site maps with overlays of the above list are available.

Figure IV-1 is a map showing the areas of concern on the LLNL site. The areas are presented in three categories: (1) known hazardous waste releases, (2) suspected contaminated areas, and (3) areas of little concern. Since it was not always possible to ensure the accuracy of information from old records, many of the areas in this report have been presented as potentially contaminated. In these cases further investigation will be necessary to determine if any actual soil contamination exists.

Appendix A lists the buildings on the LLNL site by number and gives the corresponding building name and responsible LLNL program. Appendix B consists of tables that list LLNL buildings by number with their corresponding operations in the years 1985, 1975, 1967, 1960, 1957, 1949, and 1943. Appendix C contains aerial photographs of the LLNL Site for the years 1943-1984.

An index of buildings, giving all page references to all buildings, is at the back of the report.

The conclusions of this report are being taken into consideration in the placement of new monitoring wells during the LLNL ground water investigation. As more information becomes available, through continued research, the information in this report will be updated.

II. GENERAL SITE CHARACTERISTICS

The Lawrence Livermore National Laboratory occupies 2.54 square kilometers on East Avenue, 5 km due east of the city of Livermore, CA. The Laboratory employs about 8500 people in a variety of research programs including nuclear weapons; controlled thermonuclear fusion; laser fusion; laser isotope separation; biomedical and environmental issues; and energy and resources. Two arroyos cross the site, Arroyo Seco on the southwest corner and Arroyo Las Positas along the northern boundary.

Before World War II, the land was part of a ranch and used for raising grain and grazing cattle. The U. S. Navy bought the property in 1942 and established a primary training base. From 1950 to 1954 California Research and Development, a subsidiary of Standard Oil, occupied the eastern portion of the site. The property was transferred to the U.S. Atomic Energy Commission in 1952 and established as the Livermore branch of the University of California Radiation Laboratory.

The Navy buildings were all constructed along the southern border of the landing mat. After the Navy occupation of the site, the majority of the construction was around the old buildings. Expansion occurred to the north along the western portion of the site. A few facilities were built on the eastern side. The motor pool, crafts and shops areas remained in the south eastern corner of the site.

A search through our blueprint files revealed some old records of site construction. In many cases, it is impossible to know if the old drawings found actually represent what was finally built. Figures II-1 through II-8, present the development of the site from 1942 until today. Appendix B lists buildings by number and by operations through time.

Five general characteristics of the site that do not fall into the specific categories presented in this report are presented in this section: 1) sanitary and storm sewers, 2) underground tanks, 3) drum storage racks, 4) temporary waste accumulation areas, and 5) ground water monitoring wells.

1. Sanitary and Storm Sewers

Both the sanitary and storm sewers have grown throughout the years. Maps of the sanitary and storm sewer systems are included in this submittal. The storm sewer maps (Figures II-9 through II-12) are included because through the years, operations involving hazardous materials and storage have been conducted outside of buildings. Storm runoff, or spills would have been routed along these lines. The maps allow the tracking of the drainage patterns on the site through time.

Several important changes have been noted. Since the mid-1970's the area that is noted as a future lake (Figures II-11 & II-12) has been excavated for fill dirt to be used in other areas of the site. As a result, over the years more surface drainage has been discharged there. Today, the area in the north central portion of the site, noted as soil management on the 1985 site map (Figure II-8), is used to store and remove needed fill. The areas where lined underground storm channels opened up into unlined ditches and the unlined lake area could be routes for potential contamination, and should be investigated further. The sanitary sewer system is presented through time on Figures II-13 through II-16. Rinsewater has been and continues to be disposed of into the sanitary sewer, if it meets the appropriate environmental criteria. Since the early 1970's, the effluent discharge has been subject to continued monitoring before leaving the site. Results of this monitoring can be found in the Lawrence Livermore National Laboratory Annual Monitoring Report (Griggs 1984). Exfiltration through lines are a consideration in assessing ground water contamination sources.

2. Underground Tanks

As evidenced by the attention being given to them by regulatory agencies, underground tanks are potential sources of ground water pollution. Figures showing the locations of past and current underground tanks are included in this report (Figure II-17). There are about 180 underground tanks and sumps on the LLNL site. These have been registered as required by the State of California (Cortese Bill). The tanks contain diesel, gasoline, laboratory rinsewater awaiting assessment, seawater, or ammonia (this tank, at B131, will be decommissioned in the next few months). Table II-1 lists the year specific tanks were installed, their capacity, and the type of material stored.

Tanks that have been removed or filled with sand and abandoned are also included. A few tanks appear in old blueprints. The search did not find anyone who had any recollection of these.

3. Drum Storage Racks

Figure II-18 shows the current locations of LLNL product drum storage racks. This method of storing materials has been used throughout the Laboratory. There is no documentation as to the locations of these racks or the types of materials stored in them prior to 1982. Tables II-2 and II-3 show the locations and contents found around the Laboratory at that time (Stone 1982). It has been common practice to locate a drum storage rack near to the machine shops. The materials stored are those routinely bought in 55 gallon quantities (i.e. kerosene, acetone, solvents, oils). When a decommissioned drum rack location was discovered through employee interviews, the description was included in the chapter discussing that particular area of the Laboratory.

4. Temporary Waste Accumulation Areas

Current temporary waste accumulation areas are shown on Figure II-19. The location of these waste pick-up points have not been documented in the past. They have usually been located to accommodate the generators of the waste and allow for easy pick-up by the Toxic Waste Control Group (TWC). In general, these areas contain both radioactive and hazardous wastes in dry and liquid forms. The wastes have traditionally been contained in drums, plastic or glass carboys. The dry waste is packaged in plastic bags and placed in drums. The glass carboys are placed in metal "lard cans" for secondary containment. The waste is set in a roped off area, on wooden pallets, for pick-up by the TWC group. When the Hazards Control Safety Technicians for the areas have the pallets labeled and ready for processing they call TWC. Every Thursday there is a "waste run" to transport the prepared waste to the Toxic Waste Control yard.

5. Ground Water Monitoring Wells

The wells that were completed by the end of April 1985 are shown on Figure II-20. The Navy dug two wells on the western side of the site. Only one exists today and is labeled N-1. The next wells were put in during a LLNL ground water environmental survey, conducted in 1980. More wells have been installed during the current on-going ground water investigation.

III. HANDLING OF HAZARDOUS MATERIALS AND WASTES BY FORMER USERS OF THE LLNL SITE

1. The U.S. Navy

The Wagoner Ranch was purchased by the U.S. Navy for a flight training base on March 24, 1942. Later that year 50 acres were purchased south of East Avenue. The Naval Air Station in Livermore was formally separated from the Naval Air Station in Oakland on June 1, 1943. The Fleet aircraft were serviced, stored and repaired here. The landing mat was a large asphalted area 2700 by 3000 feet. There were 648900 square feet of aircraft parking, 43500 square feet of storehouses, 65300 square feet for assembly and repair facilities (Figure II-1).

Airplane maintenance and servicing was performed in B25, B26 and B27, now B419, B511 and B514 respectively*. The waste liquids from these operations were probably poured out on the ground and washed off during rainstorms. A map of the storm sewer plan is shown in (Fig. II-9).

Buildings 241 through 247 were used for storage. There were four 29000 gallon underground gasoline storage tanks, as shown in Figure II-1. These probably were connected to the continuous fuel pit that was used to refuel the planes. There were hoses attached to the pit at regular intervals. Portions of this pit have been removed at various times. Gasoline and oil storage tanks are shown east of B16. The storm run off directions are shown on Figure II-9. The air stations sewer lines were connected to the Livermore Sewage Treatment Plant which was enlarged to accommodate the increase in sewage flow. A trash unloading ramp and burning pit is shown on a Navy blueprint. It appears there was also a garbage dump located at the southwestern end of the runway. This can be seen on an old photograph that was taken in 1950.

No records of the materials ordered or the disposal of wastes were found. The most likely hazardous materials used would have been: gasoline, oil, kerosene,

* A building cross reference can be found in Appendix B-2: LLNL Building Operations in 1985, 1957, 1949, and 1943.

dope (used for painting airplanes), and degreasing solvents. No indication was found that special arrangements for waste disposal of these materials were made. One unsubstantiated story talks about a pit on the south side of East Avenue, where dirty degreasing solvents were poured for disposal. Some photographs were obtained from the Navy Archives in Washington, DC, but no documentation on the disposal and handling of hazardous materials was found.

A supply department, paint and drum storage and diesel and oil storage, located on what is now owned by Sandia National Laboratory is shown on one navy blueprint. The underground gasoline and oil storage found are shown on the site maps included in this report.

Two small buildings, B47 and B38 are listed as scrub buildings. No documentation describing the scrub buildings on this site has been found. A contact in the Navy described scrub buildings as open sheds with paved floors that were sloped to drain out. These buildings were used to wash laundry by hand.

By late 1947 the Navy no longer was using the Livermore Naval Air Station. The site was used for stock car racing, classroom facilities, air meets, and club barbecues until 1950 when the Atomic Energy Commission and California Research and Development (a subsidiary of Standard Oil) announced that the site would be used to demonstrate the feasibility of using high-energy neutrons to produce nuclear materials such as tritium and plutonium.

2. California Research and Development (CR&D)

In June of 1950 CR&D began construction of the Materials Test Accelerator (MTA) on the east side of the air station parking apron (B157, now B431). Hot cells were built in the Pratt and Whitney Building (B121, now B412). They were used for chemical engineering research and later for work on the nuclear ramjet missile system (Pluto project). More details are in Section IV-7, on the Biomedical Services Program.

Documents issued in 1954 by CR&D on health physics operating instructions (Blank 1954) and waste disposal - decontamination and decontamination laundry facilities (Clark 1954) were found in the LLNL library. In the waste disposal document it states that there would be no "burial, cribbing or underground storage of wastes" because of the high water table in the valley. The wastes were solidified in barrels and shipped to the Naval Shipyard, at Hunter Point in San Francisco in "shielded leak proof disposal packages".

The Engine Test Building (B27, now B514) was renovated into a laboratory waste disposal and decontamination facility. The facilities handled both radioactive and hazardous chemical waste. A system of sampling (retention) tanks was added in keeping with the CR&D policy of sampling all suspected waste before discharge into a sanitary sewer system.

It is important to note that the definition of "hazardous" has changed very much in the past three decades. The materials that were then considered hazardous were dealt with carefully.

Dry waste was collected in 26-gallon galvanized iron cans with a four ply paper cement bag as primary containment. If these drums were "not contaminated" (we assume this meant radioactive contamination), the cans were reused after removal of the paper sack. Liquid waste was collected in 5-gallon steel paint cans containing a polyethylene bag liner. At the waste disposal facility 55-gallon drums with 4 inches of concrete in the bottoms were used for storage and disposal. When the drums were filled they were capped and sealed with concrete before shipment for disposal. Any objects that could not be barreled were

placed in concrete blocks using scrap metal for reinforcement. These blocks were then filled with concrete.

The decontamination laundry was established to wash any protective clothing that had been, or possibly was contaminated with radioactive materials. The clothing was collected from across the site and monitored for radioactivity. If no activity was seen, the laundry was monitored with no further controls. If it was low level (5mr/hour or less for beta-gamma, or 500cpm/100 sq. cm or less for alpha) the laundry was washed and the water retained for further testing before release to the sewer. After washing, the laundry was remonitored. If it was still contaminated, it was washed again. The high-level contaminated articles were soaked, allowed to dry and monitored. If the level dropped below the low-level limit it was laundered. If not, it was disposed of as contaminated waste.

Decontamination of significantly contaminated objects was done in a decontamination glovebox. Any waste generated during the decontamination procedures was placed in proper containers and disposed of as active waste. The floor drainage from this area of the facility went to the retention tanks.

IV. PAST AND PRESENT HANDLING OF HAZARDOUS MATERIALS AND WASTES BY LLNL PROGRAMS

This section describes past and present handling of hazardous materials and wastes by LLNL programs from 1952 to the present. The section is organized by programs, as follows:

1. Administration
2. Technical Services
3. Engineering
4. Chemistry
5. Computations
6. Energy and Resources
7. Biomedical Sciences
8. Physics
9. Lasers
10. Magnetic Fusion Energy
11. Defense Systems
12. Special Projects

Within each program, the information is organized chronologically into "A. History of Operations" and "B. Current Operations."

1. Administration

A. History of Operations

Almost all of the buildings associated with administration are located in the southern part of the site. Buildings 217, 218, 219, 316, and 319 were all constructed in the 1940's and used for barracks, instruction, or administration. Buildings 401, 402, and 403 were Navy buildings that are still used for the same types of operations today. The boiler/steam plant is located in B401. The motor pool and garage are located in B402 and B403, respectively.

The original gasoline tanks that contained fuel for the government vehicles were installed by the Navy, next to current B403, in 1943. These tanks were used until 1979, when approximately 6900 gallons of gasoline disappeared. Two new tanks had just been completed, and the operations were shifted there. At the time, it was believed that the gasoline was stolen. A leak test, done in 1980 by filling the tanks with water, showed no leak. When a soil sample from the area was analyzed, in 1984, it became apparent that it was likely a leak did occur. One theory is that the earthquake in January of 1980 shifted the ground and resealed the tank. Since the time of detection of the leak, records have been maintained of the gasoline levels in the new tank. Measurements are taken using a dipstick. No problems have been detected since. At this time, an investigation of the area around the gas tanks is being conducted.

Used motor oil has been collected in drums behind the garage. A drum rack is used to store materials such as new motor oil, Stoddard solvents, and degreasers. Trichloroethylene and perchloroethylene have not been used in recent times; however, it is still uncertain what solvents were used in the past. There have been two car washes in this area. The first one was north of the gasoline tanks. In the early 1980's the new car wash was installed to the east of B403. The drainage from these car washes and the washdown of the garage area has been drained to the sanitary sewer. The machinery wash rack located west of B518 also drains to the sanitary

sewer, through a grease trap which is cleaned out periodically. On a blueprint, estimated to be from the late 1940's or early 1950's, there is a notation of an oil tank to the west of the old gasoline tanks. We have not been able to find out if this was underground or above-ground. It is shown on Figure II-1.

The gas cylinder dock (B518), built in the early 1960's, has been used to store pressurized gas cylinders and the oil and solvent drums for the Laboratory's supply and distribution operations. Most drums of material ordered currently by Laboratory Programs are shipped from this area. No records of procurement or delivery were kept until 1984 when a system to keep track of chlorinated hydrocarbon orders was instituted. According to information from interviews, punctured or leaky drums from this area were transferred to the unpaved area south of the yard to drain. During the late 1950's the drum and gas cylinder storage area was located east of B403.

The old salvage yard was located north of B511 and west of the old ammunition bunkers. The salvage operations staff also used the strip of land parallel and west of the Taxi Strip Area (Figs. II-1 and II-2) for all materials that were reclaimable and/or recyclable. These included, for example, solvents, scrap metal, chemicals, oils, mercury, and machinery. The transferring and repackaging of chemicals and oils were done at the northern part of the strip area. Transformers were taken up here and taken apart. The aerial photographs show the area getting more and more black through time. This suggests that there were spills resulting from this operation. A large aluminum underground tank located in this soiled area was used for a mixture of waste liquids. The tank reportedly leaked.

The rest of the strip area was used for storage. The unpaved area above the north west corner of the salvage yard and the unpaved area along the east side of the strip was used to drain out the residue left in used barrels and drums.

The salvage yard was moved to its present location in about 1979. A 3200-gallon underground tank was constructed in 1980 to hold reclaimable, used motor oil. The oil is sampled to ensure that there is no PCB contamination, and when the tank is full it is sold to an off-site contractor. When the yard was first located at its present location, some barrels were temporarily stored on an unpaved area outside the northeast corner of the fenced yard. This area is no longer used.

Both the old and the current salvage yards have had many leaks and spills in them. Drums in various conditions have been stored for varying lengths of time. Old transformers and capacitors have been stored in these areas. Both salvage yard areas will be investigated further to locate all the areas of contamination.

B. Current Operations

Currently the administrative operations involving the handling and generation of hazardous materials and wastes are: a) supply and distribution; b) the automotive fleet; c) business services; d) procurement; and e) communications. Each of these operations is described separately in this section.

(a) Supply and Distribution

The supply and distribution organization of the LLNL Administration provides a number of services to the Laboratory that deal with both hazardous and non-hazardous solid and liquid wastes. Most of the relevant activities are associated with the corporation yard/salvage operations, in the southeast corner of the site. Other activities are located at the B616 and B617 storage areas, the B518 cylinder dock, and the B404 and B411 warehouse operation.

Gas cylinders are stored in the B518 yard. These are transported to locations around the Laboratory, when they are ordered. Until recently, procurement operations staff stored drums of oils,

kerosenes, and solvents along the northern and south rim of the yard in drum racks.

The salvage/reclamation yard receives material not needed for use by LLNL personnel, but which can be reclaimed or recycled.

The salvage yard area consists of an asphalt paved yard approximately 175 ft by 300 ft enclosed by an 8 ft high chain-link security fence which is locked when the area is unattended. The yard is immediately adjacent to the LLNL Storage/Excess Property section (Corporation Yard) where equipment is stored for later use by LLNL or the government.

LLNL Transportation personnel make daily trips to designated pick-up points to gather items in dedicated salvage containers and bring the containers to the Salvage Yard. The received commodities are sorted and segregated into 19 categories, such as copper, brass, aluminum, tires, batteries, oil, paper. They are accumulated until appropriate quantities are attained to facilitate sales by a competitive bid process. An exception is mercury which is collected and redistilled by outside contractors and returned to LLNL for reuse.

The following materials are received at the salvage yard and handled as described:

Used oil: Used petroleum based lubricating oil is received in 55-gallon drums and transferred to a 3000-gallon underground storage tank where it is retained for 1-2 months until sold and hauled off-site by a reclaiming company, after being checked for PCB contamination and radioactivity.

Used automobile batteries: Used automobile batteries are stored outdoors on pallets for 3-6 months until they are sold by bid to a reclaiming company.

Empty drums: Fifty-five-gallon drums that are empty are sold by bid to a reclaiming company.

Drums of collected liquid: When a drum of collected liquid is full it is transported by LLNL Transportation Department to B612 for storage and ultimate disposal as a hazardous waste. Small quantities of residual liquids are sent to TWC. TWC categorizes the contents, e.g., chlorinated solvents, non-chlorinated solvents.

Mercury: Used mercury is received in various containers and transferred to 100-pound metal flasks. The flasks are stored within a plastic spill control pan inside a storage transportainer. They are stored until they are commercially reclaimed and returned for supply reissue.

(b) Automotive Fleet

The LLNL automotive fleet is maintained and repaired in the B403 facility in the south-central part of the Laboratory. The operations involve regular use of hazardous and toxic materials, such as motor oils, solvents, fuels, lubricating oils and fluids, and industrial cleaners. Many of these substances are stored in a drum rack located east of the main shop. Drums of motor oil are also stored in an area east of the main shop. Reinforced fiberglass gasoline tanks of 10,000-gallon capacity are located underground at the fuel pumps north of the B402 shop.

The automotive fleet operations provide for the recycle or resale, of much of their hazardous and toxic materials, especially waste oil. The oil is collected in 55-gallon drums that are sent to the salvage yard. Solvents used in carburetor cleaning are retained in the cleaning system and removed by an outside contractor.

(c) Business Services

Business Services controls the Laboratory's three cafeterias, located in B312, B125, and T4675, which generate a variety of wastes. The wastes are considered non-hazardous and are either discharged to the sanitary sewer or collected for pick up to the non-hazardous municipal landfill located off Vasco Rd., north of the site.

(d) Procurement

Although procurement operations staff do not directly account for the generation of wastes at LLNL, the Department has the potential for producing an inventory of hazardous materials in use at the Laboratory and for providing information useful to the prevention of unnecessary over-stocking of hazardous materials. This department handles: (1) sales of waste oil, beryllium and other scrap materials, (2) purchase orders for analyses of various materials, and (3) purchase orders for the removal and disposal of contaminated soil and PCB's. In conjunction with the Hazards Control Department (Section IV-2), the Procurement Department obtains the pertinent safety information.

(e) Communications

Communications operations are located in a variety of buildings at the LLNL site. Most wastes are generated as part of the photo lab operations in B551W. Concentrated spent solutions are sent to Toxic Waste Control (Section IV-21) for processing, with the exception of spent fixer and developer solution, which is sent to Materials Management (Section IV-2) for silver reclamation. Other photo labs are small and generally produce only small amounts of liquid wastes that are discharged to the sanitary sewer.

2. Technical Services

A. History of Operations

The oldest buildings used by Technical Services, B310, B419 and B514, were built by the Navy. Building 310 has been used for administration, recreation and medical offices.

Building 419 was first used as the paint and dope shop by the Navy in the 1940's. We have found no records of operations in this building. In later years the building was used by a health chemistry program and as an assay laboratory. For at least the last 10 years, the building has been used by the Toxic Waste Control Group (TWC)* for decontamination operations. Retention tanks are used to store liquid waste. A leak in the plumbing has been detected and reported. A contaminated area may border B419 due to past waste operations conducted between B419 and B412 (see Biomedical Sciences, Section IV-7).

Building 514 was constructed as an engine test building for maintenance of airplane engines. It is likely that oils and solvents were used in this area. During the CR&D era the building was used for decontamination and laundry facilities. A description of this operation can be found in Section III of this report. Since the 1960's, B514 has been used by TWC for both radioactive and non-radioactive waste. Carboys and drums of liquid waste have been stored in the B514 yard for long periods of time in the past.

Spills that occurred were cleaned up at the time of occurrence. A comprehensive study of this area is necessary to determine what areas of the yard have been contaminated.

* In 1984, when the Technical Services Program was reorganized, the Toxic Waste Control Group became "Hazardous Waste Management" (HWM). The former designation, TWC, will be used in this report until later revisions or additions are made.

Since the mid-1960's, B612 has been used by TWC to package radioactive waste for shipment. Liquid and solid radioactive and non-radioactive waste has been stored in the yard. There have been spills in this area. The incinerator installed in 1979 is used to destroy security, biological, and hazardous waste. A comprehensive study of this area is necessary to determine what areas of the yard have been contaminated.

The Fire Station, (B323), was constructed in the early 1960's. The trucks housed there are washed on a regular basis. It was a fairly common practice, in the past, for firemen to rinse out greasy coveralls in TCE and dispose of the waste solvent on the ground.

From 1962 to 1964, the Fire Department conducted fire training in the central portion of the site (north of what is today B361). This training continued in the northwestern corner of the site from 1971 until B391 was built.

Pallets of flammable material such as sodium/potassium, magnesium metal, sodium, flammable solvents, acetone, toluene, paint solvents, kerosene, and transformer oil that could have included PCB's were stored near these locations. These materials were poured in an enclosed area on the runway and set on fire. When oil was used it was floated on top of water, before it was set on fire. From an employee interview, we learned that chlorinated solvents (mainly "white gas", and other flammable solvents) were not burned. Only 12 barrels of oil containing PCB's were burned.

B. Current Operations

Current * Technical Services Program activities involving the handling and generation of Hazardous materials and wastes are: a) Toxic Waste Control; b) Hazards Control; c) Materials Management; and d) Health Services.

* The Technical Services Program was reorganized in 1984. Later revisions or additions to this report will describe the reorganization.

Each of these operations is described separately in this section.

(a) Toxic Waste Control

Toxic Waste Control (TWC) operations are responsible for the accumulation, storage, treatment, and disposal of hazardous and radioactive wastes generated at LLNL. TWC consists of three major complexes: B419, the decontamination facility; B514, the liquid waste treatment and disposal facility; and B612, the solid waste storage and disposal facility. Waste liquids and solids are also incinerated at the B612 facility. Figure IV-1 shows the locations of the TWC facilities. Tables IV-1, IV-2, and IV-3, summarize the characteristics of the hazardous and radioactive wastes handled by TWC; the on-site storage facilities; and the treatment facilities, respectively.

The three TWC complexes are described in the following paragraphs.

B419. Decontamination Facility

Decontamination of radioactive equipment, parts, and supplies from various locations around the Livermore site and Site 300 is accomplished in the B419 facility. Most of the items for decontamination are equipment and supplies from programs that require reuse of the equipment. Items are cleaned by 1.) soap and water rinses, 2.) degreasing operations using solvents, 3.) sandblasting operations and baking facilities. Some pieces of equipment are decontaminated by wiping down with solvent or cleansers.

B514. Liquid Waste Treatment and Disposal

Most of the liquid is handled outside of the B514 in six 5700-liter treatment tanks. The bases of the tanks are surrounded by an epoxy coated concrete berm capable of retaining the contents of one tank

in case a leak occurs. The berm drains into a sump that can be valved either to the sanitary sewer or to the treatment tanks.

There is one 113,562-liter retention tank that is normally held in reserve to temporarily store liquid waste when all of the treatment tanks are in use. A berm, capable of retaining half the contents of this tank surrounds the base of the tank. The berm connects by a manual valve to a small sump located just south of the building. If the sump is used, the liquid is analyzed for contaminants. If the contents are clean, the liquid is pumped to the storm drains; if not, it is transferred to the retention tanks.

All of the treatment tanks are connected by a series of pipes and remotely operated valves so that the liquids can be readily pumped from one tank to another during the treatment process. Smaller tanks containing chemicals can be pumped into the treatment tanks.

The remote controls to operate the various pumps, stirrers, and valves for the waste treatment process are located inside B514.

The basic machine presently used in conjunction with the treatment tanks to decontaminate the liquid is the diatomaceous-earth, rotary drum filter, which is also located in B514.

Located just west of B514 are three underground sumps. The two southernmost tanks are interconnected and are used to retain liquids received from the toilet and shower in B514, from the treatment tanks, and from the sump beneath the treatment tanks. The northernmost sump collects liquid from the hood and sink located in B514 and from adjacent Plant Engineering Facilities (Section IV-3).

Large-volume, low-level liquid waste is treated by using several treatment tanks, plumbing, controls, and a diatomaceous-earth, rotary drum filter. The contents of portable tanks containing waste from various programmatic areas are pumped into large stationary

treatment tanks. The wastes usually contain dilute levels of metals which are higher than the release limits to the sanitary sewer. Chemicals are added to precipitate and coagulate metal ions. This material is then fed into the rotary drum that is coated with a 5-cm-thick layer of diatomaceous earth. The precipitate collects on the surface of the diatomaceous earth. As the drum rotates, a thin surface layer is constantly shaved off. These shavings (containing radioactive material and/or metals) are collected in a barrel. The barrel of solid waste is sealed and sent to the waste disposal facility (B612) area where it waits for shipment to an authorized commercial burial site. The liquid is returned to a "clean tank" where it is again sampled for metals. If this liquid is below the prescribed LLNL sewer guidelines, it is dumped into the sanitary sewer; otherwise it is retreated.

Carboys, containing concentrated nonradioactive hazardous chemicals, are pumped into barrels. These barrels are then transported to B612 for storage and ultimate off-site disposal as hazardous waste.

B612. Solid Waste Storage and Disposal

Building 612 is divided into five sections: (1) high bay, (2) mechanical equipment room, (3) mezzanine storage, (4) transuranic storage facility and (5) Laboratory, office and washrooms. Building 612 houses several hazardous waste processing, storage and disposal operations.

The mezzanine is used as a storage area for nonradioactive materials.

The facility has a series of floor drains that flow into a common sump. Normally, the sump is pumped directly to the sanitary sewer. In the event of a spill and washdown, the sump discharge can be valved off and its contents pumped into a portable tank that can

be hauled to B514 area for treatment. The yard connected to B612 is used to store radioactive and non-radioactive waste prior to processing.

A hazardous waste incinerator is located in the B612 yard. Solid and liquid wastes containing suspect carcinogens but no radioactive materials except trace quantities of tritium ($71\mu\text{Ci/g}$) are disposed of through a dual chamber, high temperature incinerator. A liquid injection system has been installed to inject the contents of the glass carboys directly into the incinerator. These glass carboys are then rinsed out, smashed and disposed of with the radioactive waste.

Other non-radioactive hazardous liquid waste contained in carboys is pumped into drums which are temporarily stored awaiting transportation off-site. The solid chemical wastes are packaged in drums at B612 and temporarily stored. The waste is packaged according to DOT regulations. A commercial waste handler trucks the non-radioactive solid and liquid hazardous waste drums to a Class I disposal site.

Building 614 is in the same area as B612. It is used to store chemicals that are awaiting disposal. The only utility that exists in this structure is water. This facility is used only for storage of reactive materials. The wastes are segregated in four areas to preclude the storing of incompatible waste in close proximity.

Building 623 is a 50-square foot enclosed metal shed on a concrete pad and is used to store gas cylinders. The shed is divided into two sections with outside access to each side. This shed is used to store gases until treatment or off-site disposal is accomplished. The plan at this time is for this shed to be dismantled in the near future.

Building 625 is the PCB storage facility. A 4800-square foot facility was built on a single pour concrete slab. The floor is sloped to the back of the building where there is a concrete berm continuous from

the floor. The floor is treated with epoxy sealant. The facility is used to store PCB waste. Low-level radioactive waste is also temporarily stored in this building.

(b) Hazards Control

The Hazards Control Department (HC) helps form LLNL safety policies, directives, and standards. It consists of several divisions responsible for fire safety, operational safety, general safety, radiation and environmental safety, and special projects. Activities include environmental monitoring and reporting (including stacks at the tritium and plutonium facilities and the real-time monitoring of sanitary sewer effluent), setting of weight limits for explosives testing at Site 300, and radiation counting services. The Hazards Control Department also generates small amounts of hazardous and radioactive materials as part of the research and analytical Laboratory activities. In addition, department personnel are involved in the handling, transport, and sampling and analysis of limited amounts of these materials and wastes.

Tables IV-4 and IV-5 summarize the hazardous and radioactive wastes respectively, handled by HC.

Hazardous Waste

Hazardous materials and wastes are generated, stored, and handled in several HC facilities. Major hazardous materials and wastes include: chlorinated and non-chlorinated solvents such as acetone, methyl ethyl ketone, trichloroethylene, freon, ether, hexanes, and kerosenes; oils such as cutting oils, lubricating oils, and machine cooling oils; acids and caustics such as nitric acid, chromic acid, and perchloric acid. Wastes from HC operations are segregated into acids, chlorinated and non-chlorinated solvents, and oils for disposal by TWC. Most wastes are generated in small quantities suitable for 5-gallon carboys. The carboys and dedicated 55-gallon waste drums

are labeled and placed on a concrete pad for removal by TWC personnel. Drains in the various laboratories and shops operated by HC are connected to the sanitary sewer.

Radioactive Waste

Hazards Control measures radiation in environmental samples from the surrounding area for the monitoring program. Ground water and surface water samples are collected in small volumes. Surfaces are checked by swiping them with filters which are measured for activity. Samples sent to Hazards Control for analysis include samples from retention tanks, and samples of effluent to the sanitary sewer. These samples are disposed of as radioactive waste. The majority of the other waste is generated from or due to analysis. Tritium is distilled into xylene for scintillation counting. These are disposed of by incineration at the TWC facility. Disposable equipment used in analysis is disposed of as radioactive solid waste.

(c) Materials Management

Materials Management keeps account of the radioactive and carcinogenic materials at the Laboratory. Materials Management operations consist of the recycling and recovery of usable substances from waste materials generated at LLNL. The major activity of Materials Management related to the handling of relatively large quantities of hazardous materials is the recovery of silver from photochemicals. This operation is performed in B404, near the south boundary of LLNL.

The silver recovery system consists of an automated process whereby a cathode collects silver in a photochemical solution. The cathode with silver is sent to a silver reclamation facility off-site, and the depleted photochemical solution is sent to TWC for disposal.

Ashes from unclassified negatives and film that are burned at the

incinerator are also sent to Materials Management, where they are accumulated and shipped to the silver recovery facility along with the silver cathode shipments.

(d) Health Services

The health services operations, located in B310, generate a small quantity of wastes, mostly 5-gallon carboys of reagents or solvents. The building has a decontamination facility for emergencies including HEPA filters and a retention tank. Miscellaneous acids are disposed in carboys that are sent to TWC.

Other wastes generated at the facility consist of biological wastes that are segregated and disposed of through TWC.

3. Engineering Program

A. History of Operations

The oldest buildings in the engineering program are B511, B516, B405, and B401. Building 405 was used for a storeroom, and still is today. Building 516 started out as a storage area and has had many operations including electronics and temporary laboratory and shop activities. Assembly and repair of aircraft was done in B511 during the Naval air stations tenure on site. Though no documentation exists of operations and materials used in this building it is fairly certain that oils and solvents were used in the machine and repair work. This area drained to the west and possibly to the north.

When California Research and Development took over the site B511 became the main shops and crafts area. Through the years, heavy machinery has been parked and worked on in the area. The pipe shop, maintenance machinists, alarms crew, paint shop (today in B418), plumbers and other groups have operated out of this building. There have been drum storage racks in different places around the building. There are no records of materials stored on these racks, but it is likely that they contained solvents and oils, among other materials.

At the northeast corner of the building, trucks were washed down with diesel and trichloroethylene. The liquids would drain down the storm drain located nearby. Solvents were also used to rinse out grease stained garments. In about 1970, a 3000-gallon diesel tanker ruptured and spilled down the storm drain. These spills could have caused soil contamination in the areas that the enclosed storm sewer opened up into an unlined ditch.

In about 1972, the plumbers shop put bright dip acid tanks on the asphalt on the east side of the building (north of B514), to treat metal pipes. Nitric and chromic acids were used. There were a number of large spills near the beginning of the operations. After that there were small leaks from the tanks and the final rinse of the pipes was done on the ground.

The rinse water flowed to the storm drain north of the area. Rainfall washed off the accumulated leaks. The soil in this area could be contaminated with metals.

The boiler plant, built by the Navy, has always been located in B401. Further investigation is needed to determine the disposal route for the water from the boiler plant. It could have been connected to the sanitary sewer or the storm drain. Boron nitrate was used in the water treatment.

The swimming pool was built by the Navy, as an emergency water supply. The backwash water from the filters have always drained to the storm sewer.

There have been six cooling towers on site. Two located north of B212 were removed in the early 1970's. The water from the towers and treatment of the towers drained to the sanitary sewer until 1968. It was re-routed to the storm drain to avoid any discharges that would compromise the operations of the Livermore Sewage Treatment Plant. LLNL received a NPDES permit to discharge to the ground in 1973. The towers were reconnected to the sanitary sewer in 1975. This was acceptable to the Livermore Sewage Treatment Plant and avoided installing costly monitoring equipment.

The chemicals used in the cooling tower operations of the towers varied. Some records of chemical use are kept by Henry White Jr. of Plant Engineering. Company product names were used, so the records alone do not present the chemicals used. Further investigation is necessary to determine the types of treatment chemicals used while the water drained to the storm sewers.

Building 131 was the warehouse for supplies in 1957. In 1960, the printed circuit board fabrication operation was in room 1535-7. Some of the chemicals used in two degreasers and one developing tank were: TCE, ferric chloride, lacquer thinner, sodium hydroxide, nitric acid, Shipley Lead/Tin (a mixture of lead, tin and fluoroboric acid), and acids. About 25

gallons of TCE were used per week. The rest of the materials was ordered in bottles.

The drums used in this area were stored at the west end of B131. Acetone, MEK, TCA, TCE, and oils were stored there.

From 1958 to 1960, the liquid waste was poured into pits by the old ammunition bunkers, shown on Figure II-2. From 1960 to 1970 waste was poured down the drain. In about 1971, a 4000- gallon concrete sump was constructed north of the north loading dock. The waste was pumped out of the sump by a chemical hauling company. The sump is used today to retain Laboratory rinsewater for testing before release to the sanitary sewer. The concentrated waste was collected in drums and staged in an area near the sump until 1980. In 1975, trichloroethylene was replaced by 1,1,1 trichloroethane.

The pipes in B131 were not built to withstand acids. In two areas the pipes dissolved and the acid-rinsewater drained into the gravel bed below the building until the operation moved to B141. No solvents were used in these areas.

The shop moved to B141 in 1980. Three above-ground retention tank systems, to hold rinsewater, were built on the east side of the building. The area is concrete and bermed. The floor of the shop and the sinks drain to sumps that are pumped to holding tanks. The contents of the tanks usually are pumped out by TWC and treated. In the event of an accidental overflow, the chromic system fills up and the sump overflows. This is held in the concrete bermed area, but it has appeared that liquid drains out in the area above the liner in the sump.

Drum storage was on the south east side of the building. Kerosene, paint and lacquer thinners, TCA, mineral spirits, and oil were stored. Trichloroethylene has never been used at B141. Chromic-sulfuric acid has replaced the use of ferric chloride, and zyanine is no longer used.

All the high pressure testing for the Laboratory is done in B343 which was built about 1960. There has always been a machine shop located here. Next to this building is a 100 foot deep test hole. It has a concrete base and a steel casing to the top. It was used for pressure testing for two to three years in the early 1970's. A vessel with some oil left from the hydraulic system, is all that is left of the testing system. A sample of the oil was taken at the top, and 10 ppm of PCB was detected. The vessel does not appear to be leaking.

Building 321 was built in 1954. Since that time there have been machine shops located in this building. Metals, depleted uranium and beryllium are worked on. There have been large quantities of oils, coolants and solvents used in this area. One interviewee mentioned machine shop spills in the northeast corner of the complex. Drum racks have stored these materials on the south and east sides of the building. Before 1960, there was a drum rack located along the east side of B321A outside of room 1116. The storm drain east of room 1126 probably received a fair amount of spilled coolants and oils. North of room 1247, there was a degreaser by a gravel sump. This area was also used to clean paint brushes. South of room 1200 is an area where oils were reportedly disposed of.

A paint shop was located in B321 from before 1959 to about 1977. Toluene, Stoddard solvent, and paint stripper was poured down the drain.

When the plating shop was located in B321, it stored chemicals on the loading dock outside of room 1152. To the north of this room there was a sump to collect plating shop waste. The floors were concrete, with trenches that connected to the sanitary sewer. Any spills on the floor of the shop were tested, if caught in time; otherwise the spill went to the sanitary sewer.

In 1970, after a plating shop release to the sewage treatment plant, an ion exchange plant was built. One of the sumps by the ion exchange plant was used to collect concentrated waste to be pumped out. The other two were used for regenerating the ion exchange columns. These sumps have held

caustics, acids and dissolved metals. After treatment, the water is released to the sanitary sewer. The spills outside the ion exchange plant have involved dilute rinsewater that has overflowed the system.

In 1976-1977 the plating shop moved into the old sheet metal shop (B322). All tank and floor drains are sent to a sump on the east side of the building, which pumps the contents to a 5000-gallon above ground tank. Cyanide waste is collected in a separate waste retention system. The waste is pumped out by an off-site chemical hauler. The rinse water is sent to the ion exchange plant. The types of chemicals used in this area have been: nitric acid, sulfuric acid, phosphoric acid, hydrochloric acid, chromic acid, potassium cyanide, potassium hydroxide and hydrogen peroxide. The materials used have been stored inside, in the yard area outside the shop, and in storage transportainers outside.

B. Current Operations

Currently the Engineering Program at LLNL consists of (a) Plant Engineering (PE), (b) Electronics Engineering (EE), and (c) Mechanical Engineering (ME) Departments. The involvement of each department in the generation and handling of hazardous substances and wastes is described in this section.

(a) Plant Engineering Department

The operations group of the PE Department is responsible for the operation, maintenance, and repair of LLNL equipment and facilities. The following operations controlled by PE are potential sources of involvement with hazardous substances or wastes: (1) the low conductivity water (LCW) stations, (2) the swimming pool, (3) the steam plant, facility boilers, and standby generators, (4) the paint shop, (5) the crafts shop, (6) heavy equipment and maintenance, (7) pest control, (8) the propane plant, and (9) the electrical substation. Each of these operations is discussed separately in this section.

(1) Low Conductivity Water Stations

LLNL has two LCW stations, located in B291 and B325. Building 291 serves the area north of 5th St.; B325 serves the remainder of the site. Using nearly identical equipment and methods, the stations produce LCW by processing city water with ion exchange columns. The facilities, summarized in Table IV-6, are regeneration wastes from the ion exchange columns, and back wash water from anthracite filters and ion exchange beds.

B291. In B291, wastewater from the backwash of ion exchange columns is directed to a 3000-gallon underground retention tank. The contents of the tank are sampled and analyzed for radioactivity, pH, and metals when full, then pumped out by a commercial waste hauler. Discharges to the sanitary sewer consist of blowdown water from the cooling towers, backwash water from the anthracite filter, and condensate/blowdown water from air traps on water lines. An underground tank for the storage of diesel fuel, a PCB-contaminated transformer, and drums of acids and caustics used in the water treatment process are also at the B291 site.

B325. Building 325, which is an older facility, has an underground retention tank with the capacity to store waste from only one regeneration, so the contents of the tank are pumped to an above-ground 19,000-gallon storage tank. The liquid is hauled to a commercial liquid waste disposal site. Discharges to the sanitary sewer include cooling tower blowdown and rinsewater from the cooling tower screen. The backwash from the activated carbon filter and other filters is currently diverted to the storm drain. Funds are being requested to re-route the discharge to the sanitary sewer.

(2) *The Swimming Pool*

The swimming pool chlorination and filter systems are located in B318. The filtering system consists of sand filters in conjunction with the chlorination system, which adds hypochlorite liquid to the pool water. Approximately 80,000 gallons of water are periodically backwashed through the filter to the storm drain. Funds are being requested to re-route this discharge to the sanitary sewer.

(3) *Steam Plant, Facility Boilers, and Standby Generators*

The central steam plant facilities, located primarily in B401, have a total of five boilers that principally serve the southern portion of the LLNL site. Smaller gas-fired units serve many buildings and complexes throughout the site. The boiler operations involve handling minor amounts chemicals and the use of diesel fuel. Standby generators, located throughout the site, are used for electricity generation when regular service is interrupted. The discharges and waste handling aspects of boiler and standby generator operations are summarized in Table IV-7.

The relatively few discharges originating from the steam plant are discharged to the sanitary sewer. Several times a year the water softeners are backwashed and the effluent disposed of in the sewer. Boiler water blowdown is also directed to the sewer, about twice a month, after being allowed to cool in a concrete underground retention tank.

(4) Paint Shop

The paint shop, located in B418, provides complete painting and surface finishing services to LLNL programs. A summary of the shop's involvement in the handling and generation of hazardous wastes is in Table IV-8.

All hazardous wastes from the paint shop operations are retained in suitable containers for shipment to TWC. These materials consist primarily of oil-base paints, solvents, regular thinners, and hot thinners (e.g., xylene, toluene, MEK) which are collected in the waste staging area for TWC. Water that is circulated through the wet spray booths is directed to a sump located outside the building. A caustic powder is added to the recirculating water in the booth to keep the paint residue in suspension. In the sump the paint residue settles out to form a sludge in the bottom of the sump. The sludge is collected as waste and the rest of the contents of the sump are released to the sanitary sewer about once a month.

Filters used in the dry paint booths are changed weekly and disposed of in the sanitary landfill. Sand, mixed with metal grit from the sandblasting operations is collected in drums and picked up by TWC for disposal.

(5) Crafts Shops

The crafts shops, located in B511 contain a wide variety of activities supporting LLNL programs: materials and equipment storage; road maintenance and trash collection; machine maintenance shops; soldering shops; electrical motor shops; sheet metal shops; pipe shops; welding shops; and refrigeration shops. Hazardous materials and wastes handled or generated in crafts shops activities are summarized in Table IV-9.

Most of the crafts shops produce relatively small amounts of hazardous wastes, the most common resulting from the use of acid dip tanks for cleaning metal surfaces. This operation uses two tanks, one containing chromic acid and the other containing nitric acid. The handling and disposal of the acid is performed by TWC. The amount of effluent to the sanitary sewer is small since the tanks are used infrequently and only a small amount of rinsewater is necessary. There are drum racks located on the east and south sides of B511. The pipe shop uses a series of dip tanks located in the area east of B511 and north of B514. The final rinse is done on the ground.

(6) Heavy Equipment and Maintenance

The heavy equipment and maintenance facility, located in B519, handles maintenance and repair for all non-automotive motor vehicles and equipment. Operations at B519 consist of degreasing, lubricating, and machining of metal parts and engine components. Many machines are parked to the south of the building. There is a drum rack located there also.

The type of hazardous materials and wastes used at the heavy equipment and maintenance facility are summarized in the Table IV-10.

Most of the hazardous materials and wastes are segregated during generation and use for collection and treatment by TWC. Waste oil from this facility is normally recyclable and is handled by reclamation and storage.

(7) Pest Control

LLNL conducts an extensive pest control operation at the Livermore site, using applicators certified by the State of California. Most of the facilities related to the storage, handling and mixing of pesticides are in the southern part of the site. Building 520 is used for pesticide storage and B515 for a pesticide mixing shelter. There is also a small temporary pesticide storage shed just south of the cooling tower at B291. The inventory of hazardous materials and wastes related to pest control is contained in Table IV-11.

Most of the pesticides at LLNL are kept in small quantities. There are no discharges of pesticides other than the planned and controlled application of the pesticides on the grounds.

When the pesticide containers are empty, the pest control personnel triple-rinse the containers into the large mixer to be used. The clean containers are disposed of at the Pleasanton Municipal Disposal Site according to the requirements of the State of California. Left-over pesticides are turned over to TWC for disposal.

(8) Propane Plant

The propane plant does not generate hazardous wastes. Ethylene glycol is used in a water bath to lower the temperature of the boilers at the propane facility. There are no other liquids or wastes involved in the processing of propane.

(9) Electrical Substation

The electrical substation does not generate hazardous waste. At the battery facility located in B510 new batteries are on standby and are expected to be used for only brief periods as an uninterrupted power supply for the TWC area.

Battery maintenance and new battery preparation are performed in the south end of B419. Batteries are purchased dry and filled with acid at a sink that is connected to an underground fiberglass retention tank.

(b) Electronics Engineering Department

Two facilities of the EE Department are involved in the generation and handling of hazardous materials and wastes: (1) the solid state devices operations and, (2) the electronics fabrication and pulsed power operations. Table IV-12 summarizes the materials and wastes related to these operations, which are discussed separately in this section.

(1) Solid State Devices

The primary operation of the solid state devices area, located in B131, relating to the generation and handling of hazardous materials and wastes is the production of solid state integrated circuits. Circuits are composed of silicon and gallium arsenide, and are produced for specialty purposes, in small quantities.

The amount of waste discharges from the solid state devices operations is small due to the low production level. Waste solvents such as alcohol, MEK, and acetone are collected in small containers; chlorinated solvents, such as TCE, are segregated from non-chlorinated solvents. TWC collects and disposes of the solvents. Rinsewater from the silicon area goes directly to a retention tank.

(2) Electronics Fabrication and Pulsed Power Research

Electronics fabrication activities, located in B141, include the screen printing and circuits manufacturing in the special processing area. Rail gun and pulsed power operations are also located in B141.

The rail gun and pulsed power operations are large users of electricity. To accommodate these operations, several hundred transformers and capacitors, all containing non-PCB

transformer oil, are installed in the building. Small quantities of solvents are used for general purpose cleaning in the area.

A variety of hazardous chemicals is used in the special processing areas: nitric acid, chromic acid, caustic soda, TCE, phosphoric acid, fluoric acid, sulfuric acid, ammonium persulfate, stannous chloride, platinum chloride, electrolysis solution, nickel sulfamate, and gold cyanide. The solutions are used in the preparation of metal surfaces for the manufacture of printed circuit boards.

A large quantity of rinsewater generated as part of the plating and printing operations in B141 are handled in a wastewater retention system located on the east side of B141. Liquid wastes are first directed to a series of smaller sumps, then to the corresponding larger above-ground tanks. When the large tanks are full, the contents are sample for pH, radioactivity, and metals. If the results of the analyses indicate that it is appropriate, the contents are discharged to the sanitary sewer. Batches that exceed the analytical limits are pumped to a portable tanker and directed to the TWC facility.

(c) Mechanical Engineering Department

In the ME Department, the operations that involve the generation and handling of hazardous materials and waste are (1) development and assembly; (2) materials fabrication, machine tools maintenance, and plating shop; (3) engineering testing; and (4) large diamond turning. Table IV-13. summarizes the relevant information, which is described in detail in this section.

(1) Development and Assembly

Operations in the development and assembly area are conducted in B131 and B231.

Building 131 houses a number of laboratories that handle radioactive and non-radioactive wastes and raw materials. The wastes from these operations are handled by segregation and collection of individual drums and by the discharge of liquids to the sanitary sewer or a retention tank.

A relatively small amount of reagents and chemicals are disposed of by operations in B131. The discharges consist of photo-reversal bleach, dry mercury-contaminated waste, and dry depleted uranium-contaminated waste, all collected in 55-gallon drums; and chlorinated and non-chlorinated solvents and miscellaneous liquid wastes, collected in 5-gallon carboys.

The development and assembly operations that are housed in B231 are discussed in Section IV-4, Chemistry, since B231 is administered by the Chemistry and Materials Science Department.

(2) Materials Fabrication, Machine Tools Maintenance, and Plating Shop

The materials fabrication, machine tools maintenance, and plating shop areas are centralized in B321 and B322 and provide fabrication services for all LLNL programs. These areas use a large amount of solvents, lubricating oils, and cleaning materials. The storage area for these materials is the largest such facility at LLNL.

The most significant discharge from the area is the wastewater discharge from the ion exchange plant at B322. Concentrated spent plating solutions and concentrated dragout and pre-rinses are collected separately from rinsewater and treated at the TWC liquid waste facility or by a commercial facility approved by the State of California. Only dilute rinsewater goes through the ion exchange plant. Cyanide wastes are routed to separate tanks. Plans to decommission the ion exchange plant and replace it with a combination of pH adjustment, spill diversion, and alarm and monitoring systems will be implemented in 1985.

Other discharges at these facilities consist of the disposal of waste solvents, lubricants and oils, plastics and resins, and radioactive solids. The waste solvents are segregated according to chlorinated and flammable materials and placed in a staging area at the east side of B321. At the northeast side of the building, beryllium materials and low level radioactive solids and liquids, primarily depleted uranium chips and coolant, are containerized in 55-gallon drums or 5-gallon carboys for removal by TWC.

The arc welding shop uses a 1500-gallon above-ground tank that accumulates resins and water. The ceramics shop uses two retention tanks that collect low level radioactive rinses. The contents are discharged to the sewer if the analytical results

indicate that the tanks have acceptable concentrations of the appropriate parameters.

(3) Engineering Testing

The major operation in the non-destructive evaluation facility located in B327 that relates to the generation and handling of hazardous materials and wastes involves the use of photo processors in the basement of the building. The high pressure facility located in B343 also has activities that generate hazardous materials and wastes.

Photo rinses from the non-destructive evaluation facility are disposed of to the sanitary sewer. The developer and fixer solutions are retained separately for materials management for the recovery of silver. Rinsewater from emulsifiers and fluorescent penetrants are also discharged to the sanitary sewer.

Testing facilities at B343 generate a small quantity of hazardous materials and wastes consisting mostly of spent solvents such as acetone, kerosene, and MEK; and hydraulic and cooling oils. TWC recovers these wastes from a waste staging area.

(4) Large Optical Diamond Turning Facility

The machinery and equipment in the large optical diamond turning facility use a variety of oils and solvents. Most of the wastes are segregated for disposal by TWC. There are no discharges of oils or solvents to the sanitary sewer.

4. Chemistry Department

A. History of Operations

Most of the buildings in the Chemistry program were built in the 1950's or early 1960's. Building 222 was built in the early fifties and had three more additions added in the same decade. It housed general, analytical and radiochemistry operations. Most laboratories had back doors and workers would pour small quantities of acetone, isoprene, and trichloroethylene outside. The TCE was used in cold traps mixed with dry ice. It is likely that over the years many different chemicals were rinsed down the drain in small quantities at a time. A blueprint from 1958 shows a sump in B222. One employee remembers that it was disconnected and filled with sand in 1968. It was probably used for Laboratory rinsewater waste.

At one time, behind B222, there were ten 1000-gallon retention tanks, and one vertical 1500-gallon tank, used for radioactive waste treatment. Further investigation is needed to learn more about this operation.

An acid dissolver for nuclear chemistry procedures was located in B224, until the early 1960's when the operation was moved to B151, along with the radiochemistry laboratories. Nitric, hydrochloric, hydrofluoric, as well as other acids were used to dissolve radioactive materials.

The other small buildings around B222 were built at different times and used for high explosives chemistry laboratories or storage. Building 223 contained tracer fabrication laboratories in the late 1950's. This operation was moved to B251.

Development and assembly of devices has been done in B231 since the late 1950's when this building was built. The gaseous chemistry laboratory (tritium work) was in the southeast wing of the building before B331 was built. Lithium hydride and uranium were also used in this area of the building. Machine, electronic, plastics, resins, and welding shops operate in B231. The plastics shop has been located in the south east portion of

the building. There was (and still is) a tank of methylene chloride located outside the shop to dissolve resins from parts. The buildings around B231 (B232, B233, B234) were built in the mid-1950's.

Building 234 has records that say it was used for scientific photography, and as a cryostat in 1957. One employee remembered the chemists in B231 pouring chemicals into the ditch 30 ft east of B234, during the 1960's. More research in this area is necessary.

Building 241 was built in 1960 for the nuclear ramjet missile project (Pluto project). Work in the building has involved beryllium, uranium and thorium. Hydraulic fluid (possibly containing PCB'S) was also used in the building. The work was done in gloveboxes. In the early 1970's there was a thorium spill inside the building. There have been two machine shops: one for radioactive work and one for clean work. The hazardous materials and wastes associated with the shop have always been stored on the south side of the building.

The Gaseous Chemistry Building (B331) was built in increments in 1958, and 1962 ("Increment I"). Tritium work is done in this building. None of the waste was ever poured down the drains. It was always collected in carboys. Until 1978, this waste was evaporated in trays on the old taxi strip described in Section V-3. The mop water left from washing the floors has always been monitored and released to the sanitary sewer in a controlled manner. The amount released has not exceeded 15 mCi per year. Vitrified clay pipe connected the vacuum aspirators from all the laboratories in Increment I, and connected to a drywell located northwest of the first structure. It was 6 feet deep, and 5 feet across. Contaminated vacuum pump oil was sampled individually and sent to TWC. The main effluent release from this building is the gaseous release of tritium through the 30 meter high stacks. The stacks are monitored and the amounts released are documented in the LLNL Yearly Monitoring Reports (Griggs 1984).

Building 332, listed as metallurgical chemistry operations, has been designed for plutonium work. The wastes are collected and sent to TWC for disposal. The building has retention tanks to collect the rinsewater from the laboratories. This effluent is sampled and assessed before release to sanitary sewer or transfer to TWC. The drum rack has been situated to the west of the building. There was a plutonium spill in the B332 yard. It was immediately fixed in place to avoid dispersion and later the area was excavated and disposed of as radioactive waste.

B. Current Operations

The current Chemistry and Materials Science Department consists of several divisions that conduct activities involving liquid and solid wastes, and radioactive materials: (a) Analytical Chemistry and Physical Chemistry; (b) Surface Science and Materials Characterization; (c) Polymers and Composites Technology; (d) High Explosives Technology; (e) Ceramics, Corrosion, and Thermochemistry; (f) Physical Metallurgy; and (g) Tritium Technology and Plutonium Technology. In addition, the development and assembly operations of the Mechanical Engineering Department (h) that are in B231 are included in this section. A summary of the major hazardous waste management facilities is given in Table IV-14.

(a) Analytical and Physical Chemistry

Operations of the Analytical and Physical Chemistry Division are in laboratories in B222 and B227. The experiments and analyses performed require the use of a variety of solvents and chemical reagents. However, solvent and chemical usage is typically in small (i.e., squeeze bottle) applications. Radioactive materials are handled by the Analytical and Physical Chemistry laboratories.

Protective equipment (e.g., hoods, glove boxes) is HEPA filtered and sinks are plumbed to a retention system. Table IV-15 presents the radioactive wastes and materials handled in these operations

(b) Surface Science and Materials Characterization

Operations of the Surface Science and Materials Characterization Division are in several buildings: B222, B231, and B241.

Laboratories in B222, B231, and B241 use a variety of solvents and chemical reagents for experiments. Most of the amounts of chemicals are segregated in 5-gallon carboys and retained for disposal. These containers are filled and placed in designated waste staging areas at the buildings.

All sinks in B222 with the exception of the northwest wing (1400 wing) are connected to a retention tank system located east of the building. Two tanks are in the system; one tank is allowed to fill within 80 inches of the top before the system is switched to the other tank. A sample from the "full" tank is then analyzed for pH, radioactivity and metals, and the contents are usually discharged to the sanitary sewer. TWC arranges for a pump-out of the tank if the sample fails to meet the minimum specifications for a direct discharge to the sewer. The 1400 wing goes directly to the sanitary sewer. The waste aging area for containers is located east of B221. This area is described in (d) High Explosives Technology.

Liquid wastes generated in B231 are directed either to the sanitary sewer or to a retention tank system located on the east side of the building. The wastes directed to the sanitary sewer consist primarily of rinses from plastics and painting operations (small amounts of solvents, resins, and chemical reagents potentially washed in the sinks). Spent plastics, resins and solvents are segregated in drums for disposal by TWC.

Rinsewaters directed to the retention tank system originate in the northeast corner of B231. These liquids have low levels of radioactivity, as well as levels of heavy metals. Wastes from the

building are first discharged to a concrete sump. The sump is connected to one of two 1,000-gallon retention tanks. The tanks are sampled and analyzed for pH, radioactivity, and metals. Wastes meeting the disposal criteria are discharged to the sanitary sewer.

Containerized solid and liquid wastes are collected in a waste staging area on the east side of the 1500 wing of the building. The wastes consist of drums of solvents and acids, D-38 metals, and sodium wastes. An oil drum storage area is located at the north side of B231 near the 1900 wing.

Building 241 contains a number of small laboratories: preparation laboratory for the TEM, metallography laboratory, coating laboratory, crystal-growing laboratory, and particle characterization. A machine shop is also located in the building. These facilities use a variety of hazardous materials, including chlorinated and non-chlorinated solvents, oils, metal powders, and acids and caustics. Selected sinks in building are connected to the retention tank system.

This system consists of a concrete/brick sump connected to two above-ground steel retention tanks. The sampling and analysis protocol for this system is identical to the systems described above for B222 and B231. The waste staging area for the building is on asphalt, and contains drums for chlorinated and non-chlorinated solvents.

(c) Polymers and Composites Technology

Operations of the Polymers and Composites Technology Division are contained in B222 and B321. Hazardous materials and wastes generated in this program are described in the paragraphs above for B222 and B321.

(d) High Explosives Technology

Operations of the High Explosives Technology Division are conducted in B224, B225, B226, B227, B228, and B229. A small quantity of hazardous wastes is generated in these buildings. Waste solvents are segregated for disposal by TWC. Several laboratories and store rooms in the buildings are not used.

The major features of interest to the handling of hazardous wastes and materials are the waste staging area for the B222's complex and a drum storage rack located near B221. Waste drums consist of chlorinated and non-chlorinated solvents, TCE, and waste oil. Radioactive solid wastes are generated at the facilities. The rack contains drums of kerosene, alcohol, freon, perchloroethylene, TCE, oil, and acetone.

(e) Ceramics, Corrosions, and Thermochemistry

Operations of Ceramics, Corrosion, and Thermochemistry are contained in B232 and B241. The waste management features and discharges from these buildings have been described in the preceding paragraphs.

Radioactive materials are handled in the laboratories in B241. Protective equipment (e.g., hoods, glove boxes) is HEPA filtered. Sinks that potentially may be rad-contaminated are connected to a retention tank system.

(f) Physical Metallurgy

Operations of the Physical Metallurgy Division are conducted in B231. The waste management features and discharges of this building are identified in Table IV-14 and have been described in the preceding paragraphs.

(g) Tritium and Plutonium Technology

Operations of the Tritium Technology and Plutonium Technology Division are contained in B331 and B332, respectively.

The tritium building (B331) has several small waste management areas located on the east side of the building. These small staging areas contain drums including radioactive solid waste, lithium hydride, and miscellaneous equipment such as vacuum pumps. The main waste staging area for the building is on a concrete pad east of the building. This area has provisions for drums of oil, flammable solvents, and chlorinated solvents. A drum rack underlain by asphalt is also located nearby and contains drums of TCA, acetone, methanol, MEK and freon.

Waste management areas for the plutonium building are located on the west side of B332. Containerized waste staging consists of an asphalt-surfaced loading area that has several drums labeled as chlorinated solvents and flammable solvents. Nearby is a drum storage rack that contains drums of alcohol, oil, kerosene, TCA, and vacuum pump oil. A waste retention tank system is in place at B332. The system consists of two 1,000-gallon steel tanks placed in a concrete vault. The sampling and analysis protocol is exactly like that of the retention tank systems at B222, B231, and B241.

(h) Development and Assembly (ME Department)

Operations of the Development and Assembly Division of ME are conducted in B231. Although this is an Engineering Program operation, B231 is administered by the Chemistry Program.

The development and assembly facilities in B231 include mechanical shops and plastics laboratories, as well as several waste management areas outside of the building. These operations involve the use of a wide variety of hazardous materials, primarily solvents, plastics and

resins, and oils in small quantities. The wastes from these operations are handled by segregation and collection in individual drums. Rinsewaters are discharged to the sanitary sewer or retention tanks. Water management features liquids and discharges from B231 were discussed in (b) of this Section, Surface Science and Materials Characterization.

V. Computations

A. History of Operations

The buildings in the Computations Program are located in the southwest corner of the site. Buildings 218, 219, and 316 were built by the Navy and used for barracks in the early years, and then for offices and graphics. Buildings 115, 116, and 117 have been used for computers. A blockhouse (B215) was built for storing nuclear materials in the early 1950's. In the early 1960's it was converted for storing classified records. Building 113 was built in 1965 for computer applications. For the past few years a microfische developing operation in B113 has been disposing of photochemicals to the sanitary sewer.

B. Current Operations

Operations in the Computations Program are housed in B113, B115, B116, B117, B215, B219, B316, B451. The only operation of the program that deals with hazardous materials and wastes is in B113, the photo processing facility. The fix bleach, which is high in dichromates and has a low pH, is delivered and stored in 55-gallon drums in the basement of the facility. Waste reversal fix bleach generated from the microfische process is collected in 55-gallon drums and picked up by the TWC group for disposal.

6. Energy and Resources

A. History of Operations

Buildings 410 and 417 (old B160c and B160d, respectively), in the southeast section of the site were built in 1962. These have been used for central stores and glovebox storage. In the west-central portion of the site, B243 (old B173A) was built in the late 1950's and used for assembly for the Pluto Project. This project was involved in the development of the reactor for a nuclear ramjet missile system. By 1967 it was used for engineering diagnostics, which probably involved electronics laboratories and a machine shop.

Oil shale is being stored in the northeast corner of the Laboratory. It is set on an old electric car runway that is no longer being used. This area was leased to local ranchers and farmers for cattle grazing in the early days of the Laboratory site.

B. Current Operations

The Energy and Resources Program uses the facilities of the Earth Sciences Department, including B243; B410, the oil shale processing facility; and the oil shale storage and rock crusher area in the northeast corner of the site. These operations involve the generation of relatively small quantities of hazardous wastes.

B243. The major facility at B243 that generates hazardous wastes is the machine shop, which uses small quantities of solvents and a metal cleaning operation. A small drum rack outside of the building contains solvents such as TCE, kerosene, alcohol, and methanol. An unused sump is also located outside of the building. All sinks in the building discharge to the sanitary sewer.

B410. Oil shale processing performed in B410 generated dust as a result of the crushing and sizing operations. Drums filled with rocks are stored

outside of the building and are on a concrete pad. Other drums of oil shale are stored at the northeast corner of the site near the rock crusher.

7. Biomedical

A. History of Operations

The oldest building in the Biomedical Sciences Program is B412, which houses biomedical laboratories and hot cells. After construction in 1945, it was used for large aircraft inspection. It is likely that oils, grease and solvents were used in this building. Cells were built in this building, by CR&D, to house large hardware for chemical engineering work. In 1953-54 Pratt and Whitney leased this building and converted the cells into hot cells for metallurgical research using Uranium. In 1964, the Pluto Project moved in and used the cells for engineering tests, using Uranium-235. Very little liquid was used because it had to be handled as radioactive waste. There were two pits inside used to store radioactive waste in drums. The drums were stored in pits to protect workers in the building from external radiation. The outsides of the drums were not contaminated and there were no leaks. Another pit was built to house radioactive sources but was never used by LLNL.

From the mid-1950's through the mid-1960's, on the east side of the building, solid radioactive waste was placed in barrels and capped off with concrete before shipment off-site. Any material too large to fit into drums was placed in large concrete blocks and capped off with concrete. These were all stored to the north of B412. Some spills would occur in the work area; however, these were cleaned up that work in the area could continue.

Drums of solid radioactive-contaminated material from the Bikini Islands were also stored north of B412. Though it was not a commonly used area for storage of hazardous liquids, one employee remembers some areas where it looked as if oil leaked onto the ground.

The cow and sheep barn was built in the mid-1960's. Experiments were conducted to study the biological cycling of radionuclides in cows. Any contaminated biological waste was sent to TWC. A few of the non-

contaminated animals were buried in the northeast corner of the site. These were never buried deeper than 20 feet. The areas where the non-contaminated animals were kept was occasionally hosed down into the storm drains.

The rest of the Biomedical Sciences laboratories were built in the 1960's and 1970's. A machine shop was built in 1977 (B376). The marine biology laboratory (B377) houses large tanks of seawater.

In 1974, a garden plot was constructed in the northeast corner of the Laboratory to study the resuspension of plutonium-contaminated dust and the uptake of plutonium into agricultural plants. An incident during June 1967 provided plutonium-contaminated sludge for use as fertilizer in the garden plot. This incident is described below.

Approximately 32 millicuries of Plutonium-239 was released from LLNL to the Livermore Sewage Treatment Plant, over a three week period in June 1967. The source was never definitely located, but it seemed likely to have been released from the decontamination facility in B514. Essentially all the plutonium was contained in the digested sludge. After an investigation, LLNL, Department of Energy, San Francisco Operations Office and the Department of Public Health decided that the release did not present a threat to the plants, personnel, or the community that used the sludge for fertilizer.

Approximately 13 cubic meters of digested sludge from the Livermore Sewage Treatment Plant was rototilled to a depth of about 14 cm on a 10 meter by 17 meter plot. After the experiment was over the soil was left in place, because it was not considered contaminated even before it was mixed with the clean ground.

B. Current Operations

Biomedical Sciences facilities generate and use a wide variety of hazardous wastes and materials as part of their operations. Most of the

facilities are located in the B361 complex and nearby areas: B361, B364, B362, B363, B365, B366, B376, B378, B379, and B377. Other operations are in B412, B413, and B414. The major waste management facilities (retention tank systems and waste staging areas) are summarized in Table IV-16. Table IV-17 provides a summary of the radioactive wastes generated in the facilities. The following paragraphs provide additional information on the waste generation and disposal activities in the Biomedical Sciences Program.

B361. Building 361 houses a variety of laboratories and offices that use hazardous materials and generate wastes. Small quantities of chemical and reagents are segregated for disposal by TWC. These liquids include low-level radioactive liquids (such as scintillation fluids), dyes for chromosome studies, carcinogenic substances, and minor amounts of solvents and acids. The laboratories designed to do work with carcinogens are connected to a retention tank system. This type of work is not being done in these rooms; therefore, all liquids in the tank are automatically discharged to the sanitary sewer without retention. Previous experience with the discharge has shown that the liquids can be discharged directly to the sewer without sampling. The central waste staging area for the main Biomedical Sciences complex is located on the north side of B361. Most of the wastes in drums and carboys are placed on carboys for pick-up by TWC. Most of the wastes (chromosome dyes, plastic scintillation vials and scintillation fluids, animal carcasses, and solvents) are incinerated at the TWC Facility.

B362. The major waste-related feature of B362 is the retention tank system located east of the building. The system consists of two above-ground steel tanks. One tank is filled from a concrete sump. When the first tank is filled, the flow is transferred to the other tank while the contents of the first one is sampled, analyzed, and discharged to the sewer (if the limits are satisfied).

B365. Handling of carcinogenic substances is performed in B365. Sinks in the building are connected to a concrete sump which in turn is connected

to one of two above-ground steel tanks. When a tank fills a local alarm sounds and a sample is collected and analyzed. Results of the analysis have indicated that the wastes are suitable for discharge to the sanitary sewer.

B367. A machine shop is located in B376. Minor amounts of solvents and oils are used in the machining operations. Generally, squeeze-bottles are used for hazardous materials, providing confirmation of the relatively insignificant usage of solvents and oils.

B377. Laboratories related to the conduct of marine biology experiments are located in B377. A waste retention tank system serves several small sinks in the building. Some of the sinks are involved in the handling of radioactive water Carbon-14. In addition, the large tanks containing seawater are connected to the retention system. A small amount of seawater is trickled to the retention system. The retention system consists of two interconnected concrete sumps.

B412. Several small laboratories in B412 are related to environmental sampling performed by the Terrestrial Group in the South Pacific. An abandoned retention tank system is located just south of the building. It was used for the retention of water from "hot cells" in the building. The experiments using these cells are no longer active and the cells have been sealed off. West of the building is the waste management pickup area and drum rack consisting of drums of acetone, MEK, alcohol, vacuum pump oil, kerosene, and waste oil. These drums are stored in a rack placed on concrete under shelter.

8. Physics

A. History of Operations

Building 212 was built by the Navy and used as a drill hall and gymnasium. Since the late 1950's, the building has been used for accelerator research. An Insulated Core Transformer pit, on the east side of B212, was used for collecting tritiated water. A large white tank, seen next to the building in aerial photographs from 1958 through the early 1960's, was used for liquid nitrogen. It was removed when the company that was supplying the liquid nitrogen lost the contract in 1964. On the west side of the building, there was a plating unit set up to fabricate printed circuit boards. Further investigation is necessary to determine the length of use and the material used.

Machine and electronics shops have operated in this building, therefore, it is likely that oils and solvents were used in this area. In 1976 a 200-gallon concrete pit was installed to catch drips from the drum rack located by the building. This was installed for fire protection.

Building 194 was built in the late 1950's for accelerator physics work. There have been small machine shop operations located in this building. The hazardous oils and solvents used in this building have been associated with the machine shop.

The Rotating Target Neutron Source is located in B292. This building was constructed in the 1980's to house accelerator research. The waste that has been produced in B292 mainly involves tritium contamination. Liquid and solid waste have been monitored and sent to TWC. If the water is at an acceptable level, as determined by the Department of Energy Order 5480.1, the water is released to the sanitary sewer.

B. Current Operations

The operations of three divisions within the Physics Department were reviewed for this report: the Materials Properties Division, the Experimental Atomic and Nuclear Science Division, and the Rotating Target Neutron Source Experiment (RTNS-II). The operations of the three divisions are carried out in B194, B212, B292, and B182. The divisions share waste management facilities.

Characteristics of the facilities that handle wastes and raw materials are summarized in Table IV-18. Characteristics of the wastes generated by the operations are summarized in Table IV-19. The facilities are discussed in detail, by building, in this section.

B194. The operations in B194 that relate to the handling of hazardous materials and the generation of wastes involve 1) the transformers in the modulator building for the accelerator and 2) the machine shop.

The modulator building has many transformers and capacitors, several of which have PCB levels in the 7-15 ppm range. Only sealed capacitors and non-leaking power supply systems contain oil with residual ($\frac{1}{2}$ 50 ppm) PCB contamination. The modular tanks contain only conventional oils. In the same general area as the modulator is the LCW cooling water system. The sump that collects minor leaks from the system is connected to a retention tank outside of the building.

The machine shop, in which a variety of solvents and oils is used, is the other significant source of hazardous materials and wastes in B194. The waste staging area and drum rack for the complex is located outside, west of B194. Wastes include radioactive materials and waste oil. Liquids stored in the drum rack include freon, kerosene, alcohol, and acetone.

B212. The operations in B212 do not generate significant amounts of kinds or non-radioactive hazardous wastes. All sinks in the building, including those in the radioactive work areas, are connected to the

sanitary sewer. Machine shops in the building use minor amounts of oils and solvents. Chromic and nitric acid dip tanks for metal cleaning are closed systems and are serviced by TWC. A large amount of non-PCB insulating oil is used in capacitors, which are new. The retention tank system in B212 is connected to sumps in the pits that house the cyclotron and other radioactive experiments. Seepage, including rad-contaminated oil collects in the sumps and is pumped to the 1000-gallon retention tank. Other radioactive wastes include contaminated equipment and solid wastes from handling radioactive materials.

B292. Operations in B292 related to RTNS-II do not generate a significant amount of non-radioactive hazardous waste. Sinks in the building discharge directly to the sanitary sewer. Only the floor drains are connected to the underground retention tank system. The machine shop in the building handles most of the nonradioactive hazardous materials, mostly solvents, lubricants, and oils. These materials are stored outside the building on a concrete base in a drum rack. The rack contains acetone, oil, and alcohol.

Radioactive wastes from B292 operations include tritium-contaminated solvents, spent tritium targets, and mole sieve cylinders from the catalytic scrubber. The tritiated solvents are collected for incineration by TWC. Targets and cylinders are packaged according to DOT requirements and shipped to NTS for disposal.

B182. Small quantities of exotic gases are used as part of a semiconductor research operation in F182. The waste cylinders are handled by TWC.

9. Lasers

A. History of Operations

Many of the Laser buildings in the northwest portion of the site (160 and 170 series) were built in the late 1950's and early 1960's. They were first used in the development of a reactor for a nuclear ramjet missile system (Pluto Project). The materials used were uranium and beryllium. There was a machine shop located in B176 and/or B171. Solvents were used in this area. The buildings were built on top of the asphalt runway. Most of the time, the liquid waste was collected in carboys and sent to TWC. One employee working in the area in 1958 saw a bright dip tank containing chromic and nitric acids, and dissolved metals drained onto the ground. This occurred where B174 is today. According to another employee, the wastes were normally collected in carboys and sent to TWC; however the tanks may have been rinsed out onto the ground.

In 1970, the Laser Program moved into B171, B174, B177 and built B161. Research on a chemical laser was conducted in B177. Many toxic and explosive chemicals were used. They were stored in ventilated transportainers and huts. No reports of spills of these materials were found. The wastes were sent to TWC.

Construction of the Nova Laser Project (B381) and the offices (B481) started in 1979. Building 298, for use in target fabrication research, and the machine shop (B383) were built in 1980.

Also, B175 and B178 were built in the late 1970's or early 1980's, for use in laser isotope separation research. The Special Isotope Separation Laboratory (B490) has just been completed. The hazardous materials that have been used in these areas are oils, solvents and laser dyes. The laser dyes are stored inside of the facilities and disposed of as carcinogenic waste by TWC. The machine shop maintained drum storage racks as a means of storing oils and solvents commonly used in machining operations. In addition, the isotope separation operations have used

depleted uranium in experiments. Any radioactive waste is sent to the TWC group.

B. Current Operations

The operations of the Lasers program that are pertinent to this report are the Inertial Confinement Fusion (ICF) program and the Laser Isotope Separation (LIS) program, which are discussed separately in this section. These programs have separate facilities and different waste profiles, which are summarized in Table IV-20 for hazardous wastes and materials and in Table IV-21 for radioactive wastes.

Inertial Confinement Fusion

Most of the ICF operations are in B391 (Nova, Shiva) and B298 (target fabrication). Other support operations are in B383, which houses the machine shop. Hazardous materials and wastes in the ICF program consist mostly of chlorinated and non-chlorinated solvents, various chemical reagents, and machining oils. For the most part, the quantities of hazardous materials and wastes are small. Solvents are segregated for disposal by TWC, but rinses and sodium hydroxide-based developers are directed to the sanitary sewer.

Radioactive materials are used in several operations, such as the tritium handling operations in the development of micro-balloons for target fabrication. Coating laboratories in B391 use a gel solution of tetraethyl orthosilicate (TEOS). Sodium silicate is also used for gel in the production cycle operations in B298.

The machine shop in B383 uses a variety of solvents and oils, such as alcohol, MEK, and acetone, similar to the other machine shops at LLNL. Wastes generated at the machine shop are staged outside of the building on a dirt pad. Waste staging for the B298 complex is located north of the facility. Drums of radioactive and solvent waste are located on a dirt/asphalt base near the underground retention tank system connected to selected laboratory sinks and all floor drains in B298.

Laser Isotope Separation

LIS operations encompass several buildings in the northwest portion of the LLNL site. Current operations are in B175; future operations will be expanding into a new facility, B490 complex. The major waste types associated with the LIS work are laser dyes (primarily rhodamine) and solvents; cleaning solvents; ethanol; phosphoric, nitric and chromic acids in welding and machining shops; non-PCB transformer oils; and various radioactive materials, primarily uranium D-38.

Most of the current LIS facilities are in B161, B166, B169, B171, B173, B175, B176, B177, B179, and B272. The dye laboratories and process laboratories generate small quantities of hazardous materials, mostly spent solvents.

The central waste staging area, east of B161, handles laser dye waste; non-chlorinated solvents; chlorinated solvents; oil; solid radioactive wastes in 55-gallon drums; and liquid radioactive wastes (carboys). A drum storage rack of liquids, north of B165 contains lacquer thinner, TCA, freon, alcohol, kerosene, cutting fluid, acetone, and MEK.

10. Magnetic Fusion Energy

A. History of Operations

When California Research and Development moved onto this site in 1950, it began construction of the Materials Test Accelerator (MTA) in B431, on the air station parking apron. Fusion research has been conducted in this area since the 1950's. In the 1960's, the coil shop (B443) and the assembly and test area and shop (B432) were built. There have been cooling towers and power stations associated with these programs.

To power the experiments conducted in B431, there have been many capacitors installed on the second and third floors of this building. Testing has shown that many of these capacitors contained PCB oils. These type of capacitors have also been set up in B435 and B436. Transformer oil, contaminated with PCB's, spilled inside B436 when a transformer ruptured. The oil was contained inside the building. The power supply that was built east of B431 contains no PCB contaminated oil.

The buildings that support magnetic fusion energy research have operated machine and ceramics shops, mechanical and diffusion pumps that use mercury, and high voltage stations. Over the years probably all types of solvents were used. In recent years freon TF, alcohol, acetone, and trichloroethane have been used. These materials are stored outside prior to use.

In the late 1970's or early 1980's a transformer containing 7000 gallons of mineral oil was pumped out into a certified temporary storage "pillow". The day before it was scheduled to be pumped out, the pillow ruptured and 5000 gallons of mineral oil spilled. The next day IT Corporation cleaned up the area, and with the agreement of the State of California, disposed of the soil at a municipal landfill.

B. Current Operations

The Magnetic Fusion Energy (MFE) Program is the second largest program at LLNL. LLNL does a significant part of the worldwide theoretical and experimental work on magnetic fusion and operates the National Magnetic Fusion Energy Computer Center.

The MFE program is carried out for the most part in B438, B443, B431, B432, B435, B436, and B423. Construction of the Mirror Fusion Test Facility (MFTF) begun in 1980 is still going on. The facility is expected to be ready for testing in 1986 and for start-up of full operations in 1987.

Waste management facilities, consisting of waste staging areas and drum storage areas are summarized in Table IV-22 and are discussed in greater detail in this section.

B438. Operations in B438, the fabrication shop, include a small plating shop for the manufacture of printed circuit boards, and facilities for cleaning and painting metals. The plating shop uses an automated process that generates a combination of acids and metal finishing rinses. The spent solutions are containerized for disposal by TWC; the rinsewater goes to the sanitary sewer. The metals cleaning and painting operations generate a variety of liquid wastes consisting of nitric and chromic acids; chromate, fluoride, and sulfuric acid compounds; paint wastes; and solvents. A waste staging area is located north of the building. Wastes include sulfuric acid; solvents (TCE); and a ferric chloride etching solution. Floor and sink drains in the building are connected directly to the sanitary sewer.

B443. Building 443, the coil shop, generates several waste types: chromic and nitric acids from the metals cleaning operation, which are disposed of by TWC; epoxy wastes; cutting and lubricating oils from the lathes and other machinery; and minor amounts of solvents. Drums of kerosene, alcohol, and epoxy are stored outside of the building. In addition, a drum storage rack is located northwest of the building on a concrete base.

B431/B432. Currently undergoing renovation for the MFTF experiment, B431 has a drum storage rack located at the southeast corner on a concrete base. Materials stored include MEK, cleaning soap, TCE, oil, and acetone. Some of the waste oil from this area contains low levels of PCB's.

Building 432 is principally a machine shop. Hazardous materials and wastes in this area include chromic and nitric acids in the metal cleaning tanks, which are serviced by TWC, and various oils and solvents used in the operation of lathes and mills. One of several transformers in the vicinity of B432 is reported to contain greater than 50 ppm PCB's.

B435/B436. Building 435 is used primarily for the magnetic fusion experiment. This operation, involving pulse radiation, is self-contained and does not discharge radioactive wastes to the environment. PCB-containing capacitors are located in an unused part of B435. Transformer oil drums are stored at the entrance to the building. A three-drum storage rack is located north of B435. The rack contains mineral oil, alcohol, and cutting oil. A mercury drum is also located outside of B435.

Building 436 is used primarily for storing capacitors. There are no floor drains in the building.

B423. There are no significant sources of hazardous materials or wastes in B423.

11. Defense Systems Program

A. History of Operations

The pool-type reactor (B281) was built in 1955. It operated until March 1980, when the fuel elements were removed. The primary coolant for the reactor was water. There were tanks for coolant, contaminated waste water and the ion exchange columns for coolant polishing. Chemistry laboratories were also housed in the building. No leaks were detected in the system (Stone 1982). However during the lifetime of the plant two spills occurred. In February 1968, a liquid retention tank overflowed and eventually entered the storm sewer system. The Iodine-131 and Strontium-90 contamination was small enough that there was no significant impact on the area (380 microcuries of I-131 and 2 microcuries of Sr-90, (Stone 1982)). The second spill occurred during the transfer of material between retention tanks. Small amounts of Co-60, Co-58, Zn-65 and Cr-51 (a total of 6.6 microcuries) were released into the storm drain. Rainwater diluted the release to an insignificant level (Stone 1982). Corrective actions were taken after the spills. The decommissioning plan that was submitted to the Nuclear Regulatory Commission called for a 5 year cool-down period.

In 1963, B341 was built. This building housed capacitor banks for high energy studies. They were removed in 1972. Any spills that would have occurred were contained inside the building.

Many of the capacitors contained only mineral oil. There was a machine shop in the building that used many solvents and oils. In the 1970's, development of lasers, laser amplifiers, and diagnostics were conducted in B341 by the Laser Program.

Building 121 was built in 1954 for physics research. The south end of the building has been office space. There has been a machine shop located in the center of the building, as well as various photo labs and electronics shops.

Building 151 was built in the mid-1960's for nuclear chemistry operations. Radioactive and chemical wastes have been collected and sent to TWC. The retention tanks that were put in at the time of construction were vinyl-lined concrete. These were relined with fiberglass. The fiberglass did not seem adequate, so steel tanks were put in their place. These tanks were always repaired before any leakage occurred.

The vacuum system aspirators in the laboratories were connected to the roof runoff discharge, so it is possible that small amounts of chemicals have been washed to the storm drain. In 1984, all the aspirators to laboratories were disconnected.

The Diagnostic Chemistry Building (B251), built in 1955 has always been used for heavy element chemistry, (involving uranium, actinides and, transuranics. The radioactive waste was picked up by TWC. The dip tanks that were operated inside were also disposed of by TWC. There have been three spills outside of B251 that were contained in the yard. In 1960, while putting out a fire, fire-fighting water, contaminated with Curium-244, spilled outside and contaminated the asphalt. A drum leaked in the yard in 1978, that contaminated the asphalt with curium again. Actinium-227 has also been spilled in the yard. The contaminated areas were either picked up and treated as radioactive waste, or monitored and asphalted over to fix the contamination in place.

B. Current Operations

Defense Systems programs are divided into several major administrative areas. Three programs generate or handle hazardous or radioactive materials or wastes: (a) Nuclear Design (B Division), (b) Nuclear Test Diagnostics (L Division), and (c) Nuclear Chemistry. These programs, which use different facilities and generate different amounts and types of wastes, are discussed separately in this section. Major waste management areas, such as waste retention sumps and tanks and waste container staging areas, and their characteristics are identified in Table IV-23. Radioactive wastes generated by Defense Systems operations are summarized in Table IV-24.

(a) Nuclear Design

Nuclear design facilities are located in B111, B341, B344, and B345.

B111. The photo lab generates a few gallons of bleach and developer per week, which is neutralized before being discharged into the sewer.

B341, B344, B345. Facilities in the B341, B344, B345 complex are involved with explosives diagnostics and experimentation. Support operations, including a machine shop, welding shop, paint booth, and photo lab, are also located in these buildings.

Of these buildings, B341 has the largest number of hazardous waste generators. Sources of hazardous waste are: a paint booth, a solvent wash tank, metal cleaning tanks, and two photo labs. The metal cleaning tanks, containing chromic and nitric acid, are changed twice a year by TWC. The two photo labs, one manual and one automated, generate about 20 gallons per month of fixer, hypocleaner, acetic acid, and stop bath. Sinks in the building are connected to the sanitary sewer.

In the B341 explosives diagnostics area, no -PCB dielectric oil for pulsed power to the test guns is circulated internally and changed by Hazard Control personnel if necessary. A decontamination crew from Hazards Control supervises clean-up operations after test shots that use depleted uranium. Waste from these shots are sent to TWC.

Drum storage racks located west of B341 contain 55-gallon drums of cutting oil and fluid, motor oil, freon, acetone, MEK, and vacuum pump oil.

Building 344 consists of a high explosives magazine where 15 pounds of high explosives are stored. Detonators are also stored in magazetts.

Building 345 houses high explosives initiation and detonation experiments. Explosive waste products from about 4 to 6 shots daily are shipped to Site 300 for disposal in the burn area.

Photochemical rinse in small quantities, from a small photo lab in the building, is discharged to the sanitary sewer. Minor paint spraying operations and metals cleaning using chromic and nitric acid dip tanks are also performed in the building. Chemical solvents including acetone, alcohol, and MEK are stored outside in a drum rack located on asphalt. All waste solvents and chemicals are segregated for disposal by TWC.

(b) Nuclear Test Diagnostics

The nuclear test diagnostics program facilities, including light assay laboratories, photo labs, computer laboratories, and laser and pulsed radiation laboratories, are located in B121 and B255.

B121. In B121 the laser operations involve the use of laser dyes and solvents. These liquids and wastes are handled by TWC. The dyes are mixed with alcohol and after use are collected in drums for disposal. A machine shop in the building uses a variety of oils and solvents. Drums of TCE, acetone, freon, and alcohol are stored in a drum rack outside the building. Two metal cleaning tanks with chromic and nitric acid are also located in the machine shop area. The waste staging area contains drums of waste laser dyes, photochemicals, and a mixed solvent drum containing TCE, alcohol, and acetone. The drums are removed by TWC about once a month.

Building 121 also houses a series of photo labs, each of which discharges to the sanitary sewer on the order of 1 to 20 gallons of diluted chemicals per month. Chemicals discharged include ferro cyanide bleach, acetic acid, stop bath, hypo, and other process chemicals and reagents. Versatec fluid from the imaging laboratory is also disposed of in the sanitary sewer.

B255. In the B255 area, most of the wastes are radioactive. These are collected and sent to TWC. This area has the cobalt-60 irradiation facility and febetron. Non-radioactive hazardous wastes generated in the B255 machine shop and photo lab are handled in a manner similar to those in the B121 complex.

(c) Nuclear Chemistry

Nuclear chemistry facilities are primarily in B151, B251, and B281. The operations in these facilities generate a variety of radioactive and non-radioactive wastes.

B151. Building 151 houses a variety of chemical research laboratories, each of which uses hazardous and radioactive chemicals and reagents in small quantities. Wastes are contained in carboys, which are accumulated in the waste staging area for disposal by TWC. Sinks in the building are connected to a retention tank system northeast of the building. The retention tank system consists of two 4500-gallon PVC-lined steel tanks. Containerized wastes are staged on a loading dock area with other waste drums, located on the asphalt parking lot area east of the building.

B251. Wastes generated by the analytical laboratories in B251 include solvents and solid wastes that are contaminated with radioactive elements.

B281. Building 281 houses the old Livermore Pool Type Reactor, shut down in 1979. The decommissioning plan calls for a five-year cool-down period, followed by demolition and removal. The reactor is currently in the cool-down period, scheduled to be complete in 1985. Although fuel elements were removed from the reactor in 1980, the reactor area is still highly contaminated. There are no current waste discharges to the environment from the reactor.

12. Special Projects Program

A. History of Operations

Building 261 was built in the 1950's. Increments were added in 1961 and 1970. It was originally constructed for critical assembly work. A criticality occurred in one of the vaults in March 1963. This was followed by a fire in the assembly. Air, vegetation, and soil samples obtained from within the Laboratory perimeter showed a small release of short-lived, high yield gaseous fission products and their daughters. No detectable alpha activity was released to the environment (Kathern 1963). The contamination inside the vault was cleaned up and fixed by painting the surfaces of the concrete blocks. This area has recently been decontaminated and dismantled.

There have always been small machine shop operations in this building. Recently some photo labs have been installed.

B. Current Operations

The Special Projects facility is located in B261. Small amounts of waste are generated in the operations of this division. Most of the wastes are solvents and oils from the machine shop. These materials consist of chlorinated and non-chlorinated solvents, chromic and nitric acid from metal cleaning tanks (handled by TWC), and lubricating oil. These wastes are prepared for transport to TWC by placing drums and containers of waste in the fenced asphalt area at the west side of the building. A photo lab in the building discharges a very small amount of dilute photo processing chemicals to the sanitary sewer. Spent reagents are sent to Materials Management for recovery of silver from the liquids.

The Special Projects program does not routinely generate radioactive wastes. However, three contaminated vaults in B261 are being decontaminated. Small quantities of radioactive solid waste are generated from this decontamination operation.

V. GENERAL SITE AREAS

For many of the early years of the Laboratory site, the northern and eastern sections were leased to local ranchers for cattle grazing. As the site grew, this was no longer done. Some of the past activities that occurred on site took advantage of what were then large open areas not associated with one program or building.

In this section, four such areas are discussed: 1) garbage trenches, 2) the traffic circle landfill, 3) the taxi strip, and 4) old ammunition bunkers.

1. Garbage Trenches

The Laboratory has never routinely buried its hazardous waste on site. Until 1975 the Laboratory had a contract to send its garbage to S-300. However, when one of the contractors' drivers came down with Valley fever, the contractor refused to continue taking garbage to S-300. Portions of the Livermore site were then used as a garbage land fill. Garbage from the site was buried in trenches along the northern and eastern boundaries of the site. Classified paper was also buried when the classified paper incinerator was not in use. However, since 1970 the Laboratory has had a contract to use the local public landfill.

2. Traffic Circle Landfill

The one area that appears to have been used for miscellaneous storage and disposal on site was discovered recently. A clean up program is under way. The area, the "East traffic circle" is located on the mid-eastern portion of the site. The area does not appear in the old Navy photos, but does appear in the earliest Laboratory aerial photograph we have found (1956). The aerial photographs through time, and employee interviews, indicate that there were varied activities conducted in this area. In the late 1950's through the mid-1960's the area looked like a large depression with a road down to the bottom. In the 1960's the area looks better, and by 1970, the area was returned to grade and used for storage or other temporary activities (not for disposal purposes). From employee interviews we have learned of some of the activities conducted at this location: (1) a burn cage was constructed to dispose of paper and construction debris (2) capacitors (some containing PCB's) were disposed of (3) drums (we assume chemicals or waste) were stored and disposed of (4) construction debris was disposed of (5) bright dip tank contents were disposed of, (6) gardening debris was disposed of (7) sandblasting sand may have been disposed of (8) three cows were buried on the northern edge (9) classified paper was buried (10) sandbags were filled at the southern end of the area and (11) during the gas shortage in the late 1970's fuel was stored in old surplus tanks at the southern end of this area.

Documentation was found that indicated the presence of an old chemical pit in the same area. When the exact location was sampled, only low levels of toluene were found (Como 1984).

The Laboratory is in the process of assessing and disposing of the contaminated material and soil. Details of this operation can be found in the East Traffic Circle Closure Plan (Como 1984).

3. Taxi Strip

In 1982 the Laboratory excavated an area that had been used for waste storage, waste evaporation, and storage of radioactive contaminated equipment throughout the years. There are no records of disposal pits in this area (Buerer 1983). It was located on the old paved taxiway of the Naval Air Station, in the south eastern area of the site (Figs. II-1 and II-2). In 1953, 5-gallon glass carboys of waste were stored in this area. Dry contaminated waste was put in drums at B412, but liquid wastes were collected and stored on the old runway. By 1959, records show that there were approximately 1500 carboys stored at the north end of the strip. Samples from 200 of these carboys were analyzed and indicated that 75% were acid solutions, 15% were alkaline, 10% were neutral and 1-2% were organic solvents. The radioactive content of these sampled carboys indicated that 90% of them contained less than 1×10^4 dpm/liter of gross alpha, 80% contained between 1000 to 1×10^6 dpm/liter gross beta and 10% contained between 1×10^7 and 1×10^8 dpm/liter gross beta. The records do not indicate the types of organic solvents; however, it is known that chlorinated solvents were widely used at that time (Buerer 1983). Non-radioactive waste solvents were handled by the salvage group.

The first successful experimental evaporation pit was set up south of B514; later pits were set up on the old taxi strip runway. The early evaporation pits were depressions in the ground covered with a liner. Later the evaporation trays used were concrete painted with 12 mils of polyamide cured epoxy paint, usually lined with PVC, and measuring approximately 10 feet by 20 feet by 1 foot deep (Buerer 1983). They can first be seen in a 1963 aerial photo* at the southern end of the strip. These were constructed and torn down at different locations on the strip through 1976. In a 1970 aerial photograph about 5 trays can be seen in the center of the strip.

In addition to carboy waste, rejection solutions from reverse osmosis treatment of radioactive contaminated liquids and evaporator bottoms were also placed in these trays. As the liquid evaporated, additional wastes were added. When a

* Aerial photos of the LLNL site between 1943 and 1984 are in Appendix C.

basin evaporated nearly to dryness, the crystallized salts were rolled up in the plastic liner and placed in 55-gallon drums, and disposed of (Buerer 1983).

In 1979, soil samples were taken in the area of the former evaporation ponds. Some samples were contaminated with transuranic elements. The contaminated soil was removed and disposed of as radioactive waste (Stone 1982). A full scale investigation and clean-up was conducted in 1982-83. A more complete description of the clean-up can be found in Buerer (1983). At the southern end of the strip a 40 feet by 80 feet area with low-level radioactive contamination (Americium-241, transuranics, and Cesium-137) was found. The contamination remained in the soil to a depth of 6 feet. This is presumed to have been caused by leakage from the solar evaporation tray that was once located at this spot. Three disposal pits were also discovered. The smallest (6 feet by 6 feet) contained broken bottles from approximately 4 to 8 feet below the surface. Low levels of Am-241, U-235, and transuranics were found here. The area was excavated to 13.5 feet deep. The next largest pit was approximately 10 feet by 10 feet. This contained about 50 broken bottles, glass tubing and plastic from 4 feet below the surface to about 12 feet. Uranium-235 was detected in the soil in this pit. This area was excavated to a depth of about 20 feet. The largest pit contained approximately 50-100 broken bottles along with other debris such as plastic bags and glass tubing. No drums were found in this or any of the other pits. The debris was distributed from 2 to 12 feet below the surface. The soil in this pit was contaminated with perchloroethylene, trichloroethylene, 1,1,1 trichloroethane, Americium-241, transuranics, Cs-137, Co-60 and Eu-152. The contaminated soil was excavated to a depth of 34 feet.

4. Ammunition Bunkers

The buried Quonset huts were constructed by the Navy to store ammunition and smoke bombs. The Laboratory has used the area for storage of radioisotopes and radioactive sources, sodium/potassium, neutron activated drift tubes, equipment for lasers programs, pesticides storage, and crafts storage. There was one solar evaporation pond at the south east corner of the fenced in area around the bunkers. Further investigation is needed to determine the size and location of this evaporation pond.

VI. CONCLUSIONS

This report was compiled to gather all the information necessary to determine the areas on the LLNL site that are contaminated, or should be investigated further to determine if contamination exists. We have also included information that can assist in determining the likelihood of environmental transport of contamination on the site.

Figure V-1 shows our initial attempt to identify areas of concern on the LLNL site as a result of our research of past and present use, storage and disposal of hazardous materials and wastes. Areas that were inadvertently left off the map are: the pipes that leaked in the past in B131, the motor pool gasoline tank leak (B403), and the possible disposal ditch near (B234). The Toxic Waste Control (TWC) areas were not highlighted in Figure VI-1, however, they are shown clearly in Figure IV-1.

All of the sites listed refer to past LLNL and/or Navy operations except the following sites which are still in operation today: B141 sumps, B231 sumps, B518 drum storage areas, pipe shop dip tanks, and the road oil storage. The gas pits and tanks from the Navy operations are labeled accordingly.

On Figure VI-1 the investigated areas are grouped into three categories according to the operation or spill, the materials at risk, and the reliability of the information concerning the area. The categories are:

1. areas of little concern
2. areas of suspected contamination
3. areas of known contamination.

The areas of little concern include areas in which operations involving the soil have occurred but have not left problems behind. Suspected areas are locations that were exposed to small amounts of hazardous materials or wastes, or locations for which information on past activities has not been substantiated. These areas need further investigation. Areas of known hazardous waste releases include areas that are most likely contaminated. Further discussion of all three categories is presented below.

1. Areas of little concern. The areas of little concern identify three non-hazardous disposal areas and one experimental plot. The garbage trenches were used for

refuse disposal, and the biomedical disposal area involved only non-contaminated cows, sheep, mice and rabbits. The experimental plot in the northeast corner was used to study the uptake of extremely low levels of plutonium into plants. The sludge used in the soil was considered to be at a level low enough for the general population to have used in their gardens. These four areas do not seem to have any potential for adverse environmental impact.

2. *Areas of suspected contamination.* The areas of suspected contamination include areas for which information on past operations has not been substantiated, or areas that were exposed to small amounts of hazardous materials and wastes. Further research and field investigation are needed to determine if any contamination exists, and if so, to what extent. These areas were ranked into three groups according to the quantities of materials spilled and the reliability of the information:

- A. The old gas cylinder and drum storage area and the B518 drum rack are areas that have most likely had larger amounts of oils and solvents spilled on them. The TWC areas were used by the Navy for airplane maintenance, by CR&D for decontamination operations, and by the Laboratory for different toxic waste handling facilities. These areas are more likely to have soil contamination than the others in this category.
- B. Anecdotal evidence has indicated that certain areas could have residual soil contamination. These are as follows: old solar evaporation pit south of B514; diesel and TCE spills at the northeast corner of B511; xylene and toluene spills near B117; TCE spills near B111; the old garbage dump; the drywell next to B331; the site of the old acid dissolver; and the old swamp area.

The present road oil storage areas, pipe shop dip tanks and the sumps in B141 and B231 may also have caused soil contamination. These should be investigated further.

- C. This group includes those areas that are least likely to have ground contamination based on the research completed-to-date. Many of the

operations that could have caused soil contamination are in areas that have been excavated for building construction. The sites should be researched further to determine whether they are areas of little concern or areas of soil contamination. They include: the old bunkers yard; the radioactive waste handling area north of B412; the Navy's continuous fuel and gas pits; spills around B321; location of the old mercury reclaimer; spills around B222 and B171; leaking pipes at B131; and the disposal ditch near B234. The possibility of contamination from the reactor in B281 is considered unlikely (Stone 1982).

3. **Areas of known soil contamination.** The areas of known soil contamination are sites already under investigation, or sites of extensive spills. The radioactive surface spill in the B251 yard was on asphalt and was covered with asphalt; thus migration through the soil column is not likely. The Taxi Strip, Traffic Circle Landfill, and gasoline leak next to B403 are known areas of contamination and are currently under investigation or have been investigated in the past. The old and new salvage yards are listed because the history of these areas shows that the routine operations in the past have probably caused contamination of the soil by oils and solvents. The areas around the TWC operations are a high priority because many unknown radioactive and hazardous wastes have been stored and treated in these yards. The oil storage area is listed because visible evidence showed that this is a likely area of soil contamination. The past Fire Training areas are listed because flammable waste liquids were routinely poured on the ground and ignited at these sites.

The locations of these sites are being taken into consideration in the placement of the new monitoring wells during the ground water investigation.

The information presented in this report is the beginning of the search for possible contaminated areas on the Lawrence Livermore National Laboratory site. Because of the large number of operations and employees that have been active on this site through time, it has not been possible to talk to everyone and research all the possibilities. During the continuing Ground Water Investigation Program, it is likely that more information will become available. The new facts will be used to revise our list and map of areas of concern.

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**Lawrence Livermore National Laboratory Resource Conservation and Recovery Act
Part B permit application 1985.**

LLNL Interim Hazardous Waste Management Plan, March 16, 1984.

FIGURES

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SITE MAPS
YEARS 1942-1985

FIGURE VI-1

LLNL
SITE MAP

Library of Congress / University
Library
University of California
Library
PLANT ENGINEERING

SUSPECTED
CONTAMINATED
AREAS
APRIL 1985

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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1

PLC85-099-031E

FIGURE II-20

LEGEND

Monitoring Well Locations

LLNL
SITE MAP

University of California / Lawrence
Livermore
Lawrence Livermore National
Laboratory

PLANT ENGINEERING

MONITORING
WELL
LOCATIONS

DATE: 10/1/85
BY: J. J. J.

REVISIONS FOR CONSTRUCTION

1

PLC85-099-040E

+

+

FIGURE 11-19

FIGURE 11-18

DO NOT WRITE THIS DRAWING

11-18

SITE MAP

History of Changes

DATE	DESCRIPTION	BY
10/84	Initial Drawing	11-18
11/84	Revised	11-18
12/84	Revised	11-18
1/85	Revised	11-18
2/85	Revised	11-18
3/85	Revised	11-18
4/85	Revised	11-18
5/85	Revised	11-18
6/85	Revised	11-18
7/85	Revised	11-18
8/85	Revised	11-18
9/85	Revised	11-18
10/85	Revised	11-18
11/85	Revised	11-18
12/85	Revised	11-18

YEAR

1985

11-18

[illegible]

LEGEND

- BUILDING
- WALKWAY
- PARKING LOT
- ROAD

FIGURE II-16

Saltatory snow
Sept. 1994

Answer:

Charged E. E. Poe

▶ Comment

LLNL
SITE MAP

University of California / Los Angeles
 Los Angeles
 University National
 Laboratory
 PLANT ENGINEERING

YEAR
1985

DATE 04/15/80 TIME 12:20
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PL 85-607-008

FIGURE 11-15

DO NOT REMOVE THIS DRAWING

LLNL
SITE MAP

University of California / Livermore
 Livermore
 Livermore National
 Laboratory
 PLANT ENGINEERING

YEAR
1975

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PLC85-09~006

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LEGEND

- BUILDING
- WOODLAND
- PARKING LOT
- ROAD

FIGURE II-14

Sanitary census
April 1942

Abstract

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Charged S. E. New
 ② Markels
 ③ Charnoff

1	Chrysler
2	Marbels
3	Chrysler

• **Chlorophyll**

100

DO NOT REVERSE THIS GRADING

LLNL
SITE MAP

University of California / Livermore
Lawrence
Livermore National
Laboratory
PLANT ENGINEERING

PLANT ENGINEERING

YEAR
1970

1	1-1-1	1-1-1
2	1-1-1	1-1-1
3	1-1-1	1-1-1

0000-0001-9786-900X

9. *Journal of Management Studies*, 1994, 31, 1, 1-14.

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FIGURE II-13

LLNL
SITE MAP

University of California / Lawrence
Livermore
Livermore National
Laboratory
PLANT ENGINEERING

YEAR
1952

PLANT ENGINEERING
1952

PLANT ENGINEERING
1952

PLANT ENGINEERING
1952

PLANT ENGINEERING
1952

PLC85-097-002

2

FIGURE II-12

References

INDEX

Legend

- Severe injury
- Drains often empty
- Moderate injury
- Division

DO NOT REVEAL YOUR BUSINESS

L L N L
SITE MAP

University of Edinburgh / Lowlands
 Lowlands
 University of Edinburgh
 Laboratory
PLANT ENGINEERING

YEAR
1985

DATE	1-22-81
TIME	1:22:03
BY	(S.S. 80)

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PLC85-09~CC8

FIGURE II-11

Storm sewers
1978
Legend
- Storm sewers
- Drainage channels
• Marshland sewers
■ Overlain

LEGEND

- BUILDING
- LOT/LINE
- PARKING LOT
- ROAD

2

2

FIGURE II-8

DO NOT REMOVE THIS BRACKET

L L N L
SITE MAP

University of Colorado / Lawrence
Livermore National
Laboratory
PLANT ENGINEERING

YEAR
1985

[illegible]

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PLCE5-69-006

FIGURE 11-7

[illegible]

PLC85-09^--006

DO NOT REMOVE THIS SLIP
 - JAMES EARL RAY -
 APR 11 1968

L L N L
SITE MAP

PLANT ENGINEERING

YEAR
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DATE	1-27-5
TIME	1-22-5
BY	1-22-5

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PLC85-09^--005

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WEST OFFSHORE
HARBORWEST OFFSHORE
HARBORWEST OFFSHORE
HARBOR

LEGEND

- BUILDING
- PARKING LOT
- ROAD

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DO NOT RELY ON THIS DRAWING

UNIVERSITY OF CALIFORNIA - LOS ANGELES
 LOWE HALL
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 LOS ANGELES
 PLANT ENGINEERING

1	D.A. 101	12-27-81
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3	D.A. 103	12-27-81

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LEGEND

□ - Building
— - Road

FIGURE II-2

DO NOT SCALE THIS CHART

LLNL
SITE MAP

Legend
 Laboratory
 Library
 Parking
 Road

YEAR
1952

PLC85-09-002

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LEGEND

- BUILDING
- ROAD

Figure II-1. LLNL Site in 1942

DO NOT REMOVE THIS BRANDING

L L N L
SITE MAP

University of California / Los Angeles

**Lowest
Livermore National
Laboratory**

PLANT ENGINEERING

YEAR
1942

DATE **REF**

DATE 2-22-68 BY 1-22-68

100-444444

may lead to a more complete understanding of the

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PLATE 100

PLC-45-1167-1115

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LEGEND

□ OPENED AREA

□ BUILDING

□ ROAD

TABLES

Table II-1. Retention Tanks on LLNL Site - January 1985

Bldg. Number	Container Type	Year Installed	Capacity (Gallons)	Material Strg. Type	Material Stored
111	TANK	1980	350	PRODUCT	DIESEL FUEL
113	TANK	1980	350	PRODUCT	DIESEL FUEL
131	TANK	1970	280	PRODUCT	DIESEL FUEL
131	TANK	1977	12500	PRODUCT	DIESEL FUEL
131	TANK	1977	12500	PRODUCT	DIESEL FUEL
131	TANK	1971	4000	PRODUCT	CONTAM.RINSEWATER
131	TANK	1959	1000	PRODUCT	AMMONIA
141	TANK	1960	1000	PRODUCT	FILLED WITH SAND
141	SUMP	1980	450	WASTE	CONTAM.RINSEWATER
141	SUMP	1980	450	WASTE	CONTAM.RINSEWATER
141	SUMP	1980	450	WASTE	CONTAM.RINSEWATER
151	TANK	1964	1000	PRODUCT	DIESEL FUEL
151	TANK	1972	4000	WASTE	CONTAM.RINSEWATER
151	TANK	1983	4000	WASTE	CONTAM.RINSEWATER
151	SUMP	1967	380	WASTE	CONTAM.RINSEWATER
151	TANK	1983	4000	PRODUCT	DIESEL FUEL
161	SUMP	1976	135	WASTE	CONTAM.RINSEWATER
175	TANK	1980	1000	WASTE	CONTAM.RINSEWATER
194	TANK	1959	280	PRODUCT	DIESEL FUEL
194	SUMP	1967	300	WASTE	CONTAM.RINSEWATER
212	SUMP	1958	50	WASTE	CONTAM.RINSEWATER
212	SUMP	1958	50	WASTE	CONTAM.RINSEWATER
212	SUMP	1962	50	WASTE	CONTAM.RINSEWATER
212	PIT	1976	200	WASTE	DRUMRACK DRYWELL
222	TANK	1970	9000	WASTE	CONTAM.RINSEWATER
229	TANK	1943	25000	UNUSED	LAST USED 1950 (EST)
229	TANK	1943	25000	UNUSED	LAST USED 1950 (EST)
229	TANK	1943	25000	UNUSED	LAST USED 1950 (EST)
229	TANK	1943	25000	UNUSED	LAST USED 1950 (EST)
231	TANK	1983	3200	PRODUCT	DIESEL FUEL
231	TANK	1983	3000	PRODUCT	DIESEL FUEL
231	TANK	1978	12500	PRODUCT	DIESEL FUEL
231	TANK	1978	12500	PRODUCT	DIESEL FUEL
231	SUMP	1959	500	WASTE	CONTAM.RINSEWATER
231	SUMP	1959	250	WASTE	CONTAM.RINSEWATER
231	TANK	1967	280	PRODUCT	DIESEL FUEL
241	TANK	1957	500	PRODUCT	DIESEL FUEL
241	SUMP	1959	345	WASTE	CONTAM.RINSEWATER
251	TANK	1967	500	PRODUCT	DIESEL FUEL
251	SUMP	1967	25000	STANDBY	STANDBY USE ONLY
251	SUMP	1968	300	WASTE	CONTAM.RINSEWATER
251	TANK	1965	280	PRODUCT	DIESEL FUEL
255	TANK	1970	350	PRODUCT	DIESEL FUEL
271	TANK	1982	2000	PRODUCT	DIESEL FUEL
281	TANK	1955	1000	WASTE	CONTAM.RINSEWATER
281	TANK	1955	1000	WASTE	CONTAM.RINSEWATER

*Contam. = Contaminated rinsewater. More detailed information on contents can be found in the text and tables presented later in the report.

Retention Tanks on LLNL Site - January 1985 (Continued)

Idg. Number	Container Type	Year Installed	Capacity (Gallons)	Material Strg. Type	Material Stored
281	TANK	1957	1500	WASTE	DOMESTIC USE:WASTEWATER
281	TANK	1957	1500	WASTE	DOMESTIC USE:WASH WATER
281	SUMP	1957	45	WASTE	CONTAM.WASTEWATER
281	TANK	1957	10000	WASTE	PRIMARY COOLING WATER
281	TANK	1957	3000	WASTE	PRIMARY COOLING WATER
281	ION EX COLUM	1958	100	WASTE	PRIMARY COOLANT POLISHING
281	ION EX COLUM	1958	100	WASTE	PRIMARY COOLANT POLISHING
281	ION EX COLUM	1958	100	WASTE	PRIMARY COOLANT POLISHING
281	ION EX COLUM	1958	100	WASTE	PRIMARY COOLANT POLISHING
281	TANK	1957	350	PRODUCT	NUCLEAR REACTOR FUEL RODS
291	TANK	1971	5000	WASTE	PLANT DEIONIZER WASTE
291	TANK	1983	1000	PRODUCT	DIESEL FUEL
292	SUMP	1974	1000	WASTE	CONTAM.RINSEWATER
298	TANK	1982	350	PRODUCT	DIESEL FUEL
298	SUMP	1983	300	WASTE	CONTAM.WASTEWATER
310	TANK	1956	500	WASTE	CONTAM.WASTEWATER
318	TANK	1981	250	PRODUCT	GASOLINE: REGULAR GRADE
321	TANK	1976	500	PRODUCT	DIESEL FUEL
321	SUMP	1958	200	WASTE	CONTAM.RINSEWATER
321	SUMP	1971	3000	WASTE	PLATING SHOP CAUSTIC WASTE
321	SUMP	1971	3700	WASTE	PLATING SHOP ACID WASTE
321	SUMP	1971	3000	WASTE	PLATING SHOP WASTE
322	SUMP	1975	3000	WASTE	CONC. PLATING SHOP WASTE
322	FLOORPIT	1975	59000	WASTE	SPILL CONTAINMENT:T0322-21X
324	TANK	UNKNOWN	1000	PRODUCT	GASOLINE: REMOVED 1982
325	TANK	1967	25000	WASTE	PLANT DEIONIZER WASTE
331	TANK	1955	280	PRODUCT	DIESEL FUEL
332	TANK	1960	1000	PRODUCT	DIESEL FUEL
332	TANK	1976	1500	PRODUCT	DIESEL FUEL
332	TANK	1981	2000	PRODUCT	DIESEL FUEL
332	TANK	1961	1000	WASTE	CONTAM.RINSEWATER
332	TANK	1961	1000	WASTE	CONTAM.RINSEWATER
361	TANK	1973	1000	PRODUCT	DIESEL FUEL
361	SUMP	1981	500	PRODUCT	CONTAM.RINSEWATER
361	TANK	1981	500	WASTE	CONTAM.RINSEWATER
361	TANK	1981	500	WASTE	CONTAM.RINSEWATER
362	SUMP	1963	150	WASTE	CONTAM.RINSEWATER
365	TANK	1977	6000	PRODUCT	DIESEL FUEL
365	SUMP	1979	350	WASTE	CONTAM.RINSEWATER
377	SUMP	1969	500	WASTE	CONTAM.RINSEWATER
377	SUMP	1969	250	WASTE	CONTAM.RINSEWATER
377	TANK	1969	2000	PRODUCT	SEAWATER (FOR AQUARIUM)
377	TANK	1969	2000	PRODUCT	SEAWATER (FOR AQUARIUM)
377	TANK	1969	6000	PRODUCT	SEAWATER (FOR AQUARIUM)
377	TANK	1969	5000	PRODUCT	SEAWATER (FOR AQUARIUM)
381	TANK	1973	12500	PRODUCT	DIESEL FUEL
391	TANK	1974	12500	PRODUCT	DIESEL FUEL
401	TANK	1943	10000	PRODUCT	DIESEL FUEL

Retention Tank on LLNL Site - January 1985 (Continued)

Rldg. Number	Container Type	Year Installed	Capacity (Gallons)	Material Strg. Type	Material Stored
401	TANK	1943	10000	PRODUCT	DIESEL FUEL
401	TANK	1943	10000	PRODUCT	DIESEL FUEL
402	TANK	1979	10000	PRODUCT	GASOLINE:REGULAR GRADE
402	TANK	1979	10000	PRODUCT	GASOLINE:UNLEADED GRADE
403	TANK	1943	10000	PRODUCT	GASOLINE:NOW FILLED W/SAND
403	TANK	1943	2500	WASTE	LUBE OIL: REMOVED 1960
403	TANK	1943	10000	PRODUCT	GASOLINE:NOW FILLED W/SAND
403	TANK	1943	10000	PRODUCT	GASOLINE:NOW FILLED W/SAND
403	TANK	1960	1000	PRODUCT	DIESEL FUEL
412	TANK	1955	1000	WASTE	CONTAM.WASTEWATER
412	TANK	1955	1000	WASTE	CONTAM.WASTEWATER
419	TANK	1976	500	WASTE	CONTAM.WASTEWATER
419	TANK	1976	500	WASTE	CONTAM.WASTEWATER
419	TANK	UNKNOWN	100	WASTE	CONTAM.WW:REPAIRED 1984
419	SUMP	1983	300	WASTE	RINSEWATER:BATTERY SHOP
424	TANK	1979	300	PRODUCT	DIESEL FUEL
431	TANK	1965	280	PRODUCT	DIESEL FUEL
435	TANK	1978	280	PRODUCT	DIESEL FUEL
451	TANK	1977	500	PRODUCT	DIESEL FUEL
490	TANK	1983	2000	PRODUCT	DIESEL FUEL
490	TANK	1983	5000	WASTE	FUTURE USE:CONTAM.WATER
490	TANK	1983	1000	WASTE	FUTURE USE:CONTAM.WATER
490	TANK	1983	1000	WASTE	FUTURE USE:CONTAM.WATER
514	SUMP	1967	135	WASTE	STORM RUNOFF
---	---	---	---	---	POTENTIAL SPILLAGE
514	SUMP	1963	200	WASTE	STORM RUNOFF
---	---	---	---	---	POTENTIAL SPILLAGE
514	SUMP	1963	200	WASTE	CONTAM.WASTEWATER
592	SUMP	1963	100	WASTE	ANIMAL WASTES
611	TANK	~1980	3200	WASTE	WASTE OIL
612	SUMP	1982	25	WASTE	CONTAM.WASTEWATER
1705	TANK	1978	350	PRODUCT	DIESEL FUEL
4181	TANK	UNKNOWN	600(EST).	WASTE	OIL: FILLED WITH SAND 1976

Table II-2. The 1982 inventory of racks used to hold 0.21 m³ (55 gal) drums which various liquids are dispensed at LLNL.

Building (side of rack lo- cation)	Rack drum capa- city	Evidence of liquid leakage	Leakage collec- tion system	Rack support surface	Rack drainage	Remarks
121(W)	4	Some	No	Asphalt	Storm sewer	
131(W)	12	Considerable	No	Asphalt	Storm sewer	Degreasing area nearby
141(SE)	7	Some	No	Asphalt	Storm sewer	
151(W)	16	Some	No	Asphalt	Grassy field	
161(W)	4	Some	No	Asphalt	Ditch	
166(W)	8	Some	No	Asphalt	Field	Degreasing area nearby
167(N)	12	Some	No	Native grd	Field	
T1726(N)	1	None	No	Asphalt	Field	
127(N)	12	Some	No	Asphalt	Field	
194(W)	8	Some	No	Native grd	Field	
212(E)	12	Some	Yes	Concrete	Sump	Leaves in leakage collection system
222(E)	8	Some	Yes	Asphalt	Storm sewer	
231(S)	48	Considerable	No	Asphalt	Storm sewer	
231(N)	2	Some	No	Asphalt	Storm sewer	
241(E)	8	None	No	Concrete	Grassy area	
243(W)	8	None	No	Concrete	Grassy area	
255(N)	1	None	No	Concrete	Storm sewer	
281(S)	8	Some	No	Asphalt	Storm sewer	
292(N)	8	Unknown	No	Asphalt	Field	Rack observed only from distance
321(S)	40	Some	Yes	Asphalt & concrete		
331(E)	12	Some	No	Asphalt	Storm sewer	
332(W)	8	None	No	Concrete	Storm sewer	
381(N)	12	Some	No	Concrete	Grassy field	
403(E)	6	Some	No	Concrete & asphalt	Not noted	
431(E)	16	Some	No	Concrete & asphalt	Not noted	
435(N)	16	Some	No	Asphalt	Not noted	
511(W)	8	None	Yes	Not noted	Not noted	
518(S)	78	Some	No	Asphalt & concrete	Not noted	
518(N)	102	Considerable	No	Asphalt	Not noted	
519(N)	8	Not noted	Not noted	Asphalt	Not noted	
519(S)	32	Some	No	Asphalt	Not noted	
520(S)	14	Not noted	Not noted	Asphalt	Not noted	

From Stone (1982)

Table II-3. In 1982 partial list of liquids dispensed from racked 0.21-m³ (55-gal) Drums at LLNL.

Building and side of rack location	Liquids present (April 1982)															Remarks
	Isopropyl alcohol	Cutting oil	Detergent oil	Perchloroethylene	Trichlorotrifluoroethane	Acetone	Trichloroethane	Mono butyl glycol	Lacquer thinner	Kerosene	Trichloroethylene	Methyl ethyl ketone	Vacuum pump oil	Mineral spirits	Ethyl alcohol	
121(W)	X			X	X	X										
131(W)	X	X	X	X	X											
141(SB)							X	X		X					X	
151(W)	X	X		X	X	X				X	X	X	X			
161(W)									X						X	
166(W)				X	X				X	X	X	X				
167(W)				X	X											
71726(W)				X												
177(W)	X					X	X					X		X	X	
194(W)	X			X	X					X	X	X	X			
212(E)	X	X			X	X				X	X	X				
222(E)		X		X	X	X				X	X	X				
231(S)						X	X			X	X	X			X	
231(W)										X	X	X			X	
241(E)	X			X	X					X	X	X	X			
243(W)	X				X					X	X				X	
259(W)				X												
281(S)	X				X								X			
292(W)																Undetermined
321(S)	X	X				X				X	X	X	X			
331(S)				X							X					
332(W)	X				X	X				X	X	X				
381(W)		X		X	X	X				X	X	X	X		X	
401(E)			X							X	X	X				
431(E)	X				X	X				X	X	X				X
435(W)		X			X						X				X	
511(W)					X											
518(S)			X					X		X	X					
518(W)			X													
519(W)			X													X
519(S)		X			X					X	X	X				
520(S)			X								X				X	

From Stone (1982)

TABLE IV-1

HAZARDOUS AND RADIOACTIVE WASTE DISCHARGES¹: TOXIC WASTE CONTROL

ID ²	Description	Chem. Comp	Radioactive	Annual Generation Rate	TSD Method
001	Caustic	NaOH, 5-30%	No	72,000 gal.	Offsite Disposal
002	Acid	Mixture HCl, H ₂ SO ₄ , H ₂ CrO ₄ , HNO ₃	No	58,000 gal.	Offsite Disposal
003	Acid	Mixture HCl, H ₂ SO ₄ , H ₂ CrO ₄ , HNO ₃ MFP, Uranium-238	Yes	100 gal.	Solidify, Offsite Disp.
004	Oil	Vacuum pump Crankcase Cutting Insulating	No	25,000 gal.	Offsite Recycle
005	Rinse Water	Heavy Metals Cr, Cu, Zn, Ni	No	76,000 gal.	Filter Treatment
006	Rinse Water	Heavy Metals Cr, Cu, Zn, Ni MFP,* Uranium-238	Yes	37,000 gal.	Filter Treatment

* MFP = Mixed fission products

TABLE IV-1 (cont.)

HAZARDOUS AND RADIOACTIVE WASTE DISCHARGES: TOXIC WASTE CONTROL

ID# ²	Description	Chem. Comp	Radioactive	Annual Generation Rate	TSD Method
007	Laboratory reagents, liquid	Mixture	No	1,000 gal.	Offsite Disposal
008	Laboratory reagents, solid	Mixture	No	425 ft ³	Offsite Disposal
009	Machine coolants	5% oil, 95% water Beryllium Uranium-238	Yes	6,700 gal.	Solidify Offsite Disp.
010	Machine coolants	5% oil, 95% water	No	1,800 gal.	Offsite Disposal
011	Mixed chemicals	Solvents Aqueous mixtures MFP, Uranium-238	Yes	4,600 gal.	Solidify Offsite
012	Flammable solvents	Acetone, paint thinner, MEK	No	2,200 gal.	Offsite Recycle

TABLE IV-1 (cont.)

HAZARDOUS AND RADIOACTIVE WASTE DISCHARGES¹: TOXIC WASTE CONTROL

ID#	Description	Chem. Comp	Radioactive	Annual Generation Rate	TSD Method
013	Chlorinated solvents	1,1,1-Trichloroethane, Perchloroethylene, Methylene chloride	No	2,300 gal.	Offsite Recycle
014	Plastics	Resins, epoxies	No	400 gal.	Offsite Disposal
015	Biological waste, solid	Carcinogens ³ H, ¹⁴ C	Yes	1,500 ft ³	Onsite. Incineration
016	Carcinogenic liquids	Flammable solvents, Carcinogens	No	1,000 gal.	Onsite Incineration
017	PCB contaminated oils	7ppm-100% PCBs insulating	No	2,000 gal.	Offsite Disposal
018	PCB capacitors	100% PCB	No	1,000 ft ³	Onsite Storage and Ultimate Offsite Disposal
019	PCB contaminated transformers	7-500 ppm PCB	No	700 ft ³	Onsite Storage

TABLE IV-1 (cont.)

HAZARDOUS AND RADIOACTIVE WASTE DISCHARGES: TOXIC WASTE CONTROL

ID# ²	Description	Chem. Comp	Radioactive	Annual Generation Rate	TSD Method
020	Filter cake	Diatomaceous earth Cr, Cu, Ni, Zn MFP, Uranium-230	Yes	2,000 ft ³	Offsite Disposal
021	Mercury-flasks bottles and tubes	Mercury - 90% water	No	1,500 lbs.	Offsite Recycle
022	Batteries	H ₂ SO ₄ , Pb	No	20,000 lbs.	Offsite Recycle
023	Battery Acid and Rinsewater	H ₂ SO ₄ , Pb	No	250 gal.	Offsite Disposal
024	Tritiated water	Tritium, water	Yes	8,300 gal. (4 ci total)	Evaporator

¹ Source: LLNL Interim Hazardous Waste Management Plan; March 16, 1984.² Keyed to Tables III.2 and III.3.

TABLE IV-2

LLNL ON-SITE STORAGE

Site Identifier (Building)	Storage Method	Waste Stored	Facility Capacity
S-514	Drum Shed	011 Mixed chemicals	22,000 gal.
S-513	Drum Warehouse	009 Machine coolants 011 Mixed chemicals	44,000 gal.
S-625	Drum Warehouse	017 PCB oils 018 PCB capacitors 019 PCB transformers	100,000 gal.
S-612	Yard storage	001 Caustic 001 Acid 004 Oil 007 Lab reagents, liquid 008 Lab reagents, solid 010 Machine coolants 012 Flammable solvents 013 Chlorinated solvents 014 Plastics	220,000 gal.
S-614	Drum Warehouse	007 Lab reagents, liquid 008 Lab reagents, solid	2,000 ft ³
S-500	Tank	005 Rinse water (cr, Cu, Zn, Ni, oil)	25,000 gal.
S-419	Tank	023 Acid	250 gal.
S-6126	Tank	004 Oil	3,000 gal.

TABLE IV-2 (cont.)

LLNL ON-SITE STORAGE

<u>Site Identifier (Building)</u>	<u>Storage Method</u>	<u>Waste Stored</u>	<u>Facility Capacity</u>
S-6127	Transportainer	021 Mercury flasks bottles and tubes	640 ft ³
S-6128	Yard Storage	022 Batteries	90 ft ²

TABLE IV-3

LLNL TREATMENT FACILITIES

Treatment Process	Treated Waste Stream	Capacity	Effluent Disposition
Incineration	015 Biological waste, solid	15 ft ³ /hr.	Ash to offsite municipal land-fill.
	016 Carcinogenic, flammable	25 gal/hr.	Ash to offsite municipal land-fill.
Chemical precipitation, vacuum filtration	005, 006 Rinse water	200 gal/hr.	Offsite disposal.
Thin-film evaporation	024 Tritiated water	0.33 gal/hr.	Air discharge.

TABLE IV-4

HAZARDOUS MATERIALS AND WASTES: HAZARDS CONTROL DEPARTMENT

Materials/Wastes	Facility	Quantity	Uses/Disposal
Solvents: acetone, methyl ethyl ketone, hexanes, freon (material and waste)	Machine shop; Aerosol Physics and Analytical Lab	Several gal/yr; << 1 gal/yr	Parts cleaning, degreasing chemical analysis; disposed in solvent waste drum
Acids: chromic, nitric, perchloric (material and waste)	Machine shop, Analytical Lab	< 10 gal/yr	Metal dip/welding, solids digestion (lab); dip tanks pumped by TWC
Oils: cooling oil, cutting oil, lubricants (material and waste)	Machine shop	Minor; squeeze bottle application	Oils collected in drum; for recycle or sale.
Xylene (material and waste)	Rad. Counting Lab	Small vials	Cocktails for liquid scintillation counter; incinerated by TWC
Trichloroethylene (material and waste)	Machine shop; Analytical Lab	5 gal/yr << 1 gal/yr	Degreasing, calibration standard for analytical instruments

TABLE IV-5

RADIOACTIVE WASTES: HAZARDS CONTROL DEPARTMENT

Wastes	Facility	Quantity	Uses/Disposal
Solid radioactive waste	Analytical laboratory	5 ft ³ /year	Handling equipment, environmental samples, planchets, air filters
Radioactive liquid waste, aqueous	Analytical laboratory	5 gals/month max	Retention tank samples, tritium in water. Environmental samples; incinerated by TWC
Tritiated liquid waste, solvent	Analytical laboratory	10 gal/month	Tritium in xylene for scintillation counting, incinerated by TWC, tritium in methane
Scintillation vials	Analytical laboratory	1 gal/2 months	Tritium in xylene in polyethylene bottles, incinerated by TWC

TABLE IV-6

HAZARDOUS MATERIALS AND WASTES: LCW STATIONS

Materials/Wastes	Facility	Quantity	Uses/Disposal
Oil/lubricants: DTE oil (material)	B291 B325	5 drums 2 drums	No waste.
Water treatment chemicals: corrosion inhibitors, boron nitrate, biocide (materials)	B291 B325	Variable; at least several drums.	Used in water treatment; no waste disposal.
Blowdown: boilers and cooling towers (waste)	B291, B325	Varies seasonally, cooling towers about 10 gpm in summer.	Discharged to sewer.
Diesel fuel (material)	B291	1,000 gallons	Fuel for air compressor.
Regeneration wastewater (waste)	B291, B325	1,000 gallons/month (estimated average discharge).	Discharged to underground retention tank. Commercial disposal at B291; discharge to storm drain at B325.
PCB transformer (material)	B291	One (1).	In use.

TABLE IV-7

HAZARDOUS MATERIALS AND WASTES: STEAM PLANT

Materials/Wastes	Facility	Quantity	Uses/Disposal
Diesel fuel (material)	3-10,000 gallon underground tanks	30,000 gallons	Standby fuel for boilers.
Boiler blowdown (waste)	Underground concrete retention tank; about 10,000 gallons.	Blowdown occurs about 2 times/month.	Blowdown has high TDS; overflows to sewer.
Chemical reagents: hydrochloric, sulfuric, nitric acids (materials)	Laboratory for water testing.	< 50 gal/month.	Sanitary sewer.
Water-softening backwash (waste)		250-500 gallons/year.	Backwashed to sewer; high TDS levels.

TABLE IV-8

HAZARDOUS MATERIALS AND WASTES: PAINT SHOP

Materials/Wastes	Facility	Quantity	Uses/Disposal
Thinners and solvents: acetone, MEK, ND150, lacquer thinner, mineral spirits (materials and wastes)	Drum storage (outside 418).	1 drum each; varies with demand.	Used solvents, paint residue collected by TWC.
Rinse water (waste)	Wet (spray) paint booth	Variable	Directed to sump, discharged to sewer.
Sand/metal grit (waste)	Sandblaster	Variable	Collected by TWC.

TABLE IV-9

HAZARDOUS MATERIALS AND WASTES: CRAFTS SHOPS

Materials/Wastes	Facility	Quantity	Uses/Disposal
Solvents: acetone, kerosene, alcohol, ethylene glycol, stoddard solvent, MEK, freon TF (materials and wastes)	All (in minor amounts).	Few gallons/year for individual shops.	Parts cleaning; wastes segregated for TWC disposal.
Acids: chromic, nitric (in dip tanks) (materials and wastes)	Electrical shop, silver soldering, sheet metal.	ND	Tanks are serviced by TWC; disposal of off-site at commercial facility.
Road oil: RS-1, MC-7D, SS-1H (materials)	Storage tanks (3) (3) east of 8612 area.	15,000-20,000 gallons per year.	Road maintenance; tanks cleaned out by commercial hauler.
Solid waste (non-hazardous) from LLNL facilities (waste)	Alameda Co. Landfill.	16,000 cubic yards (compacted), 11,000 cubic yards (loose) per year.	Disposal by LLNL truck.
Lubricants: cutting oils, lube oils (materials)	Weld shop		

TABLE IV-10

HAZARDOUS MATERIALS AND WASTES: HEAVY EQUIPMENT MAINTENANCE

<u>Materials/Wastes</u>	<u>Facility</u>	<u>Quantity¹</u>	<u>Uses/Disposal</u>
Solvents: methylene chloride, acetone, MEK (materials and waste)	Drum storage rack, parts degreaser	est. 5 drums	Parts cleaning, degreasing, Rinses to sewer.
Diesel fuel (material)	B519 - South (Asphalt)	est. 10 drums	Transferred from storage tanks; to be sent to salvage.
Lubricants, oils (materials)	B519, drum rack and parking area storage	est. 10 drums	Waste oil (with solvent) sent to salvage.

¹ Drum rack storage inventory is scheduled to be reduced and consolidated with other Plant Engineering facilities.

TABLE IV-11

HAZARDOUS MATERIALS AND WASTES: PEST CONTROL

Materials/Wastes	Facility	Quantity	Uses/Disposal
Dormat Flowable Emulsion	Lorox Betasan 4E Weedone Super D	B520, B515, B292	Pest, weed control; containers are triple-rinsed and disposed of at Pleasanton landfill.
Keltane E.C.	Trimec		
Sevin S.L.	Round Up		
Malathion 57	Maxforce		
Malathion 5	Brominal		
Rose Core	Wilco Gopher Bait		
Systemic	Talon G Bait Packs		
	Talon Weather Block		
C.O.C.S.	Weed Boomer		
Fungicide	U.L.D.B.P. 300		
	Virchem 24		
Embark 2-S	P.T. 110 Resmethrin		
Atrinal	P.T. 240 Perma Dust		
Cyprex 6sw	P.T. 140 Resmethrin		
Vorer Killer	Dursban 4E		
Fore Fungicide	Killmaster II		
Princep 90	Ficam W		
Krovar I	Baygon I.S.		
Surflan 75W	Baygon P.T. 250		
Deurinol 50WP	P.T. 515 Wasp Freeze		
Dowpon M	Spray Adjuvant Defoamer		
Nutra Sol	Spray Adjuvant		
X-77 Spreader			

TABLE IV-12

HAZARDOUS MATERIALS AND WASTES: ELECTRONICS ENGINEERING

Materials/Wastes	Facility	Quantity	Uses/Disposal
Solvents (chlorinated): TCE, TCA (materials and wastes)	B131 (Printed Circuits) B141 (Photoresist films)	10-15 gal/month	Carboys to TWC, or recycled at B141.
Solvents: acetone, MEK, alcohol, kerosene (materials and wastes)	B131 (Printed circuits) B141 (rail gun)	10-15 gal/month; greater usage at B141	Carboys and drums to TWC.
Acids, caustics (materials and wastes)	B131 (Printed circuits)	Several gallons/month	Carboys to TWC.
Oil (dielectric, non-PCB) (materials)	B141 Storage tank	> 5,000 gallons storage	Used at pulsed-power rail-gun facility.
Metal finishing solutions (materials and wastes) <ul style="list-style-type: none"> - hydrochloric, sulfuric, fluoroboric, phosphoric acids - stannous, platinum chloride - nickel sulfamate - gold cyanide - copper pyrophosphate - tin, lead fluoroborate 	B141 Printed circuits facility	10,000 gallons/month	3 underground retention tanks to 3 above-ground tanks; discharged to sewer or TWC. Concentrated solutions packaged in carboys, drums for TWC.

TABLE IV-13

HAZARDOUS AND RADIOACTIVE MATERIALS AND WASTES: MECHANICAL ENGINEERING

Materials/Wastes	Facility	Quantity	Uses/Disposal
Solvents: MEK, methylene chloride, toluene, xylene, acetone, alcohol, TCE, PCE, freon (materials and wastes)	B231 (Plastics Lab), B343 (Test), B321 B131 (Microdevices)	Est. 55 gal/yr (wastes); B321 complex waste ext. at least 200 gal/month.	Lab experiments; waste picked up by TWC. Also from machining processes.
Rad-contaminated and non-rad oil (lubricants, vacuum pump oil, hydraulic oil) (materials and wastes)	B343, B321	Several hundred gallons, some Be	Misc. machinery, wastes to TWC or Salvage.
Rinse water, including Plating Shop effluent (wastes)	B322, B131	3,000 to 6,000 gallons per day at B322; several hundred gallons per month at B131.	Retention tank systems at B322 discharged to sewer; concentrated acid; caustic disposed of by TWC. B131 retention system handles lab sink liquids.
Photo rinses (wastes)	B327 B131 (Print Lab)	50 gallons/day 20 gallons/month	Dilute effluent to sewer. Collected in 55-gallon drums; sent to TWC.
Mercury (dry)(waste)	B131	Est. 30 gallons/month.	Sent to TWC.
Solid rad waste	B321	Minute quantities	Sent to TWC.

TABLE IV-14

HAZARDOUS WASTE AND MATERIALS FACILITIES: CHEMISTRY

Facility	Location	Facility Description	Wastes, Discharge Point
Retention tanks (TWH 1,2)	B222	Two tanks (est. 4,000 gal ea.); liquid wastes from lab sinks. Tanks emptied about 2 times per month.	Contents analyzed for radioactivity, metals, pH. Discharge to sewer if under limits; to TWC if above.
Retention tanks	B231	Two above-ground tanks (1,000 gal ea.); liquid wastes from lab sinks, floor drains go to sumps, then pumped to tanks.	Contents analyzed for radioactivity, metals, pH. Discharge to sewer if under limits; to TWC if above.
Retention tanks	B241	Two steel tanks (est. 1,500 gal ea.) connected to concrete sump. Lab sinks and floor drain to sump; contents pumped to either tank.	Contents analyzed for radioactivity, metals, pH. Discharge to sewer if under limits; to TWC if above.
Retention tanks	B332	Two tanks (est. 1,000 gal ea.); liquid wastes from lab sinks. Tanks are in concrete, below-ground vault.	Contents analyzed for radioactivity, metals, pH. Discharge to sewer if under limits; to
Waste Staging	B221 area	55-gallon drums, carboys on asphalt. Area drains to storm drain. Drums are labelled, segregated by waste type.	Waste, oil TCE, chlorinated solvents, non-chlorinated solvents picked up by TWC.

TABLE IV-14 (cont.)

HAZARDOUS WASTE AND MATERIALS FACILITIES: CHEMISTRY

Facility	Location	Facility Description	Wastes, Discharge Point
Waste Staging	B321 area (east)	55-gallon drums, carboys on pallets. Wastes consist of 038 metal, sodium, acids.	Drums picked up by THC.
Waste Staging	B241	Small area for drum staging; drum rack underlain by asphalt.	Waste drums for chlorinated and non-chlorinated solvents; drum rack includes kerosene, alcohol, freon, TCA. Wastes picked up by THC.
Waste Staging	B331	Waste staging area, drum rack underlain by asphalt (cracked and patched). Rack will be merged with facility at B343, B345.	Waste drums for oil, flammable solvents, chlorinated solvents. Drums picked up by THC.
Waste Staging	B332	Waste staging area on asphalt; drum rack on concrete with run-off to storm drain.	Drums in rack include alcohol, oil, kerosene, TCA, vacuum pump oil. Wastes in drums; chlorinated solvents, flammable solvents.

TABLE IV-15

RADIOACTIVE WASTES: CHEMISTRY

Wastes	Facility	Quantity	Uses/Disposal
Solid radioactive wastes	B223, B231, B241	55 gal drum quantities	Handling materials, gloves, Kim-wipes, etc.; shipped to NTS.
Radioactive contaminated equipment	B231, B241	Varies.	Apparatus exposed to radioactivity; decontaminated for reuse or repair.
Radioactive contaminated oil	B231, B241	6 gal/month.	Oil exposed to radioactivity; solidified, shipped to NTS.
Liquid radioactive waste	B241	15 gal/month.	Contaminated solvents.
Tritiated liquid waste	B331	20 gal/month.	Solvents and water that are tritium contaminated; evaporated or incinerated.
Tritiated solid waste	B331	4 - 55 gal drum/month.	Contaminated handling materials. Incinerated or shipped to NTS.
Tritium gas	B331	3,000 ci/year.	Experiments and testing; exhausted to the atmosphere.
TRU solid waste	B332	24 - 55 gal drum/month.	Transuranium contaminated material shipped to NTS.
TRU liquid waste	B332	20 gal/month.	Contaminated solvents and wastes.
TRU contaminated equipment	B332	Varies.	Shipped to NTS; oversized equipment stored at TWC pending size reduction facility.

TABLE IV-16

HAZARDOUS WASTE AND MATERIALS FACILITIES: BIOMEDICAL

Facility	Location	Facility Description	Wastes, Discharge Point
Waste staging, drum storage	B412	Waste drums on pallets on concrete pad; many empty, rusty drums nearby for salvage. Drum rack is sheltered, on concrete, with run-on control.	Wastes include MEK, alcohol, waste oil. Drum rack has kerosene, acetone, MEK, alcohol, vacuum pump oil.

TABLE IV-17

RADIOACTIVE WASTES: BIOMEDICAL

Wastes	Facility	Quantity	Uses/Disposal
Radioactive solid waste	B361, B366	1 - 55 gal drum/wk.	Handling materials, crushed glass scintillation vials, shipped to NTS.
Radioactive liquid waste	B361	10 gal/week.	Several isotopes in carboys.
Contaminated biological waste	B363	Varies.	Radioactive contaminated animals and cages. Incinerated (B623).
Tritiated liquids	B361	10 gal/month.	Incinerated (B623).

TABLE IV-18

HAZARDOUS WASTE AND MATERIALS FACILITIES: PHYSICS

Facility	Location	Facility Description	Wastes, Discharge Point
Retention tanks, sump	B194	Lab sinks and LCW system drain to concrete sump; sump pumped to one of two tanks. Portable tanks at B194 used for retention of seepage water in basement.	Liquids (from sinks and LCW system) contain low concentrations of metals and radioactivity. Tanks are sampled, analyzed; normally discharged to sewer.
Retention tank, sump	B212	Concrete sump (500 gal) collects seepage water from pits; water pumped to above-ground tank (1,000 gal).	Above-ground tank sampled and analyzed; contents discharged to sewer.
Retention sump	B292	Concrete sump (1,000 gal) collects water from floor drains.	Contains tritium; sump sampled and analyzed; discharge to sewer.
Waste staging areas	B194	Outside facility has 55-gallon drums on pallets awaiting sampling and analysis. One drum of liquid waste inside B194 shop requires analysis.	Wastes outside consist of radioactive and unknown materials (to be analyzed). Waste oil/solvent inside needs analysis. Picked up by TWC.
		Drum rack on asphalt surface; covered by tarp.	Solvents stored include freon, kerosene, alcohol, acetone.
Waste staging area	B212	Waste staging area consists of drums placed on asphalt. Storage rack for drums on south side of B212 is on asphalt surface.	Radioactive wastes at staging area to be picked up by TWC. Drum storage has oil, kerosene, alcohol, acetone, cutting oil.

TABLE IV-18 (cont.)

HAZARDOUS WASTE AND MATERIALS FACILITIES: PHYSICS

Facility	Location	Facility Description	Wastes, Discharge Point
Waste staging area	B292	Waste storage area is east of B292; drum storage is north of building. Both facilities are on concrete/asphalt.	Wastes are mostly radioactive; picked up by TWC. Drum rack has acetone, oil, freon, alcohol.
Laser Pantography Lab	B182	Uses cylinders of exotic gases.	TWC to handle waste cylinders; difficult to dispose of if mfg will not accept old cylinders.

TABLE IV-19
RADIOACTIVE WASTES: PHYSICS

<u>Materials/Wastes</u>	<u>Facility</u>	<u>Quantity</u>	<u>Uses/Disposal</u>
Solid radioactive waste	B194, B212 B292	6 - 55 gal drums/month.	Handling materials, gloves, Kim-wipes, etc. Shipped to NTS.
Contaminated oil	B212, B292		Contaminated oil from use with radioactivity. Shipped to NTS.
Contaminated equipment	B194, B212 B292	Varies	Contaminated equipment decontaminated for repair or reuse.
Tritium contaminated solvents	B292	5 gal/wk.	Incinerated (623), ash to municipal landfill.
Tritium contaminated water	B292	200 gal/3 month	Incinerated (8623), ash to municipal landfill.
Spent tritium targets	B292	1 target/month.	Shipped to NTS.
Tritium scrubber cylinders	B292	5 cylinder/month.	Shipped to NTS.
Tritium gas	B292	80 Ci/year.	Experimentation, exhausted to the atmosphere.

TABLE IV-20

HAZARDOUS WASTE AND MATERIALS FACILITIES: LASERS

Facility	Location	Facility Description	Wastes, Discharge Point
Retention sump, tank	B161 (partial)	Steel sump receives liquids from two sinks; pumped to aboveground (1,000 gal) steel tank.	Radioactive liquids to retention system; tank contents sampled and discharged to sewer. Other, non-rad sinks connected to sewer.
Retention sump, tank and	B175	Concrete sump receives liquid leaks from cooling system pumped to below ground (1,000 gal) steel tank.	Radioactive and non-radioactive liquids from lab sinks cooling system. Normally discharged to sewer after sampling and analysis.
Retention tank	B175	Aboveground (1,500 gal) tank receives overflow (occasionally) from cooling system.	Coolant water, sampled and analyzed, discharged to sewer.
Retention sump,	B298	Sump and steel tank (est 1,000 gal) are below ground in concrete enclosure.	Sump and tank receive liquids from lab sinks. Solvents used in lab areas. Tank sampled and analyzed; contents discharged to sewer.
Retention sump, tanks	B490	Retention system recently completed; not yet in use. Liquids will first flow to 16-foot deep sump, then will be pumped to one of three tanks. Tanks are 1,000 gal fiberglass and serve the dye facility and will receive uranium contaminated wastes.	Not yet in use; will be sampled and analyzed, discharged to sewers as are other LLNL tanks.
Retention sump, tanks	B491	2000 gal steel tanks	For radioactive liquids
Retention sump, tanks	B492	2000 gal steel tanks	For alcohol and laser dye waste. Sampled and analyzed, if clean discharged to the sewer.

TABLE IV-20 (cont.)

HAZARDOUS WASTE AND MATERIALS FACILITIES: LASERS

Facility	Location	Facility Description	Wastes, Discharge Point
Waste accumulation	B176	Waste drums located on machine shop loading dock.	Drums contain acetone, TCE (separately) TWC picks up drums.
Waste staging	B161	Central waste staging area; located on asphalt/dirt. Approximately 12-15 drums, several carboys.	Wastes segregated by; laser dyes/waste, non-chlorinated solvents, chlorinated solvents, solid rad waste, liquid rad waste (carboys), oil. Containers to be picked up by TWC.
Drum storage	B165	Drum rack (to be phased out) located west of B166 on asphalt; drainage to bare ground.	Drums consist of lacquer thinner, TCA, freon, alcohol, kerosene, cutting oil, acetone, MEK.
Waste staging	B298	Drums located north of B298; drums on asphalt and dirt.	Wastes consist of radioactive solids (3 drums), non-chlorinated solvents, chlorinated solvents.
Drum storage	B296	Storage area on concrete, under shelter.	Drums contain oil, acetone, freon, TCA, alcohol.
Waste staging	B383	Drum storage located outside machine shop on concrete/asphalt surface. Waste barrel is on dirt surface.	Waste drum contains solvent, to be collected by TWC.

TABLE IV-21

RADIOACTIVE WASTES: LASERS

Materials/Wastes	Facility	Quantity	Uses/Disposal
Solid radioactive waste	B161, B298	8 - 55 gal drums/month	Handling equipment, shipped to NTS.
Liquid radioactive waste	B161, B167	10 gal/month	Contaminated solvents and rinses, solidified and shipped to NTS.
Radioactive solids	B161	1 gm/month	Depleted uranium.
Contaminated oil	B298	1/2 gal/yr	

Table IV-22. HAZARDOUS WASTE AND MATERIALS FACILITIES: MAGNETIC FUSION ENERGY

Facility	Location	Facility Description	Wastes, Discharge Point
Waste staging, drum storage	B438 (NE)	Waste staging area on asphalt outside B438 (N); drum rack on dirt pad. Drains to storm ditch (75 ft).	Wastes include TCE and water, acids and water, ferric chloride (etching solution), plating shop rinses-picked up by TWC. Drum rack has TCE, paint solvents.
Waste staging, drum storage	B443 (NW)	Waste staging area has concrete basin (drums on pallets). Drum racks on asphalt; no run-on or run-off control.	Wastes include (to be solidified), insulating oil; to be picked up by TWC. Drum storage includes TCE, kerosene, alcohol, epoxy resins.
Drum storage	B431 (SE)	Drum rack on concrete base; no drainage control or drip protection.	Materials include TCE, oil, solvents. Some oil for salvage, and PCB transformer.
Drum storage	B435/436	Drum rack on concrete pad, storm drain about 20 feet. No drainage protection.	Materials include mineral oil, alcohol, cutting oil. Mercury drum outside B435.

TABLE IV-23

HAZARDOUS WASTE AND MATERIALS FACILITIES: DEFENSE SYSTEMS

Facility	Location	Facility Description	Wastes, Discharge Point
Aspirators and dishwash sink	B151	Lab aspirators and glassware wash sink; plumbed to roof drain system.	Surface and ultimately storm drain.
Retention tank (TRW-1, TRW-2)	B151	Two underground tanks (4,500 gal ea.) are concrete; PVC-lined inside and tar-epoxy outside. These tanks replace a system that failed. TRW-2 serves as overflow.	Liquids from sinks, floor drains. Tanks sampled and analyzed; discharge to sewer.
Retention sump, tank	B251	Two steel tanks in a concrete sump and above-ground tanks (1,000 gal) located on south side of B251.	Liquids from floor drains, sinks. Use of solvents, acids, oils; mostly radioactive. Tanks sampled, analyzed; discharge to sewer.
Retention tank	B281	Two steel tanks (1,000 gal ea.) in concrete sump; connected to 1 sink in B281.	Only 1 sink discharges to retention systems; contents tested and discharged to sewer.
Waste staging, drum storage	B151	Waste drums on concrete loading dock; some waste drums at parking lot. Drum rack will be removed; currently is on concrete pad.	Rad and non-rad liquids and solids to TWC; drum rack has cutting oil, freon, acetone.
Waste staging, drum storage	B121	Waste staging in loading dock area (on concrete). Drum storage outside on asphalt with small drip trays; facility to be upgraded.	Wastes consist of used dyes, photochemicals, mixed (e.g., TCE) solvents drum storage includes TCE, acetone, freon, alcohol, cutting oil.

TABLE IV-23 (cont.)

HAZARDOUS WASTE AND MATERIALS FACILITIES: DEFENSE SYSTEMS

Facility	Location	Facility Description	Wastes, Discharge Point
Ion exchange plant	B281	Facility not in use.	None.
Waste staging, drum storage	B251	Waste staging area located south of B251.	Materials used in B251 include acids/bases, oil, benzene; radioactive wastes.
Waste staging	B281	Waste staging area located in loading dock area, on asphalt.	Wastes include liquids from NTS radioactive solids.
Waste staging, drum storage	B341	Waste staging, drum storage located on concrete pad. 800 gal storage tank for dielectric oil (pulse power).	Drum storage includes cutting oil, motor oil, freon, acetone, MEK, vacuum pump oil. Some depleted uranium wastes from shots handled by TWC.
Waste staging drum storage	B345	Wastes, raw materials used in small quantities; kept inside for collection by TWC (carboys).	Small amounts of waste solvents, acids. Drum rack has MEK, stoddard solvent, alcohol, acetone.

TABLES

Table II-1. Retention Tanks on LLNL Site - January 1985

Bldg. Number	Container Type	Year Installed	Capacity (Gallons)	Material Strg. Type	Material Stored
111	TANK	1980	350	PRODUCT	DIESEL FUEL
113	TANK	1980	350	PRODUCT	DIESEL FUEL
131	TANK	1970	280	PRODUCT	DIESEL FUEL
131	TANK	1977	12500	PRODUCT	DIESEL FUEL
131	TANK	1977	12500	PRODUCT	DIESEL FUEL
131	TANK	1971	4000	PRODUCT	CONTAM.RINSEWATER
131	TANK	1959	1000	PRODUCT	AMMONIA
141	TANK	1960	1000	PRODUCT	FILLED WITH SAND
141	SUMP	1980	450	WASTE	CONTAM.RINSEWATER
141	SUMP	1980	450	WASTE	CONTAM.RINSEWATER
141	SUMP	1980	450	WASTE	CONTAM.RINSEWATER
151	TANK	1964	1000	PRODUCT	DIESEL FUEL
151	TANK	1972	4000	WASTE	CONTAM.RINSEWATER
151	TANK	1983	4000	WASTE	CONTAM.RINSEWATER
151	SUMP	1967	380	WASTE	CONTAM.RINSEWATER
151	TANK	1983	4000	PRODUCT	DIESEL FUEL
161	SUMP	1976	135	WASTE	CONTAM.RINSEWATER
175	TANK	1980	1000	WASTE	CONTAM.RINSEWATER
194	TANK	1959	280	PRODUCT	DIESEL FUEL
194	SUMP	1967	300	WASTE	CONTAM.RINSEWATER
212	SUMP	1958	50	WASTE	CONTAM.RINSEWATER
212	SUMP	1958	50	WASTE	CONTAM.RINSEWATER
212	SUMP	1962	50	WASTE	CONTAM.RINSEWATER
212	PIT	1976	200	WASTE	DRUMRACK DRYWELL
222	TANK	1970	9000	WASTE	CONTAM.RINSEWATER
229	TANK	1943	25000	UNUSED	LAST USED 1950 (EST)
229	TANK	1943	25000	UNUSED	LAST USED 1950 (EST)
229	TANK	1943	25000	UNUSED	LAST USED 1950 (EST)
229	TANK	1943	25000	UNUSED	LAST USED 1950 (EST)
231	TANK	1983	3200	PRODUCT	DIESEL FUEL
231	TANK	1983	3000	PRODUCT	DIESEL FUEL
231	TANK	1978	12500	PRODUCT	DIESEL FUEL
231	TANK	1978	12500	PRODUCT	DIESEL FUEL
231	SUMP	1959	500	WASTE	CONTAM.RINSEWATER
231	SUMP	1959	250	WASTE	CONTAM.RINSEWATER
231	TANK	1967	280	PRODUCT	DIESEL FUEL
241	TANK	1957	500	PRODUCT	DIESEL FUEL
241	SUMP	1959	345	WASTE	CONTAM.RINSEWATER
251	TANK	1967	500	PRODUCT	DIESEL FUEL
251	SUMP	1967	25000	STANDBY	STANDBY USE ONLY
251	SUMP	1968	300	WASTE	CONTAM.RINSEWATER
251	TANK	1965	280	PRODUCT	DIESEL FUEL
255	TANK	1970	350	PRODUCT	DIESEL FUEL
271	TANK	1982	2000	PRODUCT	DIESEL FUEL
281	TANK	1955	1000	WASTE	CONTAM.RINSEWATER
281	TANK	1955	1000	WASTE	CONTAM.RINSEWATER

*Contam. = Contaminated rinsewater. More detailed information on contents can be found in the text and tables presented later in the report.

Retention Tanks on LLNL Site - January 1985 (Continued)

Idg. Number	Container Type	Year Installed	Capacity (Gallons)	Material Strg. Type	Material Stored
281	TANK	1957	1500	WASTE	DOMESTIC USE:WASTEWATER
281	TANK	1957	1500	WASTE	DOMESTIC USE:WASH WATER
281	SUMP	1957	45	WASTE	CONTAM.WASTEWATER
281	TANK	1957	10000	WASTE	PRIMARY COOLING WATER
281	TANK	1957	3000	WASTE	PRIMARY COOLING WATER
281	ION EX COLUM	1958	100	WASTE	PRIMARY COOLANT POLISHING
281	ION EX COLUM	1958	100	WASTE	PRIMARY COOLANT POLISHING
281	ION EX COLUM	1958	100	WASTE	PRIMARY COOLANT POLISHING
281	ION EX COLUM	1958	100	WASTE	PRIMARY COOLANT POLISHING
281	TANK	1957	350	PRODUCT	NUCLEAR REACTOR FUEL RODS
291	TANK	1971	5000	WASTE	PLANT DEIONIZER WASTE
291	TANK	1983	1000	PRODUCT	DIESEL FUEL
292	SUMP	1974	1000	WASTE	CONTAM.RINSEWATER
298	TANK	1982	350	PRODUCT	DIESEL FUEL
298	SUMP	1983	300	WASTE	CONTAM.WASTEWATER
310	TANK	1956	500	WASTE	CONTAM.WASTEWATER
318	TANK	1981	250	PRODUCT	GASOLINE: REGULAR GRADE
321	TANK	1976	500	PRODUCT	DIESEL FUEL
321	SUMP	1958	200	WASTE	CONTAM.RINSEWATER
321	SUMP	1971	3000	WASTE	PLATING SHOP CAUSTIC WASTE
321	SUMP	1971	3700	WASTE	PLATING SHOP ACID WASTE
321	SUMP	1971	3000	WASTE	PLATING SHOP WASTE
22	SUMP	1975	3000	WASTE	CONC. PLATING SHOP WASTE
322	FLOORPIT	1975	59000	WASTE	SPILL CONTAINMENT:T0322-21X
324	TANK	UNKNOWN	1000	PRODUCT	GASOLINE: REMOVED 1982
325	TANK	1967	25000	WASTE	PLANT DEIONIZER WASTE
331	TANK	1955	280	PRODUCT	DIESEL FUEL
332	TANK	1960	1000	PRODUCT	DIESEL FUEL
332	TANK	1976	1500	PRODUCT	DIESEL FUEL
332	TANK	1981	2000	PRODUCT	DIESEL FUEL
332	TANK	1961	1000	WASTE	CONTAM.RINSEWATER
332	TANK	1961	1000	WASTE	CONTAM.RINSEWATER
361	TANK	1973	1000	PRODUCT	DIESEL FUEL
361	SUMP	1981	500	PRODUCT	CONTAM.RINSEWATER
361	TANK	1981	500	WASTE	CONTAM.RINSEWATER
361	TANK	1981	500	WASTE	CONTAM.RINSEWATER
362	SUMP	1963	150	WASTE	CONTAM.RINSEWATER
365	TANK	1977	6000	PRODUCT	DIESEL FUEL
365	SUMP	1979	350	WASTE	CONTAM.RINSEWATER
377	SUMP	1969	500	WASTE	CONTAM.RINSEWATER
377	SUMP	1969	250	WASTE	CONTAM.RINSEWATER
377	TANK	1969	2000	PRODUCT	SEAWATER (FOR AQUARIUM)
377	TANK	1969	2000	PRODUCT	SEAWATER (FOR AQUARIUM)
377	TANK	1969	6000	PRODUCT	SEAWATER (FOR AQUARIUM)
377	TANK	1969	6000	PRODUCT	SEAWATER (FOR AQUARIUM)
381	TANK	1973	12500	PRODUCT	DIESEL FUEL
391	TANK	1974	12500	PRODUCT	DIESEL FUEL
401	TANK	1943	10000	PRODUCT	DIESEL FUEL

Retention Tank on LLNL Site - January 1985 (Continued)

Rldg. Number	Container Type	Year Installed	Capacity (Gallons)	Material Strg. Type	Material Stored
401	TANK	1943	10000	PRODUCT	DIESEL FUEL
401	TANK	1943	10000	PRODUCT	DIESEL FUEL
402	TANK	1979	10000	PRODUCT	GASOLINE:REGULAR GRADE
402	TANK	1979	10000	PRODUCT	GASOLINE:UNLEADED GRADE
403	TANK	1943	10000	PRODUCT	GASOLINE:NOW FILLED W/SAND
403	TANK	1943	2500	WASTE	LUBEOIL: REMOVED 1960
403	TANK	1943	10000	PRODUCT	GASOLINE:NOW FILLED W/SAND
403	TANK	1943	10000	PRODUCT	GASOLINE:NOW FILLED W/SAND
403	TANK	1960	1000	PRODUCT	DIESEL FUEL
412	TANK	1955	1000	WASTE	CONTAM.WASTEWATER
412	TANK	1955	1000	WASTE	CONTAM.WASTEWATER
419	TANK	1976	500	WASTE	CONTAM.WASTEWATER
419	TANK	1976	500	WASTE	CONTAM.WASTEWATER
419	TANK	UNKNOWN	100	WASTE	CONTAM.WW:REPAIRED 1984
419	SUMP	1983	300	WASTE	RINSEWATER:BATTERY SHOP
424	TANK	1979	300	PRODUCT	DIESEL FUEL
431	TANK	1965	280	PRODUCT	DIESEL FUEL
435	TANK	1978	280	PRODUCT	DIESEL FUEL
451	TANK	1977	500	PRODUCT	DIESEL FUEL
490	TANK	1983	2000	PRODUCT	DIESEL FUEL
490	TANK	1983	5000	WASTE	FUTURE USE:CONTAM.WATER
490	TANK	1983	1000	WASTE	FUTURE USE:CONTAM.WATER
490	TANK	1983	1000	WASTE	FUTURE USE:CONTAM.WATER
514	SUMP	1967	135	WASTE	STORM RUNOFF
---	---	---	---	---	POTENTIAL SPILLAGE
514	SUMP	1963	200	WASTE	STORM RUNOFF
---	---	---	---	---	POTENTIAL SPILLAGE
514	SUMP	1963	200	WASTE	CONTAM.WASTEWATER
592	SUMP	1963	100	WASTE	ANIMAL WASTES
611	TANK	~1980	3200	WASTE	WASTE OIL
612	SUMP	1982	25	WASTE	CONTAM.WASTEWATER
1705	TANK	1978	350	PRODUCT	DIESEL FUEL
4181	TANK	UNKNOWN	600(EST).	WASTE	OIL: FILLED WITH SAND 1976

Table II-2. The 1982 inventory of racks used to hold 0.21 m³ (55 gal) drums which various liquids are dispensed at LLNL.

Building (side of rack loc- ation)	Rack drum capa- city	Evidence of liquid leakage	Leakage collec- tion system	Rack support surface	Rack drainage	Remarks
121(W)	4	Some	No	Asphalt	Storm sewer	
131(W)	12	Considerable	No	Asphalt	Storm sewer	Degreasing area nearby
141(SE)	7	Some	No	Asphalt	Storm sewer	
151(W)	16	Some	No	Asphalt	Grassy field	
161(W)	4	Some	No	Asphalt	Ditch	
166(W)	8	Some	No	Asphalt	Field	Degreasing area nearby
167(N)	12	Some	No	Native grd	Field	
T1726(N)	1	None	No	Asphalt	Field	
177(N)	12	Some	No	Asphalt	Field	
194(W)	8	Some	No	Native grd	Field	
212(E)	12	Some	Yes	Concrete	Sump	Leaves in leakage collection system
222(E)	8	Some	Yes	Asphalt	Storm sewer	
231(S)	48	Considerable	No	Asphalt	Storm sewer	
231(N)	2	Some	No	Asphalt	Storm sewer	
241(E)	8	None	No	Concrete	Grassy area	
243(W)	8	None	No	Concrete	Grassy area	
255(N)	1	None	No	Concrete	Storm sewer	
281(S)	8	Some	No	Asphalt	Storm sewer	
292(N)	8	Unknown	No	Asphalt	Field	Rack observed only from distance
321(S)	40	Some	Yes	Asphalt & concrete		
331(E)	12	Some	No	Asphalt	Storm sewer	
332(W)	8	None	No	Concrete	Storm sewer	
381(N)	12	Some	No	Concrete	Grassy field	
403(E)	6	Some	No	Concrete & asphalt	Not noted	
431(E)	16	Some	No	Concrete & asphalt	Not noted	
435(N)	16	Some	No	Asphalt	Not noted	
511(W)	8	None	Yes	Not noted	Not noted	
518(S)	78	Some	No	Asphalt & concrete	Not noted	
518(N)	102	Considerable	No	Asphalt	Not noted	
519(N)	8	Not noted	Not noted	Asphalt	Not noted	
519(S)	32	Some	No	Asphalt	Not noted	
520(S)	14	Not noted	Not noted	Asphalt	Not noted	

From Stone (1982)

Table II-3. In 1982 partial list of liquids dispensed from racked 0.21-m³ (55-gal) Drums at LLNL.

Building and side of rack location	Liquids present (April 1982)																									Remarks
	Isopropyl alcohol	Cutting oil	Detergent oil	Perchloroethylene	Trichlorotrifluoroethane	Acetone	Trichloroethane	Mono butyl glycol	Lacquer thinner	Kerosene	Trichloroethylene	Methyl ethyl ketone	Vacuum pump oil	Mineral spirits	Ethyl alcohol	Methanol	Trifluoroethanol	Lap oil	Hydraulic fluid	Methylene chloride	Naptha	Dibutyl phthalate	Xylol	Diethylenetriamine	Engine oil	
121(W)	X				X	X																				
131(W)	X	X	X	X	X																					
141(SR)						X	X	X		X					X											
151(W)	X	X		X	X	X					X	X	X													
161(W)									X		X	X	X		X											
166(W)					X	X				X	X	X	X													
167(W)					X	X																				
71726(W)					X																					
177(W)	X					X	X					X				X	X	X								
194(W)	X				X	X	X				X	X	X	X												
212(E)	X	X				X	X	X			X	X	X													
222(E)		X		X	X	X					X	X	X	X												
231(S)						X	X				X	X	X					X		X	X	X	X	X		
231(N)																			X							
241(E)	X				X	X					X	X	X	X				X								
243(W)	X				X						X	X					X									
255(N)					X																					
281(S)	X					X								X												
292(W)																										Undetermined
321(S)	X	X				X					X	X	X	X												
331(E)					X							X														
332(W)	X					X	X				X		X													
381(N)		X			X	X	X				X	X	X	X			X									
403(E)			X																						X	
431(E)	X					X	X				X		X	X												
439(W)		X				X					X						X									
511(W)						X																				
518(S)				X		X			X		X	X								X						
518(N)			X																						X	
519(N)			X																							
519(S)		X				X					X	X	X						X							
520(S)			X								X								X							

From Stone (1982)

TABLE IV-1

HAZARDOUS AND RADIOACTIVE WASTE DISCHARGES¹: TOXIC WASTE CONTROL

ID ²	Description	Chem. Comp	Radioactive	Annual Generation Rate	TSD Method
001	Caustic	NaOH, 5-30%	No	72,000 gal.	Offsite Disposal
002	Acid	Mixture HCl, H ₂ SO ₄ , H ₂ CrO ₄ , HNO ₃	No	58,000 gal.	Offsite Disposal
003	Acid	Mixture HCl, H ₂ SO ₄ , H ₂ CrO ₄ , HNO ₃ MFP, Uranium-238	Yes	100 gal.	Solidify, Offsite Disp.
004	Oil	Vacuum pump Crankcase Cutting Insulating	No	25,000 gal.	Offsite Recycle
005	Rinse Water	Heavy Metals Cr, Cu, Zn, Ni	No	76,000 gal.	Filter Treatment
006	Rinse Water	Heavy Metals Cr, Cu, Zn, Ni MFP,* Uranium-238	Yes	37,000 gal.	Filter Treatment

* MFP = Mixed fission products

TABLE IV-1 (cont.)

HAZARDOUS AND RADIOACTIVE WASTE DISCHARGES: TOXIC WASTE CONTROL

ID# ²	Description	Chem. Comp	Radioactive	Annual Generation Rate	TSD Method
007	Laboratory reagents, liquid	Mixture	No	1,000 gal.	Offsite Disposal
008	Laboratory reagents, solid	Mixture	No	425 ft ³	Offsite Disposal
009	Machine coolants	5% oil, 95% water Beryllium Uranium-238	Yes	6,700 gal.	Solidify Offsite Disp.
010	Machine coolants	5% oil, 95% water	No	1,800 gal.	Offsite Disposal
011	Mixed chemicals	Solvents Aqueous mixtures MFP, Uranium-238	Yes	4,600 gal.	Solidify Offsite
012	Flammable solvents	Acetone, paint thinner, MEK	No	2,200 gal.	Offsite Recycle

TABLE IV-1 (cont.)

HAZARDOUS AND RADIOACTIVE WASTE DISCHARGES¹: TOXIC WASTE CONTROL

ID ₂	Description	Chem. Comp	Radioactive	Annual Generation Rate	TSD Method
013	Chlorinated solvents	1,1,1-Trichloroethane, Perchloroethylene, Methylene chloride	No	2,300 gal.	Offsite Recycle
014	Plastics	Resins, epoxies	No	400 gal.	Offsite Disposal
015	Biological waste, solid	Carcinogens -H, ¹⁴ C	Yes	1,500 ft ³	Onsite. Incineration
016	Carcinogenic liquids	Flammable solvents, Carcinogens	No	1,000 gal.	Onsite Incineration
017	PCB contaminated oils	7ppm-100% PCBs insulating	No	2,000 gal.	Offsite Disposal
018	PCB capacitors	100% PCB	No	1,000 ft ³	Onsite Storage and Ultimate Offsite Disposal
019	PCB contaminated transformers	7-500 ppm PCB	No	700 ft ³	Onsite Storage

TABLE IV-1 (cont.)

HAZARDOUS AND RADIOACTIVE WASTE DISCHARGES: TOXIC WASTE CONTROL

ID# ²	Description	Chem. Comp	Radioactive	Annual Generation Rate	TSD Method
020	Filter cake	Diatomaceous earth Cr, Cu, Ni, Zn MFP, Uranium-238	Yes	2,000 ft ³	Offsite Disposal
021	Mercury-flasks bottles and tubes	Mercury - 90% water	No	1,500 lbs.	Offsite Recycle
022	Batteries	H ₂ SO ₄ , Pb	No	20,000 lbs.	Offsite Recycle
023	Battery Acid and Rinsewater	H ₂ SO ₄ , Pb	No	250 gal.	Offsite Disposal
024	Tritiated water	Tritium, water	Yes	8,300 gal. (4 ci total)	Evaporator

¹ Source: LLNL Interim Hazardous Waste Management Plan; March 16, 1984.² Keyed to Tables III.2 and III.3.

TABLE IV-2

LLNL ON-SITE STORAGE

Site Identifier (Building)	Storage Method	Waste Stored	Facility Capacity
S-514	Drum Shed	011 Mixed chemicals	22,000 gal.
S-513	Drum Warehouse	009 Machine coolants 011 Mixed chemicals	44,000 gal.
S-625	Drum Warehouse	017 PCB oils 018 PCB capacitors 019 PCB transformers	100,000 gal.
S-612	Yard storage	001 Caustic 001 Acid 004 Oil 007 Lab reagents, liquid 008 Lab reagents, solid 010 Machine coolants 012 Flammable solvents 013 Chlorinated solvents 014 Plastics	220,000 gal.
S-614	Drum Warehouse	007 Lab reagents, liquid 008 Lab reagents, solid	2,000 ft ³
S-500	Tank	005 Rinse water (cr, Cu, Zn, Ni, oil)	25,000 gal.
S-419	Tank	023 Acid	250 gal.
S-6126	Tank	004 Oil	3,000 gal.

TABLE IV-2 (cont.)

LLNL ON-SITE STORAGE

Site Identifier (Building)	Storage Method	Waste Stored	Facility Capacity
S-6127	Transportainer	021 Mercury flasks bottles and tubes	640 ft ³
S-6128	Yard Storage	022 Batteries	90 ft ²

TABLE IV-3

LLNL TREATMENT FACILITIES

Treatment Process	Treated Waste Stream	Capacity	Effluent Disposition
Incineration	015 Biological waste, solid	15 ft ³ /hr.	Ash to offsite municipal land-fill.
	016 Carcinogenic, flammable	25 gal/hr.	Ash to offsite municipal land-fill.
Chemical precipitation, vacuum filtration	005, 006 Rinse water	200 gal/hr.	Offsite disposal.
Thin-film evaporation	024 Tritiated water	0.33 gal/hr.	Air discharge.

TABLE IV-4

HAZARDOUS MATERIALS AND WASTES: HAZARDS CONTROL DEPARTMENT

<u>Materials/Wastes</u>	<u>Facility</u>	<u>Quantity</u>	<u>Uses/Disposal</u>
Solvents: acetone, methylethylketone, hexanes, freon (material and waste)	Machine shop; Aerosol Physics and Analytical Lab	Several gal/yr; << 1 gal/yr	Parts cleaning, degreasing chemical analysis; disposed in solvent waste drum
Acids: chromic, nitric, perchloric (material and waste)	Machine shop, Analytical Lab	< 10 gal/yr	Metal dip/welding, solids digestion (lab); dip tanks pumped by TWC
Oils: cooling oil, cutting oil, lubricants (material and waste)	Machine shop	Minor; squeeze bottle application	Oils collected in drum; for recycle or sale.
Xylene (material and waste)	Rad. Counting Lab	Small vials	Cocktails for liquid scintillation counter; incinerated by TNC
Trichloroethylene (material and waste)	Machine shop; Analytical Lab	5 gal/yr << 1 gal/yr	Degreasing, calibration standard for analytical instruments

TABLE IV-5

RADIOACTIVE WASTES: HAZARDS CONTROL DEPARTMENT

Wastes	Facility	Quantity	Uses/Disposal
Solid radioactive waste	Analytical laboratory	5 ft ³ /year	Handling equipment, environmental samples, planchets, air filters
Radioactive liquid waste, aqueous	Analytical laboratory	5 gals/month max	Retention tank samples, tritium in water. Environmental samples; incinerated by TWC
Tritiated liquid waste, solvent	Analytical laboratory	10 gal/month	Tritium in xylene for scintillation counting, incinerated by TWC, tritium in methane
Scintillation vials	Analytical laboratory	1 gal/2 months	Tritium in xylene in polyethylene bottles, incinerated by TWC

TABLE IV-6

HAZARDOUS MATERIALS AND WASTES: LCW STATIONS

Materials/Wastes	Facility	Quantity	Uses/Disposal
Oil/lubricants: DTE oil (material)	B291 B325	5 drums 2 drums	No waste.
Water treatment chemicals: corrosion inhibitors, boron nitrate, biocide (materials)	B291 B325	Variable; at least several drums.	Used in water treatment; no waste disposal.
Blowdown: boilers and cooling towers (waste)	B291, B325	Varies seasonally, cooling towers about 10 gpm in summer.	Discharged to sewer.
Diesel fuel (material)	B291	1,000 gallons	Fuel for air compressor.
Regeneration wastewater (waste)	B291, B325	1,000 gallons/month (estimated average discharge).	Discharged to underground retention tank. Commercial disposal at B291; discharge to storm drain at B325.
PCB transformer (material)	B291	One (1).	In use.

TABLE IV-7

HAZARDOUS MATERIALS AND WASTES: STEAM PLANT

Materials/Wastes	Facility	Quantity	Uses/Disposal
Diesel fuel (material)	3-10,000 gallon underground tanks	30,000 gallons	Standby fuel for boilers.
Boiler blowdown (waste)	Underground concrete retention tank; about 10,000 gallons.	Blowdown occurs about 2 times/month.	Blowdown has high TDS; overflows to sewer.
Chemical reagents: hydrochloric, sulfuric, nitric acids (materials)	Laboratory for water testing.	< 50 gal/month.	Sanitary sewer.
Water-softening backwash (waste)		250-500 gallons/year.	Backwashed to sewer; high TDS levels.

TABLE IV-8

HAZARDOUS MATERIALS AND WASTES: PAINT SHOP

Materials/Wastes	Facility	Quantity	Uses/Disposal
Thinners and solvents: acetone, MEK, MD150, lacquer thinner, mineral spirits (materials and wastes)	Drum storage (outside 418).	1 drum each; varies with demand.	Used solvents, paint residue collected by TWC.
Rinse water (waste)	Wet (spray) paint booth	Variable	Directed to sump, discharged to sewer.
Sand/metal grit (waste)	Sandblaster	Variable	Collected by TWC.

TABLE IV-9

HAZARDOUS MATERIALS AND WASTES: CRAFTS SHOPS

Materials/Wastes	Facility	Quantity	Uses/Disposal
Solvents: acetone, kerosene, alcohol, ethylene glycol, stoddard solvent, MEK, freon TF (materials and wastes)	All (in minor amounts).	Few gallons/year for individual shops.	Parts cleaning; wastes segregated for TWC disposal.
Acids: chromic, nitric (in dip tanks) (materials and wastes)	Electrical shop, silver soldering, sheet metal.	ND	Tanks are serviced by TWC; disposal of off-site at commercial facility.
Road oil: RS-1, MC-70, SS-1H (materials)	Storage tanks (3) (3) east of B612 area.	15,000-20,000 gallons per year.	Road maintenance; tanks cleaned out by commercial hauler.
Solid waste (non-hazardous) from LLNL facilities (waste)	Alameda Co. Landfill.	16,000 cubic yards (compacted), 11,000 cubic yards (loose) per year.	Disposal by LLNL truck.
Lubricants: cutting oils, lube oils (materials)	Weld shop		

TABLE IV-10

HAZARDOUS MATERIALS AND WASTES: HEAVY EQUIPMENT MAINTENANCE

Materials/Wastes	Facility	Quantity ¹	Uses/Disposal
Solvents: methylene chloride, acetone, MEK (materials and waste)	Drum storage rack, parts degreaser	est. 5 drums	Parts cleaning, degreasing, Rinses to sewer.
Diesel fuel (material)	B519 - South (Asphalt)	est. 10 drums	Transferred from storage tanks; to be sent to salvage.
Lubricants, oils (materials)	B519, drum rack and parking area storage	est. 10 drums	Waste oil (with solvent) sent to salvage.

¹ Drum rack storage inventory is scheduled to be reduced and consolidated with other Plant Engineering facilities.

TABLE IV-11

HAZARDOUS MATERIALS AND WASTES: PEST CONTROL

Materials/Wastes	Facility	Quantity	Uses/Disposal
Dormat Flowable Emulsion	Lorox Betasan 4E Weedone Super D	B520, B515, B292	Pest, weed control; containers are triple-rinsed and disposed of at Pleasanton landfill.
Keltane E.C.	Trimec		
Sevin S.L.	Round Up		
Malathion 57	Maxforce		
Malathion 5	Brominal		
Rose Care	Willco Gopher Bait		
Systemic	Talon G Bait Packs		
	Talon Weather Block		
C.O.C.S.	Weed Boomer		
Fungicide	U.L.D.B.P. 300		
	Virchem 24		
Embark 2-S	P.T. 110 Resmethrin		
Atrinal	P.T. 240 Perma Dust		
Cyprex 6sw	P.T. 140 Resmethrin		
Vorer Killer	Dursban 4E		
Fore Fungicide	Killmaster 11		
Princep 90	Ficam W		
Krovar I	Baygon I.S.		
Surflan 75W	Baygon P.T. 250		
Deurinol 50WP	P.T. 515 Wasp Freeze		
Dowpon M	Spray Adjuvant Defoamer		
Nutra Sol,	Spray Adjuvant		
X-77 Spreader			

TABLE IV-12

HAZARDOUS MATERIALS AND WASTES: ELECTRONICS ENGINEERING

Materials/Wastes	Facility	Quantity	Uses/Disposal
Solvents (chlorinated): TCE, TCA (materials and wastes)	B131 (Printed Circuits) B141 (Photoresist films)	10-15 gal/month	Carboys to TWC, or recycled at B141.
Solvents: acetone, MEK, alcohol, kerosene (materials and wastes)	B131 (Printed circuits) B141 (rail gun)	10-15 gal/month; greater usage at B141	Carboys and drums to TWC.
Acids, caustics (materials and wastes)	B131 (Printed circuits)	Several gallons/month	Carboys to TWC.
Oil (dielectric, non-PCB) (materials)	B141 Storage tank	> 5,000 gallons storage	Used at pulsed-power rail-gun facility.
Metal finishing solutions (materials and wastes) <ul style="list-style-type: none"> - hydrochloric, sulfuric, fluoroboric, phosphoric acids - stannus, platinum chloride - nickel sulfamate - gold cyanide - copper pyrophosphate - tin, lead fluoroborate 	B141 Printed circuits facility	10,000 gallons/month	3 underground retention tanks to 3 above-ground tanks; discharged to sewer or TWC. Concentrated solutions packaged in carboys, drums for TWC.

TABLE IV-13

HAZARDOUS AND RADIOACTIVE MATERIALS AND WASTES: MECHANICAL ENGINEERING

Materials/Wastes	Facility	Quantity	Uses/Disposal
Solvents: MEK, methylene chloride, toluene, xylene, acetone, alcohol, TCE, PCE, freon (materials and wastes)	B231 (Plastics Lab), B343 (Test), B321 B131 (Microdevices)	Est. 55 gal/yr (wastes); B321 complex waste ext. at least 200 gal/month.	Lab experiments; waste picked up by TWC. Also from machining processes.
Rad-contaminated and non-rad oil (lubricants, vacuum pump oil, hydraulic oil) (materials and wastes)	B343, B321	Several hundred gallons, some Be	Misc. machinery, wastes to TWC or Salvage.
Rinse water, including Plating Shop effluent (wastes)	B322, B131	3,000 to 6,000 gallons per day at B322; several hundred gallons per month at B131.	Retention tank systems at B322 discharged to sewer; concentrated acid; caustic disposed of by TWC. B131 retention system handles lab sink liquids.
Photo rinses (wastes)	B327 B131 (Print Lab)	50 gallons/day 20 gallons/month	Dilute effluent to sewer. Collected in 55-gallon drums; sent to TWC.
Mercury (dry)(waste)	B131	Est. 30 gallons/month.	Sent to TWC.
Solid rad waste	B321	Minute quantities	Sent to TWC.

TABLE IV-14HAZARDOUS WASTE AND MATERIALS FACILITIES: CHEMISTRY

Facility	Location	Facility Description	Wastes, Discharge Point
Retention tanks (TWL 1,2)	B222	Two tanks (est. 4,000 gal ea.); liquid wastes from lab sinks. Tanks emptied about 2 times per month.	Contents analyzed for radioac- tivity, metals, pH. Discharge to sewer if under limits; to TWC if above.
Retention tanks	B231	Two above-ground tanks (1,000 gal ea.); liquid wastes from lab sinks, floor drains go to sumps, then pumped to tanks.	Contents analyzed for radioac- tivity, metals, pH. Discharge to sewer if under limits; to TWC if above.
Retention tanks	B241	Two steel tanks (est. 1,500 gal ea.) connected to concrete sump. Lab sinks and floor drain to sump; contents pump- ed to either tank.	Contents analyzed for radioac- tivity, metals, pH. Discharge to sewer if under limits; to TWC if above.
Retention tanks	B332	Two tanks (est. 1,000 gal ea.); liquid wastes from lab sinks. Tanks are in concrete, below- ground vault.	Contents analyzed for radioac- tivity, metals, pH. Discharge to sewer if under limits; to
Waste Staging	B221 area	55-gallon drums, carboys on as- phalt. Area drains to storm drain. Drums are labelled, segregated by waste type.	Waste, oil TCE, chlorinated solvents, non-chlorinated sol- vents picked up by TWC.

TABLE IV-14 (cont.)

HAZARDOUS WASTE AND MATERIALS FACILITIES: CHEMISTRY

Facility	Location	Facility Description	Wastes, Discharge Point
Waste Staging	B321 area (east)	55-gallon drums, carboys on pallets. Wastes consist of D38 metal, sodium, acids.	Drums picked up by TWC.
Waste Staging	B241	Small area for drum staging; drum rack underlain by asphalt.	Waste drums for chlorinated and non-chlorinated solvents; drum rack includes kerosene, alcohol, freon, TCA. Wastes picked up by TWC.
Waste Staging	B331	Waste staging area, drum rack underlain by asphalt (cracked and patched). Rack will be merged with facility at B343, B345.	Waste drums for oil, flammable solvents, chlorinated solvents. Drums picked up by TWC.
Waste Staging	B332	Waste staging area on asphalt; drum rack on concrete with run-off to storm drain.	Drums in rack include alcohol, oil, kerosene, TCA, vacuum pump oil. Wastes in drums; chlorinated solvents, flammable solvents.

TABLE IV-15
RADIOACTIVE WASTES: CHEMISTRY

Wastes	Facility	Quantity	Uses/Disposal
Solid radioactive wastes	B223, B231, B241	55 gal drum quantities	Handling materials, gloves, Kim-wipes, etc.; shipped to NTS.
Radioactive contaminated equipment	B231, B241	Varies.	Apparatus exposed to radioactivity; decontaminated for reuse or repair.
Radioactive contaminated oil	B231, B241	6 gal/month.	Oil exposed to radioactivity; solidified, shipped to NTS.
Liquid radioactive waste	B241	15 gal/month.	Contaminated solvents.
Tritiated liquid waste	B331	20 gal/month.	Solvents and water that are tritium contaminated; evaporated or incinerated.
Tritiated solid waste	B331	4 - 55 gal drum/month.	Contaminated handling materials. Incinerated or shipped to NTS.
Tritium gas	B331	3,000 ci/year.	Experiments and testing; exhausted to the atmosphere.
TRU solid waste	B332	24 - 55 gal drum/month.	Transuranium contaminated material shipped to NTS.
TRU liquid waste	B332	20 gal/month.	Contaminated solvents and wastes.
TRU contaminated equipment	B332	Varies.	Shipped to NTS; oversized equipment stored at TWC pending size reduction facility.

TABLE IV-16

HAZARDOUS WASTE AND MATERIALS FACILITIES: BIOMEDICAL

Facility	Location	Facility Description	Wastes, Discharge Point
Waste staging, drum storage	B412	Waste drums on pallets on concrete pad; many empty, rusty drums nearby for salvage. Drum rack is sheltered, on concrete, with run-on control.	Wastes include MEK, alcohol, waste oil. Drum rack has kerosene, acetone, MEK, alcohol, vacuum pump oil.

TABLE IV-17

RADIOACTIVE WASTES: BIOMEDICAL

Wastes	Facility	Quantity	Uses/Disposal
Radioactive solid waste	B361, B366	1 - 55 gal drum/wk.	Handling materials, crushed glass scintillation vials, shipped to NTS.
Radioactive liquid waste	B361	10 gal/week.	Several isotopes in carboys.
Contaminated biological waste	B363	Varies.	Radioactive contaminated animals and cages. Incinerated (B623).
Tritiated liquids	B361	10 gal/month.	Incinerated (B623).

TABLE IV-18

HAZARDOUS WASTE AND MATERIALS FACILITIES: PHYSICS

Facility	Location	Facility Description	Wastes, Discharge Point
Retention tanks, sump	B194	Lab sinks and LCN system drain to concrete sump; sump pumped to one of two tanks. Portable tanks at B194 used for retention of seepage water in basement.	Liquids (from sinks and LCN system) contain low concentrations of metals and radioactivity. Tanks are sampled, analyzed; normally discharged to sewer.
Retention tank, sump	B212	Concrete sump (500 gal) collects seepage water from pits; water pumped to above-ground tank (1,000 gal).	Above-ground tank sampled and analyzed; contents discharged to sewer.
Retention sump	B292	Concrete sump (1,000 gal) collects water from floor drains.	Contains tritium; sump sampled and analyzed; discharge to sewer.
Waste staging areas	B194	Outside facility has 55-gallon drums on pallets awaiting sampling and analysis. One drum of liquid waste inside B194 shop requires analysis.	Wastes outside consist of radioactive and unknown materials (to be analyzed). Waste oil/solvent inside needs analysis. Picked up by TWC.
		Drum rack on asphalt surface; covered by tarp.	Solvents stored include freon, kerosene, alcohol, acetone.
Waste staging area	B212	Waste staging area consists of drums placed on asphalt. Storage rack for drums on south side of B212 is on asphalt surface.	Radioactive wastes at staging area to be picked up by TWC. Drum storage has oil, kerosene, alcohol, acetone, cutting oil.

TABLE IV-18 (cont.)

HAZARDOUS WASTE AND MATERIALS FACILITIES: PHYSICS

Facility	Location	Facility Description	Wastes, Discharge Point
Waste staging area	B292	Waste storage area is east of B292; drum storage is north of building. Both facilities are on concrete/asphalt.	Wastes are mostly radioactive; picked up by TWC. Drum rack has acetone, oil, freon, alcohol.
Laser Pantography Lab	B182	Uses cylinders of exotic gases.	TWC to handle waste cylinders; difficult to dispose of if mfg will not accept old cylinders.

TABLE IV-19

RADIOACTIVE WASTES: PHYSICS

Materials/Wastes	Facility	Quantity	Uses/Disposal
Solid radioactive waste	B194, B212 B292	6 - 55 gal drums/month.	Handling materials, gloves, Kim-wipes, etc. Shipped to NTS.
Contaminated oil	B212, B292		Contaminated oil from use with radioactivity. Shipped to NTS.
Contaminated equipment	B194, B212 B292	Varies	Contaminated equipment decontaminated for repair or reuse.
Tritium contaminated solvents	B292	5 gal/wk.	Incinerated (623), ash to municipal landfill.
Tritium contaminated water	B292	200 gal/3 month	Incinerated (B623), ash to municipal landfill.
Spent tritium targets	B292	1 target/month.	Shipped to NTS.
Tritium scrubber cylinders	B292	5 cylinder/month.	Shipped to NTS.
Tritium gas	B292	80 Ci/year.	Experimentation, exhausted to the atmosphere.

TABLE IV-20

HAZARDOUS WASTE AND MATERIALS FACILITIES: LASERS

Facility	Location	Facility Description	Wastes, Discharge Point
Retention sump, tank	B161 (partial)	Steel sump receives liquids from two sinks; pumped to aboveground (1,000 gal) steel tank.	Radioactive liquids to retention system; tank contents sampled and discharged to sewer. Other, non-rad sinks connected to sewer.
Retention sump, tank and	B175	Concrete sump receives liquid leaks from cooling system pumped to below ground (1,000 gal) steel tank.	Radioactive and non-radioactive liquids from lab sinks cooling system. Normally discharged to sewer after sampling and analysis.
Retention tank	B175	Aboveground (1,500 gal) tank receives overflow (occasionally) from cooling system.	Coolant water, sampled and analyzed, discharged to sewer.
Retention sump,	B298	Sump and steel tank (est 1,000 gal) are below ground in concrete enclosure.	Sump and tank receive liquids from lab sinks. Solvents used in lab areas. Tank sampled and analyzed; contents discharged to sewer.
Retention sump, tanks	B490	Retention system recently completed; not yet in use. Liquids will first flow to 16-foot deep sump, then will be pumped to one of three tanks. Tanks are 1,000 gal fiberglass and serve the dye facility and will receive uranium contaminated wastes.	Not yet in use; will be sampled and analyzed, discharged to sewers as are other LLNL tanks.
Retention sump, tanks	B491	2000 gal steel tanks	For radioactive liquids
Retention sump, tanks	B492	2000 gal steel tanks	For alcohol and laser dye waste. Sampled and analyzed, if clean discharged to the sewer.

TABLE IV-20 (cont.)

HAZARDOUS WASTE AND MATERIALS FACILITIES: LASERS

Facility	Location	Facility Description	Wastes, Discharge Point
Waste accumulation	B176	Waste drums located on machine shop loading dock.	Drums contain acetone, TCE (separately) TWC picks up drums.
Waste staging	B161	Central waste staging area; located on asphalt/dirt. Approximately 12-15 drums, several carboys.	Wastes segregated by; laser dyes/waste, non-chlorinated solvents, chlorinated solvents, solid rad waste, liquid rad waste (carboys), oil. Containers to be picked up by TWC.
Drum storage	B165	Drum rack (to be phased out) located west of B166 on asphalt; drainage to bare ground.	Drums consist of lacquer thinner, TCA, freon, alcohol, kerosene, cutting oil, acetone, MEK.
Waste staging	B298	Drums located north of B298; drums on asphalt and dirt.	Wastes consist of radioactive solids (3 drums), non-chlorinated solvents, chlorinated solvents.
Drum storage	B296	Storage area on concrete, under shelter.	Drums contain oil, acetone, freon, TCA, alcohol.
Waste staging	B383	Drum storage located outside machine shop on concrete/asphalt surface. Waste barrel is on dirt surface.	Waste drum contains solvent, to be collected by TWC.

TABLE IV-21

RADIOACTIVE WASTES: LASERS

Materials/Wastes	Facility	Quantity	Uses/Disposal
Solid radioactive waste	B161, B298	8 - 55 gal drums/month	Handling equipment, shipped to NTS.
Liquid radioactive waste	B161, B167	10 gal/month	Contaminated solvents and rinses, solidified and shipped to NTS.
Radioactive solids	B161	1 gm/month	Depleted uranium.
Contaminated oil	B298	1/2 gal/yr	

APPENDIX A

BUILDING RESPONSIBILITIES

OF

LLNL PROGRAMS

Appendix A lists the buildings on the LLNL site by number and gives the corresponding building name and responsible LLNL program.

APPENDIX A: BUILDING RESPONSIBILITIES OF LLNL PROGRAMS

Bldg. No.	Building Name	Responsible Program
041	Central Mail	Administration
111	Experimental Physics	Admin/Defense Sys.
112	H.C. Monitoring Station	Engineering
113	Theoretical and Comp.	Physic. Office Computations
115	Computer	Computations
116	Computer Programming	Computations
117	Computer	Computations
119	Fiber Test	Chemistry
121	Experimental Physics	Defense Systems Admin. Library
122	West Pass Office	Administration
123	Auditorium	Defense Systems
125	West Cafeteria	Administration
131	Engineering	Engineering
141	Electronics Engineering Forms and Records	Engineering Physics
141A		Administration
151	Nuclear Chemistry	Defense Systems
152	Emergency Gen. House	Defense Systems
161	Laser Iso. Sep. Dev. Lab	Lasers
162	Laser Research	Lasers
163	Test Pit	Lasers
165	Special Research	Lasers
166	Laser Research	Lasers

Bldg. No.	Building Name	Responsible Program
167	Laser Research	Lasers
168	Laser Research	Lasers
169	Special Research	Lasers
171	Laser Research	Lasers
172	Laser Research	Lasers
173	Welding Shop	Lasers
174	Laser Research	Physics/Lasers
175	MARS Experiment	Physics/Lasers
176	Machine Shop	Physics/Lasers
177	LIS Labs	Physics/Lasers
182	O Group	Physics
194	Elec. Pos. Accelerator	Physics
195	Detector House	Physics
196	H.C. Monitoring Sta.	Engineering
198	Physics Storage	Physics
210	Scintillator	Not there
212	Accelerators	Physics
213	Physics	Physics
214	Admin. Data Center	Administration
215	Vault	Computation
216	Computation DNA	Defense Systems
217	Budget/DPS	Administration
218	Computation	Admin/Computations
219	PAO/Physics/DPS	Administration Physics

Bldg. No.	Building Name	Responsible Program
221	Chemistry Storage	Chemistry
222	Chemistry	Chemistry
223	Chemistry Engr.	Chemistry
224	High Expl. Chemistry	Chemistry
225	High Expl. Chemistry	Chemistry
226	High Expl. Chemistry	Chemistry
227	High Expl. Chemistry	Chemistry
228	Storage Magazine	Chemistry
229	Storage Magazine	Chemistry
231	Dev. and Assembly	Engineering Physics Chemistry
232	Chem. High Press. Lab	Chemistry
233	Classified Storage	Chemistry
234	Process Research	Chemistry
235	WMRDF	Under Construction
239	Radiography	Engineering
241	Refractory Materials	Chemistry
243	Energy Research	Energy
251	Heavy Elements	Defense Systems
253	Hazards Control	Technical Services
254	Toxicology	Technical Services
255	Calibration Studies	Defense Systems Administration (E)
261	Special Projects	Z Division
271	Security Office	Administration
272	Laser Electro-Optical	Lasers

Bldg. No.	Building Name	Responsible Program
281	Nuclear Chemistry	E-Lasers W-Defense Systems
291	LCW Station	Engineering
292	RTNS II	Physics
293	RTNS II Storage	Physics
295	Water Pump House	Engineering
297	Classified Waste Disposal	Engineering
298	Fusion Target Dev.	Lasers
310	Medical and Pass Office	Technical Services
311	Offices	Physics
312	South Cafeteria	Administration
313	Emer. Comm. Center	Administration
314	Accounting	Administration
315	Human Res/Beam Res.	Magnetic Fusion Administration
316	Offices	Magnetic Fusion Computations Physics
317	Multipurpose	Administration
318	Emer. Water Storage (Swimming Pool)	Engineering
319	Human Res/OEO/C.U.	Administration
Shed E321	Plasma Cutting	Engineering
321	Materials Fab Shop	Engineering
321A	Ion Exchange Plant	Engineering
322	Plating Shop	Engineering
323	Fire House	Technical Services

Bldg. No.	Building Name	Responsible Program
324	Hazards Control	Technical Services
325	Utilities Control	Engineering
326	Materials Fab Shop	Engineering
327	Nondestructive Testing	Engineering
328	Fire Test Cell	Technical Services
331	Gaseous Chemistry	Chemistry Physics
332	Metallurgical Chemistry	Chemistry
333	Chemistry Storage	Chemistry
335	L.I.S.F.	Lasers
341	Physics Research	Physics Defense Systems
343	High Pressure	Engineering
344	Detonator Res. Magazine	Defense Systems
345	Detonator Research	Defense Systems
361	Main Lab	BioMed
362	Env. Instr.	BioMed
363	Tumor Lab	BioMed
364	Main Small Animal	BioMed
365	Animal Toxicology	BioMed
366	Health Effects Lab.	BioMed
376	Machine Shop	BioMed
377	Marine Biology	BioMed
378	Transuranics	BioMed
379	Rad. Spectrometry	BioMed

Bldg. No.	Building Name	Responsible Program
381	Laser Fusion Lab	Lasers
382	T.O.F.	Lasers
383	Laser Machine Shop	Lasers
391	High Energy Laser	Lasers
401	Steam Plant	Engineering
402	Motor Pool	Administration
403	Garage	Administration
404	Warehouse	Administration
405	Elec/Electronics	Engineering
410	Oil Shale Research	Energy
411	Central Stores	Administration
412	Biomedical Lab	BioMed
413	Temp Contractor	BioMed
414	Cold Storage	BioMed
415	Sec. Admin./Orient.	Administration
417	Equipment Storage	Energy
418	Paint Shop	Engineering
419	Decontamination	Technical Services Engineering
423	MFE Shop	Magnetic Fusion
424	Elec. Substation	MFE/Engineering
425	Elec. Stockroom	MFE/Engineering
426	ATA Storage	Magnetic Fusion
428	MFE Coil Shed	Magnetic Fusion
429	ETA Storage (Tent)	Magnetic Fusion
431	MFTF	Magnetic Fusion

Bldg. No.	Building Name	Responsible Program
432	MFE Shops	Magnetic Fusion
434	MFE Shops	Magnetic Fusion
435	MFE Research	Magnetic Fusion
435	Cooling Towers	Engineering
435	MFE Capacitor	Magnetic Fusion
438	MFE Fab Shop	Magnetic Fusion
439	MFE Comp. Control	Magnetic Fusion
440	TMX Tent	Magnetic Fusion
441	TMX Tent	Magnetic Fusion
442	Cryo Shop	Magnetic Fusion
443	Coil Shop	Magnetic Fusion
444	Magnet Coil Storage	Magnetic Fusion
445	MFE Cryo Lab	Magnetic Fusion
446	Power Supply	Magnetic Fusion
447	Machine Stor (Lt Lab)	Magnetic Fusion
451	NMFECC	Computations
481	NOVA	Lasers
482	S.I.S.L.	Lasers
510	FACS/UPS	Engineering
511	Crafts Shop	Engineering
512	Craft Matl. Assembly	Engineering
513	Liquid Waste Storage	Technical Services
514	Waste Disposal	Technical Services
515	Equipment Storage	Engineering
516	Classroom/Hobby Shop	Engineering

Bldg. No.	Building Name	Responsible Program
517	Offices and Storage	Engineering
518	Gas Cylinder Dock	Administration
519	Equipment Maintenance	Engineering
520	P.E. Stor (Pest Control)	Engineering
521	MFE Storage Fac (Tent)	Magnetic Fusion
543	MFE Office	Magnetic Fusion
551	CORE 1	Engineering Administration
581	Chem. Fiber Test	?
592	Cow Barn	BioMed
593	Sheep Shed	BioMed
594	Plant Growth	BioMed
595	Green House	BioMed
611	Salvage Warehouse	Lasers Administration
612	Dry Waste (TWC)	Technical Services
614	Storage (TWC)	Technical Services
615	Tele. Operations	Administration
616	Salvage	Administration
617	Salvage	Administration
618	Salvage	Administration
619	Salvage	Administration
622	Propane Air Plant	Engineering
623	Waste Storage	Technical Services
624	Waste Storage	Technical Services
625	Waste Stor/Shed	Technical Services

Bldg. No.	Building Name	Responsible Program
639	Modular Management	Engineering
651	Visitors Center	Director's Office
661	Davis Campus	Director's Office
690	Oil Shale Storage Pile & Rock Crusher	Energy
691	LODTM Facility	Engineering

APPENDIX B

LLNL BUILDING OPERATIONS

1943-1985

Appendix B consists of tables that list LLNL buildings by number with their corresponding operations in the years 1985, 1975, 1967, 1960, 1957, 1949, and 1943.

APPENDIX B-1: LLNL Building Operations in 1985, 1975, 1967, and 1960

1985 Bldg. Operation No.	1975 Bldg. Operation No.	1967 Bldg. Operation No.	1960 Bldg. Operation No.
111	Exptl Physics	111	Exptl Physics
112	H.C. Monitor Stat		
113	Theor. & Comp.	113	Theor. & Comp.
115	Computer	115	Computer
116	Comp Program	116	Comp Program
117	Computer	117	Computer
119	Fiber Test	119	Exper Physics & Admin-Q
121	Exptl Physics	121	Exptl Physics
122	West Pass Office		
123	Auditorium	123	Auditorium
125	West Cafeteria	125	West Cafeteria
131	Engineering	131	Mech. & Elec. Engrg.
141	Electr Engr---F&R	141	Test Staging
141	Electr Engr---F&R	141	Test Staging
151	Nuclear Chem	151	Radiochemistry
152	Emerg Gen House		
161	Laser Isot S D Lab		
162	Laser Research	162	Special Research
165	Special Research	165	Special Research
166	Laser Research	166	Special Research
167	Laser Research		
168	Laser Research	168	Special Research
169	Special Research	169	Special Research
171	Laser Research	171	Special Research
172	Laser Research		
173	Laser Research	173	Special Research
174	Laser Research	174	Special Research
175	Mars Experiment	175	Special Research
176	Laser Research	176	Special Research
177	Laser Research	177	Special Research
182	O Group		
194	Electr Pos Accel	194	Electr Pos Accel
195	Detector House		
196	H.C. Monitor Set		
210	Scintillator	210	Scintillator
		211	Maintenance Shop
212	Accelerators	212	Accelerators
213	Physics	213	Dormitory
214	Admin Data Center	214	Accounting
215	Vault	215	Security Vault
216	Computation - DNA	216	Exper Physics & Engr
217	Budget/DPS	217	Mechanical Engineering
218	Computation	218	Exper Physics & Engr
219	PAO/Physics	219	Administration - P
221	Chem Storage		
222	Chemistry	222	Chemistry
			101 Chemistry
			120 Computer
			120C Programming
			120B Computer
			161 General Offices
			112 Physics
			170 Engineering
			116A L-Division
			108B L-Division
			191 Special Research
			182C Special Research
			182B Special Research
			182A Special Research
			192B Special Research
			192A Special Research
			154A Pluto
			154C Pluto
			154D Pluto
			154B Pluto
			194 High Flux
			105 Maintenance Shop
			153 Accelerators
			146 Dormitory
			109 Print Shop
			103 Block House A
			155 Pluto Offices
			151 Pluto Offices
			152 Apparatus Engr.
			144 General Offices

APPENDIX B-1: LLNL Building Operations in 1985, 1975, 1967, and 1960

1985 Bldg. Operation No.	1975 Bldg. Operation No.	1967 Bldg. Operation No.	1960 Bldg. Operation No.
223 Chemical Engineering	223 Chemical Engineering	223 Chemical Engineering	106 Chemical Engineering
224 High Expl Chem	224 High Expl Chem	224 High Expl Chem	117 Dissolver
225 High Expl Chem	225 High Expl Chem	225 High Expl Chem	107A Special Chemistry
226 High Expl Chem	226 High Expl Chem	226 High Expl Chem	107B Special Chemistry
227 High Expl Chem	227 High Expl Chem	227 High Expl Chem	107C Special Chemistry
228 Storage Magazine	228 Storage Magazine	228 Storage Magazine	104 Chem Equip Storage
229 Storage Magazine	229 Storage Magazine	---	---
231 Dev. & Assembly	231 Dev. & Assembly	231 Dev. & Assembly	102 Fabrication & Assembly
232 Chem H.P. Labs	232 Chem H.P. Labs	232 Chem H.P. Labs	147 High Pressure Chemistry
233 Classified Storage	233 Classified Storage	233 Classified Storage	176 Classified Storage
234 Process Research	234 Process Research	234 Process Research	118 Special Research
235 WNRDF	---	---	---
239 Radiography	239 Radiography	---	---
241 Refractory Mat's.	241 Refractory Mat's.	241 Refractory Mat's.	173B Pluto Fuel Element
243 Energy Research	243 Energy Research	---	173A Pluto Assembly
251 Diagn Chem	251 Diagn Chem	251 Diagn Chem	190 Diagn Chem
253 Hazards Control	253 Hazards Control	253 Hazards Control	175 Hazards Control
254 Toxicology	254 Toxicology	254 Toxicology	---
255 Calibrat & Stnds	255 Calibrat & Stnds	---	---
261 Special Projects	261 Critical Tests	261 Special Projects	110 SAGA
271 Protect Serv. Div.	---	---	---
271 Security Office	271 Security Office	---	---
272 Laser Electro-Optical	---	---	---
281 Pool Type React/R/U Chem	281 Pool Reactor	281 Pool Type Reactor	193 Pool Type Reactor
---	---	283 Instrument Calibration	---
---	284 Storage	284 Storage	---
291 LNC System	291 LNC System	---	---
292 RTNS Facility	---	---	---
295 Water Pump Hse	295 Water Pump Hse	295 Water Pump Hse	---
297 Class Waste Disp	297 Class Waste Disp	297 Class Waste Disp	---
298 Fusion Target Dev.	---	---	---
310 Med & Pass Office	310 Med & Pass Office	310 Admin. - Unclass.	133 Medical & Badge Office
311 Human Resources	311 Plant Engr & Personnel	311 Plant Engr & Personnel	---
312 South Cafeteria	312 South Cafeteria	312 East Cafeteria	130 Cafeteria
313 Emerg Communication Ctr	313 Telephone	313 Telephone Ctr Control	---
314 Accounting	314 Ctr Engr. Support	314 Administration - Q	132 AEC Office
315 MFE Physics	315 Ctr Physics	315 Exper Physics & Engr	131 M Division
316 Beam Research Comp	316 Graph Arts/Corp. Eng.	316 Graphic Arts	136 Graphic Arts
317 Multipurpose	317 Multipurpose	317 Multipurpose	---
318 Emergency Water Res	318 Emergency Water Res	318 Emergency Water Res	145 Emergency Water Res
319 Comp/OEO/Credit Union	319 Purchasing - Travel	319 Admin. - Unclassified	143 General Office
321 Mt's Fab Shops	321 Mt's Fab Shops	321 Mechanical Shops	114 Mechanical Shops
322 Plating Shops	322 Plating Shops	322 Sheet Metal Shop	---
323 Fire House	323 Fire House	323 Fire House	148 Fire House
324 Hazards Control	324 Hazards Control	324 Maintenance Shop	149A Maintenance Machinist
325 Utilities Control	325 Utilities Control	325 Utilities Control	149B Control House

APPENDIX B-1: LLNL Building Operations in 1985, 1975, 1967, and 1960

1985 Bldg. Operation No.	1975 Bldg. Operation No.	1967 Bldg. Operation No.	1960 Bldg. Operation No.
326	Mt's Fab Shop	326	Mt's Fab Shop
327	Mech Engr Mdt Lab	327	Nondestructive Testing
328	Fire Test Cell	328	Fire Test Cell
331	Gaseous Chem	331	Gaseous Chem
332	Metallurgical Chem	332	Metallurgical Chem
333	Chem Storage		
341	Physics Research	341	Physics Research
343	High Pressure	343	High Pressure
344	Detontr Res Mag	344	Detontr Res Mag
345	Detonator Res	345	Detonator Res
361	Biomedical	361	Biomedical
362	Biomedical	362	Biomedical
363	Animal House	363	Animal House
364	Animal House	364	Animal House
365	Bioned Exp Fac		
366	Health Effect Lab		
376	Machine Shop		
377	Marine Biology	377	Marine Biology
378	Atmospheric Res		
381	Laser Fusion Shop	381	Laser Fusion Shop
382	Laser L.O.S.		
383	Laser Machine Shop		
391	High Energy Laser		
401	Steam Plant	401	Steam Plant
402	Automotive Fleet	402	Motor Pool
403	Garage	403	Garage
404	Warehouse	404	Warehouse
405	Warehouse	405	Warehouse
410	Special Research	410	Special Research
411	Central Storage	411	Central Storage
412	Biomedical Lab	412	Biomedical Lab
413	Marine Biol Lab	413	Marine Biol Lab
414	Cold Storage	414	Cold Storage
415	Sec Adm-Orient	415	Sec Adm-Orient
417	Storage	417	Storage
418	Paint Shop	418	Paint Shop
419	Decontamination	419	Decontamination
423	Ctr Power Supply	423	Ctr Power Supply
424	Electr Substation	424	Electr Substation
425	Electr Substation	425	Electr Substation
426	ATA Storage		
431	MFE Research	431	CRT Research
432	MFE Shops	432	Crt Shops
434	Power Supply	434	Power Supply
		436	Police
		437	Glove Box Storage
		438	Paint Shop
		439	Assay Lab
		443	Research Power Supply
		444	Electr Substation
		457	Experimental Physics
		458	Assembly & Test
		459	Jet Plating
		460	Experimental Physics
		140A	Dev Lab Water Boiler
		115	Nondestructive Test
		172	Gas Lab
		171	Metallurgy
		174	High Pressure Lab
		134	Heating Plant
		135	Garage
		138	Garage
		166	Warehouse
		167	Warehouse
		160	Central Stores
		121A	Hot Cells
		113	Plant Engineering
		139	Communication/Police
		177	Paint Shop
		125	Assay Lab
		158	Research Power Supply
		159	Substation 3
		157	Sherwood

APPENDIX B-1: LLNL Building Operations in 1985, 1975, 1967, and 1960

1985 Bldg. Operation No.	1975 Bldg. Operation No.	1967 Bldg. Operation No.	1960 Bldg. Operation No.
435	NFE Research	435	Crt Research
436	NFE Research	436	Crt Research
439	NFE Comp Cntl	---	---
440	TMX Tent	---	---
441	TMX Tent	---	---
442	NFE Research	442	Crt Research
443	Coil Shop	443	Coil Shop
444	Magnet Coil Storage	444	Magnet Coil Storage
445	NFE Magnet Lab	---	---
446	Power Supply	446	Power Supply
447	Machine Storage	---	---
451	NMFECC	---	---
481	Laser Fusion Office	---	---
482	Spec Isotope Separation	---	---
511	Crafts Shops	511	Crafts Shops
512	Crafts Mt'l Assem	512	Crafts Mt'l Assem
513	Liquid Waste Storage	---	---
514	Waste Disposal	514	Waste Disposal
515	Equipment Stor	515	Equipment Stor
516	Temp Lab & Shop	516	Temp Lab & Shop
517	Warehouse	517	Warehouse
518	Gas Cylinder Dock	518	Gas Cylinder Dock
---	---	---	---
520	P.E. Storage	---	---
---	---	---	---
521	NFE Storage Fac	523	Salvage
551	Core 1	---	---
581	Chemistry	---	---
592	Cow Barn	592	Cow Barn
593	Sheep Barn	593	Sheep Shed
594	Plant Growth Facility	---	---
595	Greenhouse	---	---
611	Salvage Warehouse	611	Salvage Warehouse
612	Dry Waste	612	Dry Waste
614	Storage	614	Storage
615	Phone Oper & Pin	615	Dept. Applied Science
616	Employee Devel	616	Dept. Applied Science
617	Salvage Tent	---	---
618	Employee Devel	618	Dept. Applied Science
619	Salvage Reclam	---	---
622	Propane Air Plant	622	Propane Air Plant
623	Waste Storage	623	Waste Storage
624	Waste Storage	623	Propane Plant-Vaporizer
625	Waste Storage	---	---
651	Visitors Center	651	Visitors Center
661	Dept. Applied Science	661	Dept. Applied Science

APPENDIX B-1: LLNL Building Operations in 1985, 1975, 1967, and 1960

1985 Bldg. Operation No.	1975 Bldg. Operation No.	1967 Bldg. Operation No.	1960 Bldg. Operation No.
662 Storage	662 Storage		
691 LODM Facility	691 LODM Facility		
			141 R Division
			142 Weapons Engineering
			161 Physics
			162 Physics

APPENDIX B-2: LLNL Building Operations in 1985, 1957, 1949, and 1943

1985 Bldg. Operation No.	1957 Bldg. Operation No.	1949 Bldg. Operation No.	1943 Bldg. Operation No.
111 Exptl Physics			
112 H.C. Monitor Stat			
113 Theor. & Comp	122 Health Chemistry		
115 Computer	120 Computer		
116 Comp Program			
117 Computer	Computer		
119 Fiber Test	161 General Offices		
121 Exptl Physics	112 Physics		
122 West Pass Office			
123 Auditorium	111 Auditorium		
125 West Cafeteria			
131 Engineering	108 Stores Warehouse		
141 Electr Engr---F&R	Operations		
141 Electr Engr---F&R			
151 Nuclear Chemistry			
152 Emerg Gen House			
161 Laser Isot S D Lab			
162 Laser Research			
165 Special Research			
166 Laser Research	182 Special Research		
167 Laser Research			
168 Laser Research	Special Research		
169 Special Research	192 Special Research		
171 Laser Research	154 R Div Central/Maint.		
172 Laser Research			
173 Laser Research			
174 Laser Research			
175 Mars Experiment			
176 Laser Research			
177 Laser Research			
182 O Group			
194 Electr Pos Accel	194 High Flux		
195 Detector House			
196 H.C. Monitor Set			
210 Scintillator			
	105 Maintenance Shop		
212 Accelerators	153 Accelerators	53 Drill Hall	53 Drill Hall
213 Physics	146 Dormitory	46 Officer Club	46 Officer Club
214 Admin Data Center	109 Print Shop		
215 Vault	103 Block House A		
216 Computation-DNA	155 Electrical Emergency	55 Barracks	55 Barracks
217 Budget/DPS	151 Mechanical Engrg.	51 Barracks	51 Barracks
218 Computation	152 General Engrg.	52 Barracks	52 Barracks
219 PAO/Physics	144 Sandia	44 Instruction Bldg. #2	44 Instruction Bldg. #2
221 Chem Storage			
222 Chemistry	101 Chemistry		
223 Chemical Engr	106 Berkeley Box Storage		
224 High Exptl Chem	117 Dissolver		

APPENDIX B-2: LLM. Building Operations in 1985, 1957, 1949, and 1943

1985 Bldg. Operation No.	1957 Bldg. Operation No.	1949 Bldg. Operation No.	1943 Bldg. Operation No.				
225	High Expl Chen	107	Special Chemistry				
226	High Expl Chen						
227	High Expl Chen						
228	Storage Magazine	104	Chem Equip Storage				
229	Storage Magazine						
231	Dev. & Assembly	102	Fabrication & Assembly				
232	Chem H.P. Labs	147	High Pressure Chemistry				
233	Classified Storage						
234	Process Storage	118	Cryostat				
235	MMRDF						
239	Radiography						
241	Refractory Mat's.						
243	Energy Research						
251	Diagn Chen		Diagn Chen				
253	Hazards Control						
254	Toxicology						
255	Calibrat & Stnds						
261	Special Projects	110	SABA				
271	Protect Serv. Div.						
271	Security Office						
272	Laser Electro-Optical						
281	Pool Type React/R/U Chem	193	Pool Type Reactor				
291	LMC System						
292	RTNS Facility						
295	Water Pump House						
297	Class Waste Disp						
298	Fusion Target Dev						
310	Med & Pass Office	133	Reception	33	Recreation Building	33	Administration
311	Human Resources						
312	South Cafeteria	130	Cafeteria				
313	Emerg Communication Ctr	123	--				
314	Accounting	132	REC Office	32	Barracks	32	Barracks
315	HFE Physics	131	NTA & ARC Res. Office	31	Barracks	31	Barracks
316	Beam Research Comp	136	Administration	36	Waves Quarters	36	BOR
317	Multipurpose	145B					
318	Emergency Water Res	145A	Emergency Water Res.	45	Swimming Pool	45	Swimming Pool
319	Compo/OED/Credit Union	143	General Service	43	Instruction Bldg. #1	43	Instruction Bldg. #1
321	Mt'ls. Fab. Shops	114	Mechanical Shops				
322	Plating Shops						
323	Fire House						
324	Hazards Control						
325	Utilities Control						
326	Mt'ls. Fab. Shop	140	Water Boiler				
327	Mech. Engr. Mdt. Lab						
328	Fire Test Cell						
331	Gaseous Chem						

APPENDIX B-2: LLNL Building Operations in 1985, 1957, 1949, and 1943

1985 Bldg. Operation No.	1957 Bldg. Operation No.	1949 Bldg. Operation No.	1943 Bldg. Operation No.
332 Metallurgical Chem	171 Metallurgy		
333 Chem Storage			
341 Physics Research			
343 High Pressure			
344 Detontr Res. Mag.			
345 Detonator Res.			
361 Biomedical			
362 Biomedical			
363 Animal House			
364 Animal House			
365 Biomed Exp Fac			
366 Health Effect Lab			
376 Machine Shop			
377 Marine Biology			
378 Atmospheric Res			
381 Laser Fusion Shop			
382 Laser L.O.S.			
383 Laser Machine Shop			
391 High Energy Laser			
401 Steam Plant	134 Heating Plant	14 Boiler Plant	14 Boiler Plant
402 Automotive Fleet	135 Garage	15 Garage	15 Garage
403 Garage	138 Garage	16 Bus Garage	16 Shops
404 Warehouse	156 Warehouse	244 Cold Storage Bldg.	244 Cold Storage Bldg.
405 Warehouse	167 Warehouse	245 Supply & Stores Bldg.	245 Stores
410 Special Research			
411 Central Storage	160 Central Stores		
412 Biomedical Lab	121 Pratt & Whitney Aircraft	21 Check Building	21 Check Building
413 Marine Biol Lab			
414 Cold Storage			
415 Sec Adm-Orient	113 Administration	13 Administration	13 Administration
	139 Communication		
417 Storage			
419 Decontamination	125 Health Chemistry	25 Paint & Dope Shop	25 Paint & Dope Shop
	158 Research Power Supply		
424 Electr Substation	159 Substation 3		
425 Electr Substation			
426 ATA Storage			
431 NFE Research	157 NTA & ARC Res. Lab		
432 NFE Shops			
434 Power Supply			
435 NFE Research			
436 NFE Capacitor	150 Capacitor		
439 NFE Comp Cntl			
440 TMI Tent			
441 TMI Tent			
442 NFE Research			

APPENDIX B-2: LLNL Building Operations in 1985, 1957, 1949, and 1943

1985 Bldg. Operation No.	1957 Bldg. Operation No.	1949 Bldg. Operation No.	1943 Bldg. Operation No.
443	Coil Shop		
444	Magnet Coil Storage		
445	MFE Magnet Lab		
446	Power Supply		
447	Machine Storage		
451	MFECC		
481	Laser Fusion Dtc		
482	Spec Isotope Separation		
511	Crafts Shops	126 Crafts	26 Assembly & Repair
512	Crafts Material Assen	124 Accelerator Development	26 Assembly & Repair
513	Liquid Waste Storage		
524	Waste Disposal	127 Active Laundry	27 Engine Test Building
515	Equipment Storage		
516	Temp Lab & Shop	128 Electronics Maintenance	246 Supply & Stores AS
517	Warehouse	129 Electronics Installation	247 Supply & Stores AS
518	Gas Cylinder Dock		29 Stores
520	P.E. Storage		
531	MFE Storage Fac		
551	Core 1		
581	Chemistry		
592	Cow Barn		
593	Sheep Barn		
594	Plant Growth Facility		
595	Greenhouse		
611	Salvage Warehouse		
612	Dry Waste		
614	Storage		
615	Phone Oper & Pin		
616	Employee Development		
617	Salvage Tent		
618	Employee Development		
619	Salvage Reclam		
622	Propane Air Plant		
623	Waste Storage		
624	Waste Storage		
625	Waste Storage		
651	Visitors Center		
661	Dept. Applied Science		
662	Storage		
691	LODTH Facility		
		11 Operations Demolished	11 Operations
		12 Check Bldg. Demolished	12 Check Bldg.
		17 Public Works Demolished	17 Public Works
		22 Link Trainers	22 Link Trainers
		23 Firehouse	23 Firehouse
		39 Operations Demolished	39 Operations

APPENDIX B-2: LLNL Building Operations in 1985, 1957, 1949, and 1943

1985 Bldg. Operation No.	1957 Bldg. Operation No.	1949 Bldg. Operation No.	1943 Bldg. Operation No.
---	141 R Division	41 Barracks Demolished	41 Barracks
---	142 Weapons Engineering	42 Barracks Demolished	42 Barracks
---	161 Physics	61 Dispensary	61 Dispensary
---	162 Physics	62 BOQ	62 BOQ
---	---	63 Wells Capped	63 Wells Capped
---	---	64 Wells Capped	64 Wells Capped
---	---	34 Recreation	34 Recreation
---	---	35 Subsistence	35 Subsistence
---	---	37 Barracks	37 Barracks
---	---	38 Scrub	38 Scrub
---	---	47 Scrub	47 Scrub
---	---	54 JOQ	54 JOQ
---	---	222 Synth. Training Devices	---
---	163 Uncleared Personnel	241 Stores #1	241 Stores #1
---	164 Stores	242 Stores #2	242 Stores #2
---	165 Stores	243 Stores #3	243 Stores #3
---	---	112 Operations Annex	112 Operations Annex
---	---	113 Operations Annex	113 Operations Annex
---	---	223 Gunnery Instruction	223 Gunnery Instruction
---	310 Ordnance	310 Ordnance	310 Ordnance
---	311 Ammunition Storage	311 Ammunition Storage	311 Ammunition Storage
---	312 Radio Transmitter	312 Radio Transmitter	312 Radio Transmitter

APPENDIX C

**AERIAL PHOTOGRAPHS OF
LLNL SITE, 1943-1984**

LLNL Site
Circa 1943

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