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Preoperational Environmental Monitoring Report for the SLL Tritium Research Laboratory

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PREOPERATIONAL ENVIRONMENTAL MONITORING REPORT FOR THE SLL TRITIUM RESEARCH LABORATORY

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ABSTRACT

The Tritium Research Laboratory is designed to conform with the ERDA philosophy to keep tritium release "as low as practicable." Though the main emphasis is on controlling tritium release at the source, an environmental monitoring program is maintained to ascertain the effectiveness of the control and containment measures and to determine whether any radiological changes in the environment are the result of TRL operations.

PREOPERATIONAL ENVIRONMENTAL MONITORING REPORT FOR THE SLL TRITIUM RESEARCH LABORATORY

Introduction

Sandia Laboratories, Livermore, (SLL) is located 50 miles southeast of San Francisco in the Livermore Valley midway between the Pacific Ocean and the San Joaquin Valley. Climate in the valley is typically warm and dry with an average annual rainfall of 14 inches occurring during the winter months. Surface water drainage from the valley is from east to west through various arroyos with outflow near Sunol in the southwestern corner of the valley. Prevailing winds are from the west and there are frequent nighttime thermal inversions.

Sandia Laboratories is a prime contractor to the Energy Research and Development Administration (ERDA) and is operated under the provisions of a nonprofit, no-fee contract with the Western Electric Company. SLL employs approximately 900 people. The SLL site comprises 164 acres located approximately three miles east of the City of Livermore, immediately adjacent to the Lawrence Livermore Laboratory.

The Tritium Research Laboratory (TRL) is an 80 x 180 foot, single-story building located in the test area east of the main complex. The laboratory will be used for research and development on various isotopes of hydrogen. All tritium activities formerly carried out in other locations will be moved to the TRL; and when fully operational, the facility may contain as much as 300 grams (3mCi) of tritium.

The TRL was designed to conform to the ERDA philosophy, which is to limit tritium release to "as low as practicable" (ALAP). To this end, the TRL employs a secondary containment system connected to the central gas purification system (GPS). This system is used to remove and recover tritium before venting to the 30m stack. Thus release of tritium to the environment will be minimal. A separate drain system is provided for liquid effluent that may be contaminated with tritium. The effluent empties into holding tanks, where it is checked to make certain that tritium content is below applicable discharge limits before release to the SLL sanitary sewer.

Pollutants other than tritium will be virtually nonexistent. The TRL uses steam produced at the SLL steam plant, which is fired primarily by natural gas backed up occasionally by fuel oil. The pollutant inventory

produced by the TRL is well within air quality guidelines. The sanitary effluent from the rest rooms is the only source of liquid waste other than the holding tanks. No chemical wastes are disposed of via the sewer system. Any nonradioactive liquid wastes are disposed of in accordance with California guidelines and approval. Nonradioactive solid wastes are disposed of in the usual manner at the Alameda County disposal site.

Even though the main emphasis is on controlling effluents at the source, an environmental monitoring program is maintained to ascertain the effectiveness of the control and containment measures and to determine whether any radiological changes in the environment are the result of TRL operations. Because of its location next to the Lawrence Livermore Laboratory, by agreement the LLL environmental monitoring program evaluates the effectiveness of the SLL program as well as their own. This monitoring program uses complex analytical techniques capable of detecting the activity of numerous radionuclides in the environment at natural background levels. SLL has been granted an exemption from filing a separate Environmental Monitoring Report. Close contact is maintained between the labs concerning changes in the sampling program and any significant increases in discharge levels.

The principal sources of tritium release in the Livermore-Amador Valley are building 331 at LLL and the TRL at Sandia. Thus the environmental measurements of tritium predominantly amount to effluent surveillance of these facilities. Tritium may be released either as the elemental gas (HT) or in chemical combinations such as tritiated water (HTO). The stack effluent from the TRL will be continuously monitored with a real time, autoranging monitor capable of reading from 1 $\mu Ci/m^3$ to $2kCi/m^3$. The output will also drive a totalizer which integrates the total amount of tritium which is exhausted through the stack. Another system will measure the integrated ratio of HT/HTO. Since the maximum permissible concentration for HTO is 200 times lower than that for HT, environmental monitoring is restricted to HTO measurements. Ratios measured in the stack are probably applicable to the environmental measurements, but at present, the environmental ratio is not measured.

The environmental tritium monitoring conducted by LLL consists of: (1) air sampling at perimeter locations, (2) analysis of vegetation collected on a monthly basis in the vicinity of the laboratory, and (3) analysis of rainwater and other open sources. Also, both the LLL sewer effluent and the City of Livermore sewage treatment plant effluent are analyzed for HTO. Sampling locations at the LLL perimeter and elsewhere in the Livermore Valley are shown in Figures 1 and 2, respectively. Typical annual average wind pattern is shown in Figure 3.

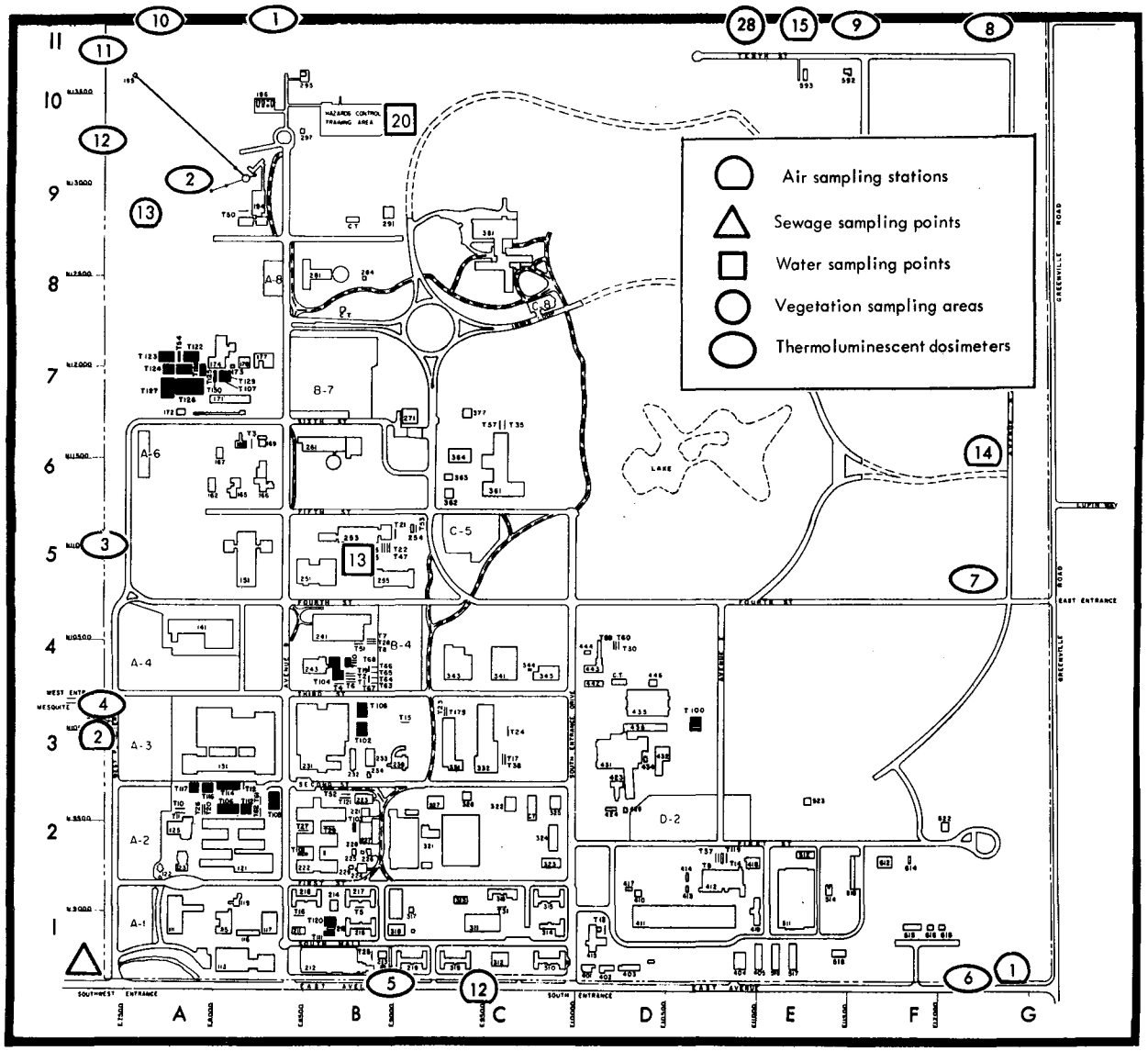
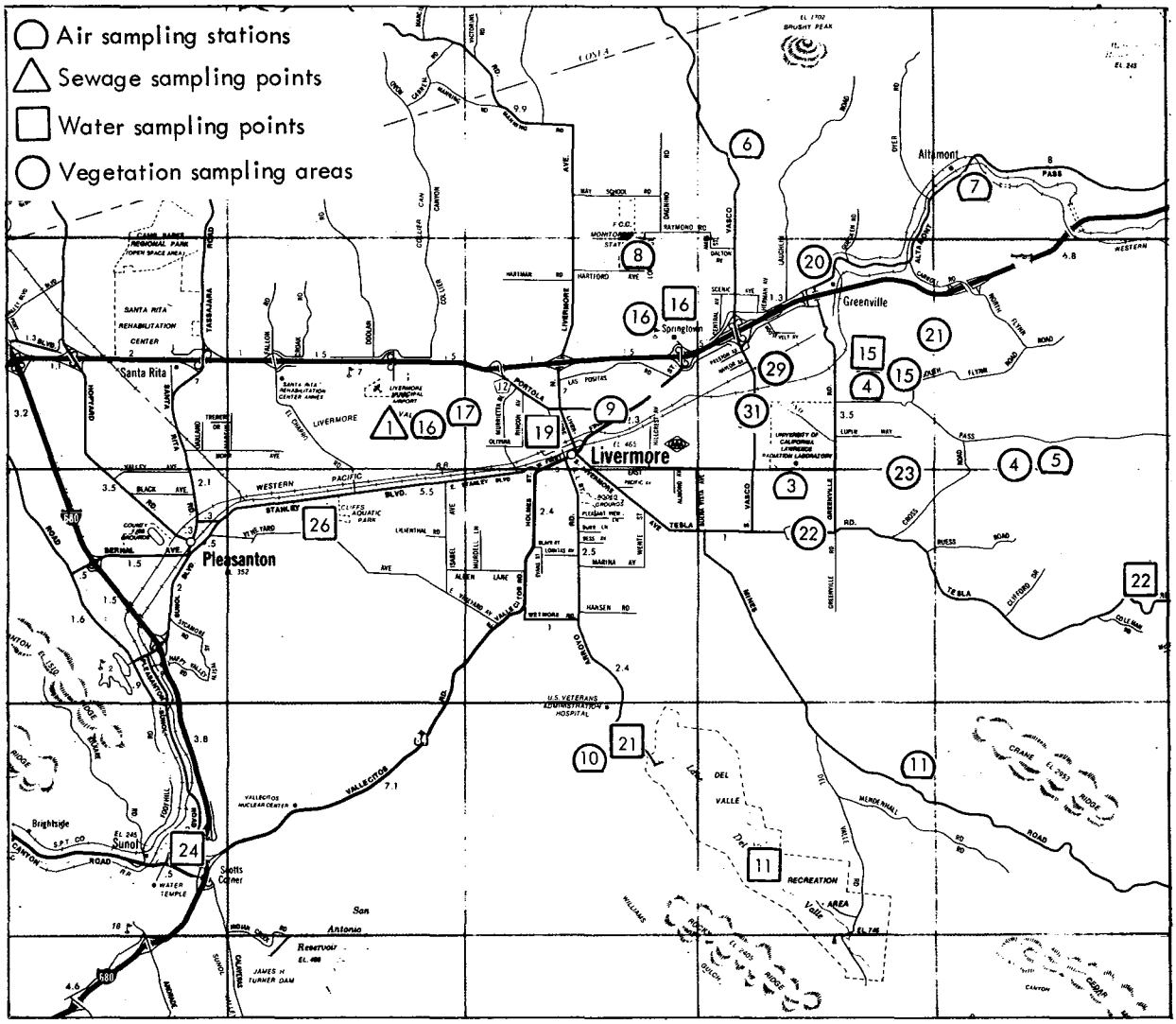


Figure 1. Lawrence Livermore Laboratory On-Site Environmental Sampling Locations


Air sampling stations
Sewage sampling points
Water sampling points
Vegetation sampling areas
Livermore
Pleasanton
Greenville
Altamont
Springtown
Santa Rita
Sunol
Brightside
Scotts Corner
San Antonio
Resetuout
Del Valle
Recreation Area
Brushy Peak
Vallecitos Nuclear Center
U.S. Veterans Administration Hospital
Santa Rita Rehabilitation Center
Camp Parks Regional Park (Open Space Area)
Water Temple
James H Turner Dam
Cedar Canyon
Crane Canyon
Cedar Ridge
Crane Ridge
Cedar Ridge
Canyon
Williams Ridge
Rocky Ridge
Gulch
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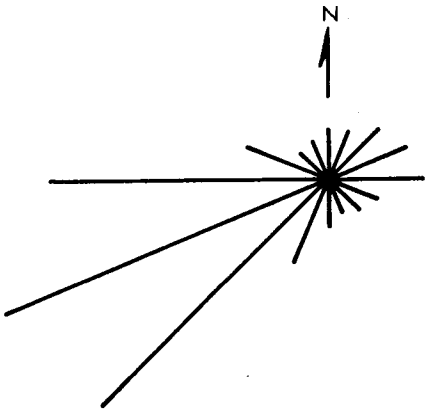

Wind rose shows relative frequency of wind direction (by the length of the line) obtained from the tabulated annual data below

Frequency of Wind In Percent for Livermore — 1971

Mo	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Calm
Jan	2.7	2.2	7.2	12.1	17.8	6.8	6.2	2.2	3.9	3.8	4.9	7.0	9.7	7.6	2.0	2.6	1.3
Feb	2.2	2.5	6.9	12.9	14.8	7.2	5.1	2.8	3.5	3.0	4.9	8.0	11.2	8.5	3.4	2.0	1.4
Mar	2.1	2.2	6.4	12.3	13.5	6.9	4.9	2.7	3.3	2.6	4.6	10.5	12.2	9.1	3.1	1.8	1.7
April	2.1	2.3	4.6	8.7	9.4	5.1	3.2	2.1	3.0	4.8	10.8	16.1	13.9	7.4	2.2	1.8	2.3
May	2.2	1.9	3.8	6.5	7.1	4.0	2.4	1.7	2.4	4.7	15.3	17.7	16.7	6.0	1.9	1.9	3.8
June	2.1	1.7	3.4	5.6	6.2	3.5	2.1	1.4	2.2	4.6	16.9	19.8	17.7	5.4	1.7	1.6	3.9
July	1.7	1.4	2.8	4.6	5.1	2.9	1.8	1.3	2.0	5.3	19.5	22.9	17.2	4.6	1.4	1.4	4.0
Aug	1.6	1.4	2.7	4.5	5.0	2.8	1.7	1.3	2.1	5.3	19.8	23.5	17.0	4.5	1.4	1.4	4.1
Sept	1.9	1.4	2.5	4.0	4.4	2.5	1.6	1.3	2.2	5.4	21.1	23.3	17.3	4.7	1.4	1.2	3.7
Oct	2.4	1.6	2.7	4.1	4.5	2.7	1.6	1.3	2.2	5.7	20.6	22.5	16.3	4.6	1.5	2.2	3.5
Nov	2.6	2.5	3.4	4.5	4.9	2.7	1.9	1.9	2.6	5.4	19.2	20.5	15.5	4.7	2.0	2.3	3.3
Dec	2.8	3.0	3.9	4.6	5.3	3.0	2.6	2.2	2.7	5.1	17.7	19.2	15.3	4.8	2.1	2.4	3.1
Annual Average	2.2	2.0	4.2	7.0	8.2	4.2	2.9	1.8	2.7	4.7	14.6	17.6	15.0	6.0	2.0	1.9	3.0

Figure 3. Typical Annual Average Wind Pattern for Livermore, California (LLL Data--1971)

Measurements of tritiated water (HTO) in the air at LLL perimeter air-sampling locations were begun in 1973. Water vapor is collected on silica gel samplers and analyzed on a weekly basis. The results of these measurements are summarized below.

TABLE I

AIRBORN TRITIATED WATER CONCENTRATIONS ON LLL PERIMETER -- 1973-75

(in $\mu Ci/m^3$)

Location	1973 Annual Average	1974 Annual Average	1975 Annual Average
1	2.8×10^{-5}	3.3×10^{-5}	3.5×10^{-5}
2	3.5×10^{-5}	5.6×10^{-5}	4.9×10^{-5}
12	6.2×10^{-5}	8.6×10^{-5}	8.8×10^{-5}
13	2.4×10^{-5}	2.7×10^{-5}	2.5×10^{-5}
14	6.2×10^{-5}	5.4×10^{-5}	5.0×10^{-5}
15	2.0×10^{-5}	2.8×10^{-5}	3.5×10^{-5}
Annual Average	3.85×10^{-5}	4.7×10^{-5}	4.7×10^{-5}
%RCG*	1.9×10^{-2}	2.4×10^{-2}	2.4×10^{-2}
Release**	2500 Ci	1900 Ci	3380 Ci***

*RCG for HTO in air is 0.2 $\mu Ci/m^3$.

**The total tritium release from all LLL sites.

***Increase attributed to increased sensitivity of stack monitoring.

The average annual background concentrations are comparable to natural background levels. The effect of releases from LLL is not measurable, except perhaps at location 12 which is situated between two tritium release points.

Water samples are collected from various locations in the Livermore Valley as shown in Figures 1 and 2. The annual average for these locations as determined since 1971 is shown in Table II.

TABLE II

TRITIUM CONCENTRATIONS IN
LIVERMORE VALLEY WATER -- 1971-75
(in μCi/ml)

Location	1971	1972	1973	1974	1975
11	2.6×10^{-7}	1.9×10^{-7}	1.3×10^{-7}	1.3×10^{-7}	1.2×10^{-7}
15	2.8×10^{-7}	1.8×10^{-7}	1.6×10^{-7}	1.5×10^{-7}	1.7×10^{-7}
16	8.7×10^{-7}	2.3×10^{-7}	2.3×10^{-7}	2.5×10^{-7}	2.7×10^{-7}
19	1.6×10^{-7}	1.0×10^{-7}	1.1×10^{-7}	1.3×10^{-7}	1.2×10^{-7}
20	8.1×10^{-7}	3.1×10^{-7}	4.6×10^{-7}	8.7×10^{-7}	3.1×10^{-7}
21	2.7×10^{-7}	2.0×10^{-7}	1.4×10^{-7}	1.5×10^{-7}	---
22	4.0×10^{-7}	3.0×10^{-7}	1.7×10^{-7}	1.5×10^{-7}	---
24	6.0×10^{-7}	9.0×10^{-7}	6.7×10^{-7}	1.1×10^{-6}	1.1×10^{-6}
26	---	---	1.4×10^{-7}	2.3×10^{-7}	9.1×10^{-7}
Annual Average				3.3×10^{-7}	4.3×10^{-7}

RCG (HTO) = 3×10^{-3} μCi/ml.

These values are typical of tritium concentrations which occur naturally.

Liquid effluents from the Tritium Research Laboratory are collected in one of two 2500-gallon stainless steel holding tanks. When the tank is full, the contents are analyzed for tritium content and released to the sanitary sewer.

The effluent is monitored at the outfall for pH, radioactivity, and various trace metals. The tritium content is measured at the outfall and at the Livermore Water Reclamation Plant (LWRP). The annual averages are summarized in Table III.

TABLE III

TRITIUM CONCENTRATIONS IN LWRP AND LLL LIQUID EFFLUENTS -- 1971-75

(in μCi/ml)

	1971	1972	1973	1974	1975
LLL Outfall			4.9×10^{-5}	5.1×10^{-5}	7.6×10^{-5}
LWRP	1.3×10^{-5}	4.2×10^{-6}	3.3×10^{-6}	6.0×10^{-6}	9.3×10^{-6}

The concentration guide for HTO is 3×10^{-3} μCi/ml.

Vegetation samples are collected on a monthly basis and analyzed for tritium. The samples, usually native grasses, are freeze-dried and the tritium activity in the recovered water is determined by liquid scintillation counting. The tritium data on the Livermore Valley vegetation sampling program are summarized in Table IV.

TABLE IV

TRITIUM CONCENTRATIONS IN LIVERMORE VALLEY VEGETATION -- 1971-75

(in μCi/g-dry wt)

Location	1971	1972	1973	1974	1975
4	3.3×10^{-7}	5.6×10^{-7}	1.5×10^{-6}	1.5×10^{-6}	4.9×10^{-7}
5	4.7×10^{-6}	2.7×10^{-6}	1.3×10^{-5}		
7	4.5×10^{-7}	3.1×10^{-7}	5.3×10^{-7}		
10	1.1×10^{-5}	1.9×10^{-6}	7.6×10^{-6}		
11	3.9×10^{-5}	2.0×10^{-6}	9.9×10^{-6}		
12	1.8×10^{-6}	1.9×10^{-6}	4.2×10^{-6}		
13	3.0×10^{-7}	4.0×10^{-7}	1.2×10^{-6}		
15	1.4×10^{-6}	1.5×10^{-6}	6.8×10^{-6}	6.6×10^{-6}	1.9×10^{-6}
16	3.5×10^{-6}	4.3×10^{-7}	7.5×10^{-7}	8.0×10^{-7}	4.0×10^{-7}
17	1.6×10^{-7}	7.0×10^{-7}			
18	2.8×10^{-7}	4.3×10^{-7}			
19	2.2×10^{-7}	2.7×10^{-7}	6.2×10^{-7}		
20	6.4×10^{-6}	8.3×10^{-6}	5.0×10^{-6}	2.2×10^{-6}	1.4×10^{-6}
21			4.9×10^{-6}	2.9×10^{-6}	1.4×10^{-6}
22			2.2×10^{-6}	4.6×10^{-6}	9.3×10^{-7}
23			4.1×10^{-6}	1.1×10^{-5}	4.1×10^{-6}
24			4.5×10^{-6}		
25			2.5×10^{-6}		
28			1.8×10^{-5}		
29			1.8×10^{-5}	1.3×10^{-5}	2.4×10^{-6}
30			1.1×10^{-5}	1.0×10^{-6}	1.4×10^{-6}
31			3.4×10^{-6}	5.8×10^{-6}	2.9×10^{-6}
Annual Average	5.3×10^{-6}	1.6×10^{-6}	6.0×10^{-6}	5.5×10^{-6}	1.7×10^{-6}

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