

# **Radioactive Neighbor:**



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Initial samples collected from around LLNL in December 2003 found 4 types of previously unreported radioactivity.

## Conclusions

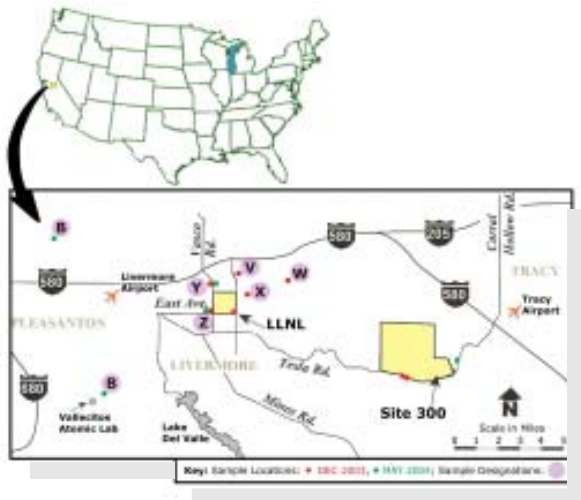
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- The Lawrence Livermore National Laboratory's (LLNL's) environmental self-monitoring program is fundamentally un-protective of LLNL's surroundings. Short-term, independent monitoring of radioactivity from LLNL has identified very low levels of four artificial radionuclides unreported by LLNL: iron-59, strontium-90, cesium-137, and americium-241. These detections show that fundamental deficiencies of LLNL's self-monitoring translate into real releases that go unreported.
- LLNL's releases of unreported radioactivity stopped for the duration of the short-term, independent monitoring by The RadioActivist Campaign (TRAC). This effect suggests that LLNL's practices might be improved with independent monitoring, making Livermore cleaner and safer. Independent monitoring works!
- LLNL's self monitoring program needs to be corrected to prevent unreported releases of radioactivity in the future.
- Vegetation in Arroyo Las Positas, northwest of LLNL, provides citizen groups and local regulators a unique opportunity to *cost effectively* monitor some unreported releases of radioactivity and toxic materials from LLNL.
- TRAC recommends that Livermore residents and local regulators establish independent, cumulative, radiological monitoring at one location in Arroyo Las Positas, to help improve public oversight of this nuclear weapons facility.

## Introduction to This Study

The Lawrence Livermore National Laboratory (LLNL) reports releases of radioactive and toxic materials into its surroundings. LLNL also monitors its environment for radioactive and toxic materials, with results published in an annual Environmental Report.

LLNL's radiological monitoring focuses on two radionuclides "often associated with LLNL operations": hydrogen-3 (called tritium) and plutonium. Other radioactive by-products of nuclear fission and nuclear activation are not included in LLNL's routine monitoring. Thus, neighbors of LLNL have to largely rely on LLNL to report its own sources of radioactivity (such as pipes, stacks, effluent, etc.). Livermore residents also have to rely on LLNL to report on its compliance with "all federal, state, and local environmental permitting requirements."



Study area, with sample locations. TRAC's results suggest LLNL stopped releasing radioactivity during TRAC's 5 month study.

In December 2003, The RadioActivist Campaign (TRAC) began a 5 month radiological survey around LLNL's perimeter to monitor LLNL's releases of artificial radioactivity into the surrounding environment. TRAC sought to identify and sample air and waterborne pathways that could potentially release radioactivity. TRAC's study served a "Red Team" role to determine whether LLNL completely reports all of its artificial radioactive releases.

TRAC then analyzed those samples in its in-house broad-band spectrometric laboratory. TRAC's analysis is relatively sensitive to most nuclear fission and activation products, but not to tritium or plutonium.

TRAC used the results of the December study to plan follow-up monitoring in May 2004. The follow-up monitoring provided confirmations of positive "hits" and checks on alternative explanations for those results. This is TRAC's final report from the December 2003 and May 2004 radiological monitoring around LLNL.

## Introduction to Livermore



Photo: City of Livermore

Livermore Valley as it may have looked when the Spanish established Mission San José, a portion of which later became the city of Livermore.

In June 1779, Father Fermin Francisco de Lasuen founded Mission San José, which extended southeast from the Livermore Valley to the San Joaquin Valley. Mission San José was the fourteenth of 21 Spanish Mission way stops, in a chain along El Camino Real, from San Francisco to San Diego.

By 1830, nearly 2,000 native Ohlones (Costonoans) lived at Mission San Jose. In 1834, 12 years after Mexico won its independence, the government secularized the Spanish Church's missions and divided them into private ranchos. The natives fled.

In 1835 Robert Livermore settled in the area at Rancho Las Positas. Rancho Las Positas encompassed much of the present day city of Livermore, which was founded in 1869 by William Mendenhall. Livermore grew into an agricultural community, with ranches and vineyards near the railroad.

During World War I, the Red Cross launched the Livermore Rodeo to raise funds for its humanitarian work. During World War II, the U.S. Navy trained personnel and serviced and repaired aircraft at the Livermore Naval Air Station, a mile east of town.

After the war, Edward Teller, the "Father of the Hydrogen Bomb" appealed successfully to the Atomic Energy Commission (now the Energy Department) for a second weapons lab as "competition" for the Los Alamos National Laboratory. Teller believed his idea for a hydrogen bomb had too low a priority at Los Alamos. The Lawrence Livermore National Laboratory was founded at the old Naval Air Station in September 1952. LLNL later acquired an Experimental Test Site, Site 300, 12 miles to the east. (See the map on the previous page.)



Photo: LLNL

Edward Teller, the "Father of the Hydrogen Bomb," petitioned for a weapons lab (LLNL) to develop his bombs.

LLNL's 1.3 square-mile site is located on the eastern edge of the residential expansion of the city of Livermore. A business park is developed on the north side of LLNL, with zoning for light industry to the northeast; downwind of LLNL. An Energy Department weapons prototyping facility, Sandia National Laboratories/California, abuts the southern boundary of LLNL.

LLNL's original purpose was "to support the Nation's nuclear weapons program by providing innovative design and engineering."

During the Cold War, LLNL became a *world premier scientific center* with programs in advanced defense technologies, energy, environment, biosciences, and fundamental physics. LLNL's present day, self-described purpose is "to promote innovation in the design of our nation's nuclear [weapons] stockpile through creative science and engineering."



Lawrence Livermore National Laboratory became a world premier scientific center during the Cold War.

LLNL's priorities include environment, safety, and health considerations. LLNL seeks to comply with all applicable laws, regulations, and requirements. LLNL monitors air, water, soil, vegetation, foodstuffs, and effluents from LLNL to assure regulatory agencies and the public of its legal compliance. LLNL publishes its assurances in an annual Environmental Report and reports the monitoring results at its website at <http://www-envirinfo.llnl.gov>.

The Environmental Protection Agency (EPA) listed LLNL and Site 300 as Superfund sites in 1987 and 1990, respectively. Superfund sites are areas the EPA considers a threat to human and/or environmental health due to their high levels of contamination.



Present-day LLNL innovates U.S. nuclear weapons.

Radioactive and toxic contaminants move off-site along several kinds of pathways, including groundwater, discharges to Livermore sewage treatment lines, and animal movements. Two kinds of contaminant pathways from LLNL are especially conducive to independent monitoring: (1) airborne pathways with fallout and rainout downwind (predominately to the northeast and east) of LLNL, and (2) surface water pathways of discharges and storm runoff into the arroyos flowing to the west and

northwest from the lab. Rainfall to the northeast and east of the lab contributes to the flow of Arroyo Las Positas, from the northwest corner of the site.

Arroyo Las Positas, downstream of LLNL, provides optimal locations for sampling combined airborne and surface waterborne pathways of contaminants from LLNL into public air, land, water, and vegetation.

## Results

The RadioActivist Campaign (TRAC) met with LLNL staff and with representatives of regional public-interest groups to plan TRAC's initial sampling of radiological pathways coming from LLNL.

That initial sampling, between December 13<sup>th</sup> and 18<sup>th</sup> 2003, occurred during the Livermore Valley's rainy season.

TRAC focused its initial sampling on pathways of

- (1) airborne fallout, downwind (northeast) of LLNL.
- (2) rain run-off in Arroyo Seco and Arroyo Las Positas, downstream (west and northwest) of LLNL.

TRAC also collected two deep-rooted vegetation samples from the south side of LLNL's testing area, Site 300, to check for groundwater contamination. TRAC collected one anecdotal sample, an anthill at the southeast corner of the LLNL fence line, to check for an animal-borne pathway of radioactivity. For sampling locations and their designations, see the map on Page 1.



Arroyo Seco. Water collected here in December 2003 tested positive for strontium-90.

TRAC analyzed the samples collected in December 2003 for artificial radioactivity, by counting each in its wide-band photon spectrometer for 23 hours. TRAC's spectrometer is sensitive to most artificial radionuclides, with notable exceptions of hydrogen-3 (tritium), carbon-14, and plutonium-239. The presence of plutonium-239 in a sample is often evidenced by the detection of its by-product, americium-241, in the sample.

TRAC's radiological analysis is slightly biased to avoid false positive results that might needlessly raise public concerns. TRAC's sampling and analytical procedures are designed to yield robust radiological results and conclusions; but they are not comprehensive.



TRAC's Norm Buske collects tree leaves from near Site 300. Site 300 samples all tested negative for artificial radioactivity.

TRAC used the **December 2003** results to plan its **May 2004** sampling. Background "B" samples, an anecdotal anthill sample from the southeast corner of the LLNL fence line, and three samples from outside Site 300 tested negative for artificial radioactivity. See [www.radioactivist.org/lnlreports.html](http://www.radioactivist.org/lnlreports.html) for all results and sampling and analytical details. All positive results appear on the next page.

**Analysis Results: Radioactivity in picocuries/kilogram(wet)**

- 1 pCi/kg(wet) = one nuclear disintegration per minute, in a pint of liquid.
- **Sample collected in December 2003 (in red).**
- **Sample collected in May 2004 (in green, underlined).**

Location <b>V</b> :	Greenville Roadside mudpuddle. Near northeast of LLNL. Downwind of LLNL with rain runoff.				
Sample Material:	<b>settled sediment</b>		<b>unfiltered water</b>		
Cesium-137:	<b>0.25±0.06</b>		<b>0.02±0.03</b>		
Wet/Dry Ratio:	<b>984.**</b>		<b>11.22 Kg*</b>		
Location <b>W</b> :	Flynn Roadside. Far northeast of LLNL. Downwind of LLNL				
Sample Material:	<b>young grasses</b>		<u>mature grasses</u>		
Strontium-90:	<b>190.±160.</b>		<u>-100.±160.</u>		
Wet/Dry Ratio:	<b>6.8</b>		<u>2.8</u>		
Location <b>X</b> :	Arroyo Las Positas. Near east of LLNL. Downwind and upstream of LLNL.				
Sample Material:	<b>rain runoff water</b>		<b>young grass</b>		
Cesium-137:	<b>0.03±0.016</b>		<b>2.9±1.6</b>		
Wet/Dry Ratio:	<b>20.38 kg*</b>		<b>6.2</b>		
Location <b>Y</b> :	Arroyo Las Positas. Near north of LLNL. Upwind and downstream of LLNL.				
Sample material:	<b>sediment</b>	<b>young reed grass</b>	<u>mature surface grasses</u>	<u>water</u>	<u>terrestrial moss</u>
Iron-59:	--	<b>290.±90.</b>	--	--	--
Cesium-137:	--	<b>8.7±2.1</b>	<u>-0.2±1.3</u>	<u>0.027±0.011</u>	--
Americium-241:	--	<b>4.5±2.0</b>	<u>3.5±1.1</u>	--	--
Wet/Dry Ratio:	<b>1.0***</b>	<b>5.3</b>	<u>3.9</u>	<u>21.16 kg*</u>	<u>5.1</u>
Location <b>Z</b> :	Arroyo Seco. Near west of LLNL. Upwind and downstream of LLNL.				
Sample Material:	<b>surface water</b>		<b>sorrel</b>		<u>aquatic moss</u>
Strontium-90:	<b>1.3±0.4</b>		--		--
Wet/Dry Ratio:	<b>20.66 kg*</b>		<b>8.1</b>		<u>8.9</u>

\* Mass of water sample is given instead of Wet/Dry Ratio.

\*\* From 11.22 kg puddle water, sediment settled and dried to 11.4 g.

\*\*\* Dried weight is given as wet weight.

- To convert pCi/kg(wet) to Bq/g(dry), multiply by 0.000037X(Wet/Dry Ratio).
- Wet/Dry Ratio is weight of sample as collected, divided by weight after drying.
- Locations having no detection of artificial radioactivity are omitted.
- "--" negative counts are reported only to allow comparisons.
- "--" means radionuclide was not detected in this sample.

## Discussion

TRAC's analyses of its initial samples collected in December 2003 yielded two surprises:

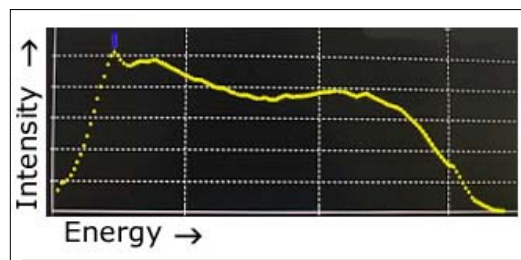
**1. Superficial radioactivity, previously unreported from LLNL, was detected at low levels in environmental samples.** That radioactivity was:

Iron-59, with a half-life of only 45 days, is a product of neutron activation of steel. The short half-life of this isotope implies that the detected iron-59 was recently produced and released from LLNL, less than a year before TRAC sampled.

Strontium-90, with a half-life of 29 years, is a product of nuclear fission.

Cesium-137, with a half-life of 30 years, is a product of nuclear fission.

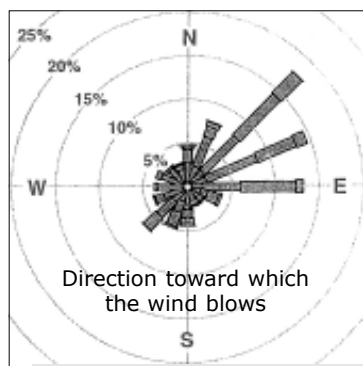
Americium-241, with a half-life of 433 years, is a by-product of production of plutonium.



Strontium-90 photon energy spectrum.

TRAC's discovery of this previously unreported radioactivity revealed fundamental inadequacies of LLNL's radiological monitoring program. TRAC's discovery implies that LLNL might release radioactivity to its surroundings without that radioactivity being detected or reported by LLNL's routine self-monitoring.

**2. The surface water pathway of Arroyo Las Positas, running out of the north side of LLNL, is fed both by on-site sources and by rain run-off from LLNL fallout to the northeast of LLNL.**



Weathervane for Livermore. Fallout from LLNL is primarily deposited to the northeast.

This finding showed that Arroyo Las Positas, northwest of LLNL is a surprisingly advantageous location to monitor airborne and waterborne contaminants from LLNL.

Airborne radioactivity from LLNL falls out primarily downwind, to the northeast of LLNL. Rainstorms wash some of that fallout into the valleys that are tributaries to Arroyo Las Positas. Rainstorms also wash on-site fallout into Arroyo Las Positas. Any additional unidentified and unreported liquid discharges from LLNL might also add contamination to the surface water flow in the arroyo. Therefore, Location Y (Arroyo Las Positas, see detail map) is an excellent location for cumulative

monitoring of releases from LLNL. TRAC focused on Location Y for follow-up sampling in May 2004.

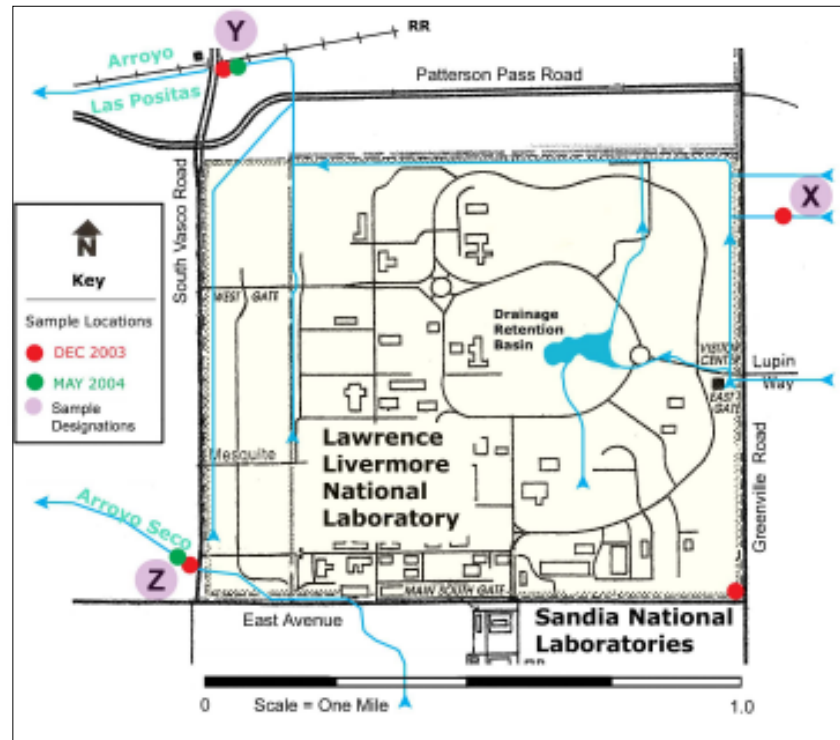
Young reed grasses TRAC had sampled at Location Y in December 2003 were re-sampled as mature grasses in May 2004. Both the iron-59 and cesium-137 had disappeared by May.

These results are explained by a combination of **wash-off** and **dilution**: Superficial radio-iron and radio-cesium

contamination may have been washed off by rain fall after December 2003, and artificial radioactivity within the young grasses was not supplemented by additional releases from LLNL, as the grasses grew. The negative result for strontium-90 in the May sampling, at downwind Location W, accords with this explanation. This explanation suggests that:

***unreported releases of radioactivity from LLNL practically stopped during TRAC's independent monitoring.***

According to this explanation of the radiological results of this study, artificial radioactivity that LLNL had released into its surroundings shortly before TRAC's December sampling had been washed away by rainstorms, before TRAC re-sampled the following May. The record of rainstorms and rainfall in Livermore accords with this explanation; see next page:



TRAC's sample locations near LLNL. Surface water drainages are in blue. Arrows show that stormwater run-off from the east contribute to Arroyo Las Positas' flow.

Month:	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
Storms:	0	0	0	0	3	4*	2	6	0	0	0
Rainfall:	0.0	0.3	0.0	0.0	2.0	3.6	2.2	4.0	0.4	0.2	0.1

“Storms” is the number of days in the month with rainfall >0.25 inches in Livermore.  
“Rainfall” is monthly total precipitation for Livermore, in inches.  
\* In December 2003, there were two storms before TRAC sampled, and two afterward.

These independent results raise public concern for accidental radioactive releases from LLNL: (1) LLNL’s self-monitoring program is inadequate to detect and report releases of radioactivity into LLNL’s surroundings; and (2) LLNL does not measure enough radionuclides, it measures insensitive materials at non-indicative locations, and it samples too infrequently.



Arroyo Las Positas allows cumulative sampling for air- and water-borne releases from LLNL. Grass from the arroyo tested positive for Americium-241, a by-product of plutonium production.

TRAC’s findings show how LLNL’s monitoring program meets all federal, state, and local environmental permitting requirements, with priority considerations for the environment, safety, and health, and yet;

**LLNL still fails to ensure public safety and environmental protection.**

This regulatory insufficiency should be remedied as soon as feasible.

In May 2004, TRAC re-sampled Location W (Flynn Roadside) to confirm the strontium-90 detected in December 2003. TRAC also sampled two background “B” locations (see the location map on the inside cover) and collected a sample from downslope, downstream, and downwind of Site 300. Those samples yielded negative results for artificial radioactivity. (See TRAC’s data reports at [www.radioactivist.org/llnlreports.html](http://www.radioactivist.org/llnlreports.html) for details.)

Fortunately, the radioactive releases measured by TRAC’s monitoring in December 2003 and May 2004 are themselves far below levels recognized for public concern. An exception is the marginally significant result of  $190 \pm 160$  pCi/kg(wet) strontium-90 in one grass sample from Location W (Flynn Road) that TRAC reported in December 2003.



