DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

September 30, 1992

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Allyn M. Davis, Ph.D.
Director
Hazardous Waste Management Division
U.S. Environmental Protection Agency
Region VI
1445 Ross Avenue
Dallas, Texas 75202

Dear Dr. Davis:

Attached, for your information, is a copy of the ATSDR health consultation on Acid Canyon/Los Alamos National Laboratory, Los Alamos, New Mexico. This consultation was prepared in response to a request for an assessment of environmental data submitted by a concerned citizen.

If you have questions regarding the document, please feel free to contact our office.

Sincerely,

George L. Pettigrew, P.E.
Regional Representative
ATSDR Region VI

Attachment

cc: (with attachment)
Barbara Driscoll
Hank May

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DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service
Agency for Toxic Substances
and Disease Registry

# Memorandum

Date September 14, 1992

From Environmental Health Scientists, EFAS, FPB, DHAC (E56)
Environmental Health Physicist, EFAS, FPB, DHAC (E56)
Environmental Health Scientist, TSS, ERCB, DHAC (E32)

Subject
Health Consultation: Acid Canyon/Los Alamos National Laboratory (6PZF) Los Alamos, New Mexico

To
George Pettigrew
ATSDR Regional Representative
U.S. EPA Region VI
Through: Director, DHAC (E32)
Chief, FPB, DHAC (E56)
Chief, ERCB, DHAC (E32)

**BACKGROUND AND STATEMENT OF ISSUES**

A member of the Working Group to Address Los Alamos Community Health Concerns has asked the Agency for Toxic Substances and Disease Registry (ATSDR) to comment on the health implications of plutonium found in Acid Canyon (1). Acid Canyon is one of several canyons adjacent to the Los Alamos National Laboratory (LANL) and is one site in the Department of Energy's (DOE's) Formerly Utilized Sites Remedial Action Program (FUSRAP). ATSDR has received several petitions to conduct a public health assessment of LANL and has recently completed a site visit (2). At this time, ATSDR is in the process of determining whether a public health assessment is warranted.

LANL, which is currently operated for DOE by the University of California, was built as a nuclear weapons research and development facility in 1943. Part of the Manhattan Project, its mission was to develop the world's first nuclear fission weapon. LANL occupies approximately 28,000 acres in Los Alamos County in north-central New Mexico, about 60 miles north of Albuquerque and 25 miles northwest of Santa Fe. Part of LANL is also in Santa Fe County. The facility and much of Los Alamos County are on the Pajarito Plateau, which is made up of finger-like mesas separated by deep canyons. The mesas were created volcanically, and the canyons were cut by intermittent streams (3,4).

Plutonium isotopes from LANL have been disposed of in Acid Canyon. When operations began at LANL in 1943, untreated liquid waste was discharged at the canyon's edge. Treated waste was discharged beginning in 1948. Waste discharges into the canyon were reported to have stopped in 1964. For the purposes of this consultation, ATSDR focused on data documenting plutonium contamination, although other

contaminants may be present in Acid Canyon (2,3,4). Very little information on the presence of other contaminants exists (5).

Liquids discharged into the canyon generally would be expected to flow along its floor. Material in the canyon soil and sediments would tend to migrate in flowing water present during and after storms, and in air if soil and sediments are disturbed by wind or human activity. Acid Canyon leads into Pueblo Canyon, which eventually leads to the Rio Grande River (2,3,4).

The groundwater in the area is regularly monitored. The aquifer supplying potable water to the Los Alamos area is reported to be 800 feet or more below the canyon floor. The overlying geologic formations in the area are believed to be quite impermeable. A perched aquifer exists in parts of some canyons, but ATSDR saw no evidence (April 29, 1992) that, if perched water exists below the surface of Acid Canyon, it is used (2).

Past remediation efforts have removed radioactive contaminants from the walls and floor of Acid Canyon. Contaminated soil from parts of the canyon was removed in 1966. By July 1967, DOE considered the canyon sufficiently free of radioactive contamination to allow unrestricted access. Part of the area was surveyed again in 1976-77. As a result, additional remediation took place in 1982 in the outfall area at the canyon's edge (2,3).

Soil samples were taken below the rim of Acid Canyon during the 1970s as part of the LANL routine environmental surveillance program. The samples were analyzed for radionuclides. Based on these data, the highest plutonium-239 ($^{239}Pu$) activity level found in Acid Canyon soil samples was about 630 picocuries of $^{239}Pu$ per gram of soil (pCi-Pu/g) or 23.3 becquerels per gram (Bq/g -- disintegrations per second per gram) (2,3,4). This hot spot (the size of which was not reported) was identified in 1977, but the area was not remediated (2,3). The average activity levels of $^{239}Pu$ and $^{240}Pu$ on the canyon floor, according to 1976-77 data, were an order of magnitude below the 630 pCi-Pu/g (23.3 Bq/g) level. The average activity levels in the banks of the canyon were about 15-20% of the 630 pCi-Pu/g (23.3 Bq/g) level. The radionuclide americium-241 ($^{241}Am$), a decay product of $^{241}Pu$, was also identified in Acid Canyon soil at a maximum activity level of 43.4 pCi-Am/g (1.6 Bq/g) (4). No information was available to determine if Acid Canyon biota have elevated levels of those radionuclides or if people use the biota.

ATSDR is not aware of more recent data on the nature and extent of the contamination in Acid Canyon (5).

Public access to Acid Canyon is currently not restricted and during a site visit (April 29, 1992) ATSDR personnel observed several persons jogging and walking there. During the ATSDR site visit and once a few weeks before the visit, LANL personnel conducted real-time monitoring for radiation using alpha meters, micro R meters, and a FIDLER gamma radiation detector. LANL reports that, during both trips into Acid Canyon, no radiation above background levels was identified (2).

LANL is beginning to fulfill requirements under Resource Conservation and Recovery Act (RCRA) permits. Specific areas at the facility and around the townsite have been designated as Solid Waste Management Units (SWMUs). Acid Canyon received waste from several SWMUs; LANL personnel are reportedly planning to take about 50 soil samples from the canyon this year to identify any contaminants present (2).

**DISCUSSION**

$^{239}$Pu emits alpha particles of discrete energies. The alpha particles are easily absorbed by materials such as soil and travel only a few centimeters in the air. For that reason, detection of $^{239}$Pu particles in the canyon using alpha meters such as those utilized by LANL is unlikely. To detect the particles at all, the $^{239}$Pu would have to be sitting on the very surface of the soil, and the alpha meters would have to be placed within a few centimeters of the contaminated area.

$^{239}$Pu also emits some gamma radiation. Although the FIDLER detector may be adequate to detect $^{239}$Pu gamma radiation in soil in some cases, ATSDR was informed by LANL personnel operating the instrument that it was not calibrated before its use on April 29, 1992, the day of ATSDR's trip through Acid Canyon. The other gamma detectors (the micro R meters) are not adequate to detect environmental levels of $^{239}$Pu because $^{239}$Pu does not emit gamma radiation of significant energy frequently enough to be adequately detected by micro R meters.

Sampling performed in the mid 1970s relied on laboratory analysis to determine the activity levels of $^{239}$Pu in soil. When soil samples were collected during the 1970s in Acid Canyon, an area about 100 yards long was surveyed. Results of some of those samples are reported in Table I.

Table I. Activity levels of samples from Acid Canyon (3,4)

| Sample | Gross Alpha Activity Level (pCi/g) | $^{239}$Pu Activity Level (pCi-Pu/g) |
|---|---|---|
| 1[a] | 580 | 629 |
| 2[a] | 460 | 500[b] |
| 3 | 60 | 33.5 |
| 4 | 50 | 38.4 |
| 5 | 80 | 50-60[c] |
| 6 | 110 | 50-60[c] |

[a]samples taken within approximately 5-10 meters of each other
[b]reported as a calculated value
[c]estimated by ATSDR based on the gross alpha/plutonium activity ratios of the other samples

Sample locations were noted if gross alpha activity levels in any individual sample exceeded 50 pCi/g (1.8 Bq/g), approximately two standard deviations above typical background levels of alpha activity. LANL probably considered a value above 50 pCi/g (1.8 Bq/g) indicative of residual contamination (3,4).

In the past, DOE used a *maximum residual contamination* limit, at Formerly Utilized Sites and Remote Surplus Facilities Management Program Sites for unrestricted use of land and structures, of 300 pCi/g (11.1 Bq/g) for $^{239}$Pu. In addition, DOE policy stated that "A site-specific analysis will be prepared for each site prior to determining residual contamination guidelines for a specific site..." and that "It is the policy of DOE to decontaminate sites to contamination levels at or below the limits and in a manner consistent with DOE's as-low-as-is-reasonably-achievable (ALARA) policy on site-specific basis." (6).

Consistent with those policies, DOE has implemented new guidelines for *residual surface contamination*. The guideline denotes the maximum allowable total residual surface contamination for an isotope such as $^{239}$Pu as 300 disintegrations per minute (dpm) per 100 cm$^2$ for existing structures and equipment. In addition, DOE requires the use of RESRAD--a computer program which includes a methodology for deriving soil concentration guidelines--to determine residual

radioactive soil limits at sites identified by the Formerly Utilized Sites Remedial Action Program (FUSRAP) (4) and remote sites identified by the Surplus Facilities Management Program (SFMP) (7).

LANL apparently did not carry out additional sampling even though there were soil samples with activity levels above DOE guidelines. LANL is reported to have theorized that, at that time, human exposure to contaminated soil and sediment in Acid Canyon was unlikely (3). LANL stated that the remedial action criteria for re-suspension/inhalation was 7,600 pCi/g (281 Bq/g); therefore, no additional action was needed (3). LANL considered human exposure through the food/gardening pathway as unlikely because of the canyon's terrain. LANL also estimated that, as the canyon eroded, additional soil and sediment would dilute the radioactive material present and leave a value of approximately 20 pCi/g (0.74 Bq/g), the level then found in lower Pueblo Canyon (3,4).

The International Commission on Radiological Protection (ICRP) has reviewed recent data regarding plutonium's metabolism in order to evaluate its past exposure recommendations (8). Those data included information obtained since 1971 from human tissue. With respect to inhalation exposure, ICRP classified plutonium oxides as compounds that are retained in the lungs in excess of 100 days. In other words, it takes more than 100 days for half of the plutonium inhaled and deposited in the lungs to be removed. Removal is accomplished by a variety of mechanisms, including movement from the lungs to the blood stream via translocation, and ciliary movement from the lungs to the gastrointestinal (GI) tract. Once plutonium compounds enter the GI tract, a fractional amount is absorbed into the blood; the remainder is excreted. That fractional amount is extremely low, ranging from $1x10^{-3}$ to $1x10^{-5}$, depending on the isotope and chemical form (8-10).

As a result of new data (8) and new recommendations on radiation exposure (9), the ICRP has reduced its recommendations for annual exposures to plutonium compounds. In 1991, ICRP published new recommendations for exposure that limited occupational exposure (effective-dose-equivalent) to 20 milliSievert (mSv) or 2,000 millirem (mrem) per year, averaged over 5 years, and not to exceed 50 mSv (5,000 mrem) in any one year. For the public, exposure from nuclear facilities or operations is limited to 1 mSv (100 mrem) per year above background (9). That public exposure limit considers factors that may enhance the effects on sensitive populations such as pregnant women, unborn fetuses, and children.

The annual limit on intake (ALI), as defined by ICRP, is the amount of a radionuclide that delivers the occupational effective-dose-equivalent, 20 mSv/yr, from ingestion or inhalation exposures. ALIs account for the average career span of an occupationally exposed person--50 years (10). To address similar types of public exposures, ICRP recommends using the average lifetime of an individual, 70 years, instead of the 50 years used in occupational calculations (10).

Using the ICRP methodology and incorporating the public's effective-dose-equivalent over a period of 70 years, the public's annual limit on intake of $^{239}Pu$ and $^{240}Pu$ for inhalation is 10 Bq (270 picocuries). Similarly, the public's annual limit on intake of $^{239}Pu$ and $^{240}Pu$ for ingestion is 1,000 Bq (0.027 microcuries).

Because $^{239}Pu$ and its decay products are primarily alpha emitters, canyon soil would have to be inhaled or ingested to pose a health hazard. Using the highest reported activity levels of $^{239}Pu$ in Acid Canyon (about 630 pCi/g), members of the public would have to inhale more than 420 milligrams (0.015 ounces) of contaminated, respirable soil particles or ingest 42 grams (1.5 ounces) of soil, annually to exceed the recommended limits.

A respirable particle is considered by ICRP to be particles ranging from 0.1 to 20.0 micrometers in diameter. Particles 0.1-1.0 can reach the lowest portions of the lungs--the alveolar region. Particles 1-5 micrometers in diameter are generally deposited in the tracheobronchial region of the respiratory system where they will eventually be transported upwards and into the GI tract. Particles 5-20 micrometers in diameter are generally deposited in the nasopharyngeal region (11).

At Acid Canyon, ingestion and inhalation rates resulting in intake above the public's recommended intake are unlikely. LANL plutonium discharges into Acid Canyon have stopped. Past characterization does not indicate widespread, high-level contamination near 630 pCi-Pu/g (23.3 Bq/g), and people using Acid Canyon for recreation are not expected to frequent areas where contaminated soil and sediment would accumulate. The trails are in areas above the canyon floor, and much of the canyon floor and its walls are difficult to access.

Nevertheless, because existing analytical results are from samples collected many years ago, ATSDR cannot completely assess the potential for human exposure to $^{239}Pu$ in canyon soil. Sediments and soil may have been transported by wind

and rain over the years, making it difficult, if not impossible, to estimate current environmental concentrations. That data gap may be filled this year as LANL fulfills its RCRA requirements and characterizes the contamination in Acid Canyon.

**CONCLUSIONS**

Using available information, ATSDR has reached the following conclusions:

1. plutonium levels in Acid Canyon do not represent an imminent public health threat;

2. it is not necessary to restrict access to the canyon at this time;

3. use of real-time monitoring devices is not an effective method of determining the levels of plutonium in Acid Canyon soils and sediments;

4. additional analytical characterization of Acid Canyon soils, such as that planned by LANL to fulfill RCRA requirements, is needed to determine the environmental concentrations of $^{239}Pu$ and other contaminants and to estimate the complete potential for human exposure;

5. soil samples taken in areas near jogging and walking trails would help characterize the potential for human exposure to contaminants;

6. potable groundwater does not appear to be threatened by plutonium contamination in Acid Canyon; and

7. sufficient data are not available to characterize the current extent of plutonium contamination that may be accumulating in plants and animals, or that may be migrating from Acid Canyon.

**RECOMMENDATIONS**

1. Instead of using real-time monitoring devices, use appropriate laboratory methods to assess RCRA soil samples for radionuclides and other chemicals that have been used in LANL's operations and experiments.

2. In addition to sampling canyon floor soils and sediments, sample soil in areas near jogging and walking trails to enable evaluation of the routes and points of public exposure.

3. Investigate the current migration of contaminants from Acid Canyon into Pueblo Canyon and towards the Rio Grande River.

ATSDR requests that all other pertinent information on Acid Canyon be provided for review. ATSDR will continue to review additional information as it becomes available and will amend the conclusions and recommendations in this health consultation as necessary. If further clarification is required, please do not hesitate to contact this office at (404) 639-6068 or (404) 639-0616.

Alan G. Parham

Neil M. Abel, R.Ph., M.S., M.P.H.

Michael J. Grayson, M.S.H.P.

Steven J. Haness, Ph.D.

**REFERENCES**

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cc: M. Lichtveld
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