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Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

MEMORANDUM

Date: March 10, 1995

To: Barbara Driscoll
6H-PN

From: Senior Regional Representative
ATSDR Region 6

Subject: Health Consultation - LANL

Attached for your information is a copy of the health consultation completed by ATSDR on the tritium contamination in ground water wells near LANL.

Should you have any questions, please feel free to contact my office.

George L. Pettigrew

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HEALTH CONSULTATION

ON

TRITIUM CONTAMINATION IN AREA GROUNDWATER WELLS

LOS ALAMOS, NEW MEXICO

AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

DIVISION OF HEALTH ASSESSMENT AND CONSULTATION

FEDERAL FACILITIES ASSESSMENT BRANCH

ENERGY SECTION A

FEBRUARY, 14, 1995

Health Consultation

Los Alamos National Laboratory
Tritium Contamination in Area Groundwater Wells
Los Alamos, New Mexico

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

February 14, 1995

Background and Statement of Issues

The Agency for Toxic Substances and Disease Registry was notified on October 26, 1993, by the All Indian Pueblo Council (AIPC) Environmental Office, that tritium contamination had been detected in several groundwater wells in and around Los Alamos National Laboratory (LANL) (1). AIPC staff and San Ildefonso Pueblo officials were concerned about the accuracy of the sampling and analysis, and potential health effects from the tritium in groundwater wells, which are used for public water supplies. Several of these wells were located on San Ildefonso Pueblo land. ATSDR, through its Interagency Agreement with the Environmental Protection Agency's (EPA) National Air and Radiation Environmental Laboratory (NAREL), has reviewed available information from LANL and AIPC on the contamination and possible health implications.

LANL, which is currently operated for the U.S. Department of Energy (DOE) by the University of California, was built as a nuclear weapons research and development facility in 1943. 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 (2). Groundwater is said to occur in three different modes in the Los Alamos area: water in shallow alluvium in canyons, perched water (a groundwater body above an impermeable layer

that separates it from the underlying main body of groundwater by an unsaturated zone), and the main aquifer (2). Until recently, LANL had reported that operations at the laboratory had not resulted in any contamination of the main aquifer which is the major potable water supply for the region (2). However, some of the measurements during the past two to three years indicate that there are some pathways for transport of water from the land surface to the main groundwater aquifer beneath the Pajarito Plateau. In Los Alamos County the main aquifer lies hundreds of feet beneath the surface and is the source of municipal and industrial water supply for Los Alamos County, including both the Los Alamos National Laboratory and the adjacent community areas. The main aquifer also provides water for several residences in Los Alamos Canyon and discharges through springs into the Rio Grande in White Rock Canyon.

The measurements made starting in 1991 include several advanced techniques that heretofore have not been used in environmental measurement programs commonly applied to groundwater samples. These techniques have much lower detection limits than can be achieved by conventional analytic methods and at sensitivities of one to ten thousand times that regulated in drinking water. Some of the techniques also permit measurement of the exact proportions of different isotopes of a single chemical element that can tell whether it is of natural or anthropogenic origin, and may even be used to distinguish between specific sources such as world-wide fallout from atmospheric nuclear testing or laboratory effluents. In some cases, the isotopic measurements permit estimates of the time it has taken water to move from the surface to the groundwater (3).

The document "Fact Sheet - Measurements of Tritium in Groundwater at Los Alamos - September 29, 1993, Section: Recent Low-Detection Measurements and Interpretation," was reviewed. Table 1 is a summary of that information.

Table 1

	Tritium pCi/L	Sample Collection Date	Well Depth (ft)	Construction Date	Condition Of Casings	Depth Where Screens Begin (ft)
Supply Well PM-3	1.0	8/18/92	2552	1966	Good	956
	21.0	5/19/93				
Test Well 4	11.0	5/19/93	1200	Unknown	Unknown	Unknown
Test Well 1	350.0	10/8/92	642	1949	Unknown	Unknown
	350.0	5/19/93				
Test Well 1A	146.0	10/8/92	225	1949	Unknown	Unknown
	132.0	5/19/93				
Test Well 2A	2233.0	10/8/92	150	Unknown	Unknown	Unknown
	2233.0	5/19/93				
Test Well 2	132.0	10/8/92	250	Unknown	Good	Unknown
	146.0	5/19/93				
Observation Well LA-1A	63.0	5/12/93	400	1946	Unknown	Unknown
Supply Well LA-2	13.0	5/12/93	882	1946	Unknown	105
Supply Well LA-1B	0.064	10/22/91	1750	1960	Good	326
	0.576	5/12/93				
Otowi House	143.0	5/12/93	Unknown	Unknown	Unknown	Unknown
Halladay House	< MDA*	2/5/92	Unknown	Unknown	Unknown	Unknown
	< MDA*	5/12/93				

* Minimum Detectable Activity

Discussion

Through a contract with the University of Miami, LANL measured tritium using a method with a detection limit as low as 1 pCi/L. To our knowledge, methods for measuring tritium at concentrations this low have not been validated by the EPA. The National Air and Radiation Environmental Laboratory (NAREL) performs tritium analysis in accordance with Method 906.0, "Tritium In Drinking Water," as described in EPA-600/4-80-032, Prescribed Procedures for Measurement of Radioactivity in Drinking Water, which has a detection limit of approximately 300 pCi/L. The EPA required detection limit for measurement of tritium by liquid scintillation is 1000 pCi/L. The maximum contaminant level (MCL) for tritium in drinking water, as stated in the National Interim Primary Drinking Water Regulations (NIPDWR), is 20,000 pCi/L; however, on July 18, 1991, proposed rules were published by the EPA that increased the MCL for tritium in drinking water to 60,000 pCi/L (Federal Register Vol. 56, No. 138) (4).

Before any atmospheric nuclear testing, the tritium levels in atmospheric water were about 6 Tritium Units (TU), or about 20 picocuries per liter of water (pCi/L). By the mid-1960s, tritium in atmospheric water in northern New Mexico reached a peak level of about 2000 TU or 6400 pCi/L (annual average for 1963-1964). Since then, both radioactive decay and dilution by mixing through the global hydrologic cycle have reduced the concentrations of tritium in atmospheric water. At present, general atmospheric level in northern New Mexico are about 10 TU or about 30 pCi/L. As a basis for comparison, the present EPA and New Mexico State drinking water standard is 20,000 pCi/L (about 6200 TU). Routine compliance with the drinking water regulations is done by liquid scintillation counting with a detection limit of about 300 to 700 pCi/L (about 100 to 200 TU)(5). The documents reviewed discuss the analytical results of low-level tritium analyses conducted on groundwater samples collected from areas around the Los Alamos National Laboratory (LANL) which imply that the intermediate perched groundwater and perhaps the channel alluvium contain detectable amounts of tritium. The documents report that the concentrations of tritium detected range from approximately 1 to 2,200 pCi/L. The levels measured range from about one percent to less than a hundredth of a percent of current drinking water standards, and most are less than the level that could even be detected by the EPA-specified analytical methods normally used to determine compliance with drinking water regulations. Although ATSDR is not aware that methods for measuring tritium at concentrations this low have been validated by EPA, we are aware that the laboratory reported to have performed these analyses has conducted significant research into this method for several years (4). These very low levels of tritium may not be uncommon in groundwater at various areas; but, their values were not previously known because technology that could have detected these low levels of tritium was not available until recently. If the results of low-level tritium analyses are to be compared to background concentrations, it is essential that representative background concentrations be determined employing technology that will detect these very low concentrations of tritium. Cross-contamination of samples during sampling and analyses at these low levels is also a distinct possibility.

Supply Well PM-3

Supply Well PM-3 is located in Sandia Canyon and was constructed in 1966. The well extends 2552 feet from the surface, into the main aquifer with screens beginning at 956 feet. This well has produced approximately 15 percent of the total water supply for Los Alamos in recent years. Until recently, tritium had not been detected in this well and there was no known source of tritium contamination in close proximity to the well. The recent detection of tritium at the low level of 20 pCi/L was not anticipated. Other wells within 1 to 2 miles which were tested have not shown measurable amounts of tritium. (5) Re-analysis of an unused portion of the same sample in November 1993 showed no detectable tritium. Well PM-3 was resampled at four specific depths in April 1994. These samples are currently being analyzed. (3)

Test Well 4

Test well 4 was capped and out of service for 20 years until it was refurbished in 1992. The well extends 1200 feet below the surface into the main aquifer. However, water fills only the bottom 10 feet of the well and therefore must be pumped at a very slow rate. The date the well was constructed and the condition of the casing is not stated. Some water was introduced into the well when the new pump was installed in 1992. There is also some question as to whether the well was purged sufficiently before the sample was collected. Therefore, the tritium concentration of 11 pCi/L, although not anticipated, could have resulted from environmental contamination introduced during the 1992 repair of the well. (5)

Test Well 1 and Test Well 1A

These wells were drilled in 1949. The condition of the casings are suspect, suggesting the possibility that contamination in the intermediate perched groundwater could be seeping into the casing and be contaminating the main aquifer. However, since the condition of the casing is not thoroughly understood, the possibility that the intermediate perched groundwater is itself moving downward and flowing into the main aquifer cannot be ruled out from the data provided. Documentation of the tritium concentration previously identified in the intermediate perched groundwater was not provided. (5)

Test Well 2A and 2

The depths and dates of construction for these two wells are not given. However, a table of tritium concentrations, which is included in the fact sheet, indicates that the depths of the wells are probably 150-250 feet. Test Well 2A is thought to extend to the intermediate perched groundwater and Test Well 2 is thought to extend through the intermediate perched groundwater into the main aquifer. A review of the data attached to the fact sheet indicates that Test Well 2A contained tritium at about 2000 pCi/L, and no tritium was detected in Test Well 2. This seems to indicate that the casing of Well 2 is in good condition. (5)

Observation Well LA-1A

This well, constructed in 1946, flows as a result of artesian pressure and extends through the channel alluvium into the main aquifer (400 feet). The construction of the well or the depth of the placements of the screens in the casing are not documented, but are thought to begin not far below the canyon alluvium. Also the casing is thought not to be grouted. Because the placements of the screens are shallow and condition of the casings is questionable, water from upper regions could be infiltrating into the casing and thus contaminating the main aquifer. (5)

Former Supply Well LA-2

LA-2 was also constructed in 1946 and penetrates the alluvium into the main aquifer (882 feet). Screens or slotted casings begin at 105 feet. As in Well LA-1A, water from upper regions could be infiltrating into the casing and contaminating the main aquifer because the placements of the screens are shallow and condition of the casings is questionable. (5)

Supply Well LA-1B

This well was constructed in 1960 and extends into the main aquifer (1750 feet). The documentation provided does not give the distance between Wells LA-1B and LA-2; it states only that they are close. The casing is cemented and extends 64 feet through the alluvium with screens beginning at 326 feet. The tritium concentration observed in samples collected from this well were very near the detection limit. (5)

Otowi House

The Otowi house is a private residence at the mouth of the Los Alamos Canyon with a shallow well of undocumented construction. The well probably does not extend into the main aquifer but instead probably draws water from the alluvium and gravel of the Rio Grande. Tritium concentrations detected here could be a result of natural environmental sources or from areas further up the Los Alamos Canyon where known tritium contamination exists. (5)

Halladay House

The Halladay house is also a private residence but is located on the south side of Los Alamos Canyon. The documents provided do not state the depth or construction type; however, it is stated that "its location is far enough away from the stream channel as to be unlikely to penetrate any saturated alluvium." No measurable tritium has been detected here. (5)

A review of the data provided, with regard to the levels of tritium detected, sample collection, and analytical processes, indicate that the detected tritium could have originated from one, or a combination of, the following sources:

1. from areas of known contamination on or around the LANL;

2. from tritium which occurs naturally in rain water or in the moisture contained in soil;

3. from tritium which has been deposited in the environment as a result of worldwide nuclear weapons detonations;

4. occurred naturally at these locations but was not recognized because the technology to detect levels of tritium this low had not been developed, or low-level tritium analysis had not been performed on samples earlier; and

5. contamination introduced during sample collection or analysis.

While ATSDR is aware that the main issue is whether the groundwater is being contaminated to any degree, it should be emphasized that 20 pCi/L is only 0.1% of the present EPA drinking water limit and 0.03% of EPA's proposed limit for drinking water. ATSDR considers water at these drinking water levels to be safe for human consumption. The 20 pCi/L is orders-of-magnitude below a level that would present a health hazard to individuals drinking this water. In addition, this concentration is one to two orders of magnitude less than the minimum detectable limit (MDL) of the recommended liquid scintillation counting method used by the EPA.

A calculation was performed to determine the effective dose equivalent to an individual drinking water at the highest tritium concentration of 2,237 pCi/L found in TW-2A as listed in the "Fact Sheet - Measurements of Tritium in Groundwater at Los Alamos - September 29, 1993." Even though this well is only a test well and apparently does not provide drinking water, the calculated effective dose equivalent was based on the assumption that this well does provide drinking water consumed at 2 liters per day (L/day) per person. The calculated dose equivalent was 0.104 millirem per year (mrem/yr). Again, compared to the EPA drinking water limit of 4 mrem/yr total radioactivity, this level is not of concern to affect health.

Conclusions

Using available information, ATSDR has reached the following conclusions:

1. Tritium concentrations at the levels reported do not represent a public health threat at this time.

2. Procedures or descriptions of the methodology employed to perform the low-level tritium analyses described in the documents reviewed were not provided; therefore, a technical review of the method could not be performed.

3. No information regarding the analysis of any quality control samples is provided. Without the results of quality control samples that were analyzed concurrently with the samples being discussed, the accuracy and precision of the analyses cannot be determined.

Recommendations

1. The 11 pCi/L measured in water from Well TW-4 was likely due to contamination that occurred during reactivation of the well. It would be prudent to resample Well TW-4, after adequate purging, to determine if elevated tritium levels actually exist in water from this well.

2. Quality control information should be provided to ATSDR for past and/or future samples.

3. Representative background concentrations should be determined employing technology that will detect these very low concentrations of tritium.

The interpretation, advice, and recommendations provided are based on the data and information referenced. Additional data could alter the advice presented. The conclusions and recommendations are situation-specific and should not be considered applicable to any other situation.

References

1. All Indian Pueblo Council Environmental Office. Draft Summary Analysis of Tritium Contamination in the Pueblo of San Ildefonso Aquifers.

2. Los Alamos National Laboratory. 1991 Environmental Surveillance Report. April, 1993.

3. Los Alamos National Laboratory, "Fact Sheet - Measurements of Low Level Tritium and other Isotopes in Groundwater in the Los Alamos Environs. (Draft for Release Early October 1994)

4. National Air and Radiation Environmental Laboratory (NAREL). Memorandum to Alan Parham from Paula R. Goode concerning tritium contamination in Los Alamos and San Ildefonso groundwater wells. February 1994.

5. Los Alamos National Laboratory, "Fact Sheet - Measurements of Tritium in Groundwater at Los Alamos - September 29, 1993"

6. Los Alamos National Laboratory, "Recommendations for Sampling in the Surrounding Areas at the Los Alamos National Laboratory (LANL) for the Latest Tritium Situation - October 21, 1993"

7. U.S. Environmental Protection Agency. Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600 4-80-032, August 1980.