

Report on Water Tests for Radioactive Contamination

by

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PREFACE

Defenders of the Black Hills is an American, non-profit environmental organization. Members of the organization are not race or tribe specific but are people concerned with the preservation, protection, and restoration of the environment of a northern Great Plains Region comprised of western South Dakota, and the bordering parts of the surrounding states of North Dakota, Montana, Wyoming, and Nebraska. Charmaine White Face, Coordinator and Board Member, handles the uranium issues. She has a Bachelor of Science degree in Physical Science and Biology with enough credits for minors in Chemistry and Microbiology.

This report is being written so that all people can understand the terms and the procedures used to gather this information, to provide a general overview of the water situation in portions of the region, to make recommendations both specific and general.

ACKNOWLEDGEMENTS

The issue of abandoned uranium mines first came to the attention of Defenders of the Black Hills when an Environmental Impact Study was being completed by Custer National Forest in order for additional oil wells could be built near the North Cave Hills area which is under their jurisdiction. The Forest Service was seeking input regarding sacred sites and burial places and the need to build catch ponds near one of the abandoned uranium mines. However, the place where they planned on building a catch pond was also a place that contained an old Native American burial ground. The number of abandoned uranium mines were discovered while reading the Draft Environmental Impact Study.

A few month later, a delegation representing the people of the small community of Rock Creek (AKA Bullhead) on the Standing Rock Indian Reservation were the first to approach Defenders regarding their concerns of the water they were drinking and the impact on health in the community. They had already approached many federal and tribal entities with no help forthcoming.

Our deep appreciation is given to the people of Rock Creek for their continued support. Special gratitude must be given to Harold One Feather, Wanda and Ansel White Eagle Sr., Paul Archambeault, Michael Pourier, Pat Pourier, and all the others who have assisted in these efforts to awaken the general public to the dangers of radioactive pollution in the water.

Thank you also to those who helped in researching information and providing documentation for our efforts to continue the mission of the organization. Special thanks to Ingrid Long Soldier, Ruth Laffey, Sylvia Lambert, Professor Perry Rahn, Dr. Brandon Brygider, and Dr. Kimberley Kearfott for their research, information, and input. Our gratitude also to Incomindios and all the generous donors for their assistance without which we would not have been able to complete our tasks. A special appreciation also to the Board of Directors of Defenders of the Black Hills for their volunteerism that has kept the organization able to continue to help the people and

environment of the Region.

BACKGROUND INFORMATION

Approximately 100 miles to the west of the Standing Rock and Cheyenne River Indian Reservations are the North Cave Hills and Slim Buttes areas mostly under the management of the US Forest Service. There are approximately 89 abandoned uranium mines in this area, as well as a number of undocumented mines on private land. The runoff from these mines eventually reaches the Grand and Morreau Rivers which flow through both the Standing Rock and Cheyenne River Indian Reservations to eventually reach the Missouri.

Approximately 50 miles to the west of the Pine Ridge Indian Reservation are more than 200 abandoned uranium mines whose runoff enters the Cheyenne River. Following the Cheyenne River and the Belle Fourche Rivers into Wyoming, an innumerable number of abandoned uranium mines can be found whose runoff enters these two Rivers. This information was obtained from the US Forest Service. (See Attachment, Abandoned Uranium Mines and Prospects Map. Note: the yellow dots represent abandoned uranium mines or prospects.)

As these abandoned mines were completed in the 1960s and 1970s, the runoff has entered the Rivers for nearly 40 years. Defenders subsequently approached the State-Tribal Relations Committee and requested water samples be made at all River entries into the state of South Dakota to test for uranium and other radioactive contamination. The only test completed as requested, the place where the Cheyenne River enters the state from Wyoming, showed that radioactive pollution was entering at that boundary.

It was from considering all this information, and the requests from Rock Creek Community, from community members at Red Shirt Village and a large family near Sharp's Corner on the Pine Ridge Reservation, that we undertook the task of gathering preliminary water samples at various locations throughout the Region.

The purpose of collecting water samples was to investigate whether there was radioactive contamination at the various sites near inhabited communities. Some of the communities drink water taken from the rivers. Some of the test samples were taken from well sources. Should the water contain radioactive pollutants, the people need to be aware of the fact so they will have an opportunity to do something to protect their health and the health of generations to come. Many radioactive pollutants require billions of years to decay into less harmful elements.

METHODOLOGY

Water samples were obtained at the various sites using plastic 4 liter containers into which were emptied 3 small vials of nitric acid as a stabilizer. The nitric acid provides an acidic solution so the uranium will not begin precipitating and distort the results in the analysis. This was the recommended procedure from Energy Laboratories in Rapid City, SD. Although Energy Laboratories was the primary laboratory used in analyzing the samples, two other samples were sent to two other laboratories: ALS Paragon Analytics, Fort Collins, Colorado, and Radiation Safety Engineering, Inc. in Chandler, Arizona. The purpose of using the additional laboratories was due to questions on one of the samples that had a very high reading. All laboratories reported essentially the same results on that specific source confirming the initial results.

Although we would have liked to do more sampling in many more locations, our efforts were hampered by the expenses and the distances needed to travel. The average cost for a minimum of information on a water sample was \$450. As Defenders of the Black Hills operates on donations and small grants with all volunteers and has more projects than just the uranium project, the cost of the tests was prohibitive to more extensive sampling. Please see Recommendations in this Report.

EXPLANATION OF RADIATION AND RADIONUCLIDES

In order to understand the terms used in this report, the following is a summary of information taken from the Health Physics Society website.

Alpha Radiation -- Alpha radiation is a heavy, very short-range particle, made up of two protons and two neutrons, that has broken away, or been ejected from an element such as uranium, thorium, radon, or radium. Some characteristics of alpha radiation are: most alpha radiation cannot penetrate human skin. Alpha-emitting materials can be harmful to humans if the materials are inhaled, swallowed, or absorbed through open wounds. Instruments cannot detect alpha radiation through even a thin layer of water, dust, paper, or other material, because alpha radiation is not penetrating. Alpha radiation is not able to penetrate clothing.

Beta Radiation -- Beta radiation is a very small, short-range particle which is actually an ejected electron. Some characteristics of beta radiation are: Beta radiation may travel several feet in air and can penetrate human skin. If high levels of beta contaminants are allowed to remain on the skin for a period of time, they may cause skin injury and may be harmful internally. Clothing provides some protection against beta radiation.

Gamma and X Radiation -- Gamma radiation and x rays are highly penetrating electromagnetic radiation. Some characteristics of these radiations are: Gamma radiation or x rays are able to travel many feet in air and many inches in human tissue. They readily penetrate most materials and are sometimes called "penetrating" radiation. Dense materials are needed for shielding from gamma radiation. Clothing provides little shielding from gamma radiation. Gamma radiation is easily detected by certain instruments. Gamma radiation is frequently found with alpha and beta radiation.

Curie (Ci) -- The original unit used to express the decay rate of a sample of radioactive material. The curie is equal to 37 billion (3.7×10^{10}) atoms decaying per second. The foundation is the rate of decay of atoms within one gram of radium. The curie is the basic unit of radioactivity used in the system of radiation units in the United States, referred to as "traditional" units.

Pico curie (pCi) -- is one trillionth (10^{-12}) of a curie.

rem (Roentgen Equivalent Man) -- A unit in the traditional system of units that measures the effects of ionizing radiation on humans.

Millirem -- One thousandth of a rem. ($1 \text{ mrem} = 10^{-3} \text{ rem}$) **Microrem** is one millionth of a rem.

Liter (L) is a measure of volume and is a little more than a U. S. liquid quart (1.056 688 qt or 33.814 fluid ounces).

Half-life -- The time in which one-half of the activity of a particular radioactive substance is lost

due to radioactive decay. Half-lives vary from millionths of a second to billions of years.

Uranium -- A radioactive element found in natural ores. The two principal natural isotopes are uranium-235 (0.7 percent of natural uranium), which is fissile, and uranium-238 (99.3 percent of natural uranium), which is fissionable by fast neutrons. Natural uranium also includes a minute amount of uranium-234.

Fissile -- A characteristic of an element whose nucleus of its atom can change into at least two other nuclei and the release of a relatively large amount of energy called radiation. This changing is also called decay.

CONTAMINANT LEVELS

The Radioactive Contaminants and the Maximum Contaminant Levels (MCL) by the U.S. Environmental Protection Agency as taken from the Internet are shown below. Radioactive Contaminants include Alpha and Beta emitters, and combined Radium 226/228. Some people who drink water containing these contaminants in excess of the MCL over many years may have an increased risk of getting cancer.

The regulated radioactive drinking water contaminants are:

- combined radium 226/228 is 5 pCi/L as determined in 1976;
- Gross alpha is 15 pCi/L (not including radon or uranium) as determined in 1976;
- Beta radiation is 4 mrem/year as determined in 1976;
- Uranium is 30 micrograms per Liter as determined in 2000.

However, a report by Mark Greenblatt dated February 21, 2011, and called 'EPA underreports radiation in America's drinking water' on Television station, KHOU, Houston, Texas, stated:

“KHOU has discovered the EPA never updated its regulations to make sure water utilities test for or measure certain naturally occurring types of radiation that may actually produce a far greater radiation dose, and thus a greater health risk,... For instance, lead 210, which is not the form of lead commonly found in pencils and other industrial uses, is a common byproduct of radon gas and is in itself radioactive. However the EPA does not regulate the element, effectively ignoring the threat from the very real possibility of it contaminating your water.”

The reason given for not regulating naturally occurring radioactive materials was “since the rule covers man-made radionuclides only.” This greatly brings into question the safety of EPA Maximum Contaminant Levels which were established in 1976 and 2000.

The report further states:

“KHOU also discovered that politics and pressure from utilities can play a part in the EPA's regulatory decisions about drinking water. In some instances, the agency's solution for fixing a problem with high amounts of certain radioactive elements in water is to not look for the problem.

“Take radium 224, which emits a form of radiation called alpha particles. In a Federal Register entry dated Dec. 7, 2000, the EPA stated in its final rulemaking on regulating radiation in drinking water that if water systems actually had to test

for radium 224, “doing so could cause many systems to find themselves to be out of compliance with the (law).”

As a result, national rules for testing for alpha radiation do not include appropriate methods that would pick up radiation from radium 224.

Ironically, the EPA mandates that all states and water systems inform the public about their “gross” exposure to alpha radiation. However, because the energy for radium 224 is not included in that measurement, the “gross alpha” result that the public is told about by their water utilities isn’t truly a “gross” number at all.”

Furthermore, with more research and new technology since the years 1976 and 2000 when the EPA levels were determined, many scientists are now stating that no dose of radioactive contamination is safe.

“There is **no safe level** of exposure and there is no dose of radiation so low that the risk of a malignancy is zero”—Dr. Karl Z. Morgan, dubbed the father of Health Physics

“...there is **no safe level** of exposure to ionizing radiation, and the search for quantifying such a safe level is in vain.”—Rosalie Bertell, PhD.

In 1940, several members of the US Committee on X-Ray and Radium Protection “proposed that the [radiation exposure] standard be lowered by a factor of five in response to the accumulating evidence that ANY amount of radiation, no matter how small, can cause genetic damage, injuring future generations.” Gioacchino Failla argued against the lowering of the standards saying that “if genetic damage were to be a consideration for standard-setters, then logically **no radiation exposure** should be allowed.”

“...the human epidemiological evidence establishes—by any reasonable standard of proof—that there is **no safe dose** or dose-rate...the safe-dose hypothesis is not merely implausible—it is disproven.” Dr. J.W. Gofman See attached “No Dose is Safe” from Nuclear Information Resource Service for more information.

As Defenders of the Black Hills advocates for the good health and safety of human beings, livestock, and the environment, this report is being presented to promote a level as close to zero radiation as possible in the water. With naturally occurring radioactivity already present, man-made disturbances must be prevented to not increase pollution from radioactive sources.

TEST SITES AND RESULTS (All attached at the end of the report)

Grand River at Rock Creek Community, Standing Rock Reservation

On Jan. 9, 2008, a water sample was obtained on the Grand River near the Rock Creek Community on the Standing Rock Reservation by breaking through the ice and submerging the sample bottles. Nitric acid as a stabilizer was added, as uranium stays in solution in an acid

environment. Should the sample turn basic, the uranium would have begun precipitating. The samples were taken to Energy Laboratories, Inc. on Jan. 11 for analysis.

The following information was of interest. Gross Alpha radiation was at 12.6 pCi/L; Gross Beta was 12.9 pCi/L and Uranium was at 13.6 micrograms per Liter. Isotopes of Uranium were not determined at that time. Therefore, man-made disturbances such as mining up river could not be established.

Although for many years, the people of the Rock Creek Community drank the water from the Grand River, they do not currently drink the water. However, ingesting these doses over long periods of time could possibly lead to increased rates of cancer, birth defects and other health concerns.

Recommendations: Additional tests of the water in the Grand River at this location should be completed and include an analysis of Uranium isotopes. A health survey covering the past 20 years should be completed to determine if there is unusual health data including cancers and birth defects or miscarriages.

Rock Creek District Building, Standing Rock Reservation

On July 30, 2009, a sample was taken from the kitchen faucet in the Rock Creek Community Building. The sample was orange-brown in color and disturbing in that it was collected at an indoor faucet. The community members said they no longer use the water in their Community Building. The samples were taken to Energy Laboratories, Inc. on July 31, 2009, for analysis.

The results of specific interest were as follows: Gross Alpha radiation was at 10.2 pCi/L; Gross Beta radiation was 6.9 pCi/L; Uranium was 1.9 micrograms; Potassium 40 was at 858 pCi/L; Gross Gamma radiation was 858 pCi/L.

Our greatest concern is the Potassium 40 and Gross Gamma radiation levels. Potassium 40 occurs in a tiny fraction of naturally occurring Potassium with only 0.012% being Potassium 40 which is radioactive according to Argonne National Laboratory, Human Health Fact Sheet, August 2005. Of that small amount of Potassium 40, the majority, or 90% emits Beta radiation while the other 10% emits Gamma radiation according to the National Nuclear Data Center.

However, the information from this Rock Creek District Building analysis shows Beta levels at only 6.9 pCi/L but Gamma levels at 858 pCi/L! This is disturbing and had we not used Energy Laboratories for many other test results and trusted their technique, we would be questioning the integrity of their laboratory analysis. Specifically targeting this community would not be a factor as the water tests are submitted with a site code unique to Defenders of the Black Hills to eliminate the possibility of site analysis bias.

Concerns for the health of this community arise because of the health risk factors of Potassium 40. As stated by the Argonne National laboratory,

“Potassium - 40 can present both an external and an internal health hazard. The strong gamma radiation associated with the electron-capture decay process (which occurs 11% of the time) makes external exposure to this isotope a concern. While in the body, potassium-40 poses a health hazard from both the beta particles and

gamma rays...what is taken is readily absorbed into the bloodstream and distributed throughout the body, with homeostatic controls regulating how much is retained or cleared. The health hazard of potassium-40 is associated with cell damage caused by the ionizing radiation that results from radioactive decay, with the general potential for subsequent cancer induction...

“...To estimate a lifetime cancer mortality risk, if it is assumed that 100,000 people were continuously exposed to a thick layer of soil with an initial average concentration of 1 pCi/g potassium-40, then 4 of these 100,000 people would be predicted to incur a fatal cancer over their lifetime...”

In this case, the people of Rock Creek Community have Potassium-40 levels of 858 pCi/L. It would appear that the people of the Rock Creek Community have been drinking water that will increase their fatal cancer rates by 858 times.

Recommendations: Many more water samples in the households of the Rock Creek Community need to be analyzed to determine if they are still drinking water with high Potassium-40 levels of Gamma radiation. Is the Potassium 40 from the old system? Or is the abundance of Gamma emitting Potassium 40 from another source?

Also, a health survey covering the past 20 years should be completed to determine if there is unusual health data including cancers and birth defects or miscarriages. Could these be caused by the elevated amounts of gamma emitting Potassium 40?

Grand River at Little Eagle Community, Standing Rock Reservation

On August 7, 2005, a water sample was taken from the running water of the Grand River near Little Eagle on the Standing Rock Reservation. It was taken to Energy Laboratories on August 9, 2005. As this was one of the first water samples for radioactive contaminants to be taken, the sampling technique was in error. The sample should have been taken at a place with deep still water rather than in swiftly flowing area.

The results show Radon 222 at 193 pCi/L and uranium activity at 6.8 pCi/L. The Maximum Contaminant Level for Radon 222 indoors is 4 pCi/L and it is an alpha emitter. The MCL for Gross Alpha is 15 pCi/L excluding Radon according to the EPA. The Radon 222 result of 193 pCi/L is disturbing. However, as this Radon is open to the air from this swiftly flowing river, it will quickly evaporate.

Recommendation: Until the Radon 222 levels at this site of the Grand River are greatly reduced, human beings should not be swimming in the water, or near the water for other recreational purposes as radon is a heavy gas and will be in the air in greater concentrations. Radon gas which is colorless, odorless, and tasteless will enter the lungs where it is one of the major causes of lung cancer. Furthermore, ranchers should be wary of allowing livestock to drink from the river as effects on livestock are not available at this time.

Another sample needs to be correctly taken at this site to determine uranium isotopes, other radionuclides, and gross alpha, beta, and gamma levels.

Grand River entering the Missouri River, Standing Rock Reservation

A water sample was taken on Jan. 9, 2008, at the Grand River where it enters the Missouri River on the Standing Rock Reservation. It was received at Energy Laboratories on Jan. 11, 2008.

The results show Gross Alpha at 3.6 pCi/L, Gross Beta at 7.6 pCi/L and Uranium at 3.9 micrograms/L. No tests for isotopes were requested at that time. The sampling site was a few hundred yards from the intake valve for water for the Wakpala community.

The people of the Wakpala Community currently use the water for drinking and other household uses. Although the results are small, ingesting these doses over long periods of time could possibly lead to increased rates of cancer, birth defects and other health concerns.

Recommendations: Additional tests of the water in the Grand River at this location should be completed and include an analysis of Uranium isotopes to determine if man-made disturbances upriver are contributing to the results.

Prolonged exposure to alpha radiation by ingestion, showering, and exposure to the radon gas produced by the uranium could cause genetic damage and cancer. Distilling the water for drinking purposes is strongly recommended.

A health survey covering the past 20 years should be completed to determine if there is unusual health data including cancers and birth defects or miscarriages.

Wakpala District Pow Wow Grounds, Standing Rock Reservation

On July 30, 2009, a sample from the spigot at the Wakpala District Pow Wow Grounds on the Standing Rock Reservation was taken. The results show Gross Alpha at 5.1 pCi/L; and Gross Beta at 7.7 pCi/L with no detection of Uranium. The Alpha level at the Pow Wow Grounds was 1.5 pCi/L higher than the results from the Intake at the entry to the Missouri River. The Beta levels were almost identical.

Recommendations: The absence of Uranium at the Pow Wow Grounds obviously does not exclude other radioactive elements. The presence of Alpha and Beta levels indicates another source of radioactivity is present. Although all radionuclides were requested in the analysis, another, more inclusive analysis should be done possibly using two separate laboratories to determine what is causing the Alpha and Beta levels in the water.

Additional tests of the water in the Grand River at this location should be completed and include an analysis of Uranium isotopes to determine if man-made disturbances upriver are contributing to the results. Tests further downstream in the Missouri River should also be taken to determine how far this contamination has traveled.

As the water at the Pow Wow Grounds is also used for drinking, ingesting these doses over long periods of time could possibly lead to increased rates of cancer, birth defects and other health concerns. Distilling the water for drinking purposes is strongly recommended.

A health survey covering the past 20 years should be completed to determine if there is unusual health data including cancers, birth defects or miscarriages.

Moreau River at Green Grass Community, Cheyenne River Reservation

On August 7, 2005, a water sample was taken from the running water of the Moreau River near Green Grass on the Cheyenne River Indian Reservation. It was taken to Energy Laboratories on August 9, 2005. As this was the first water sample for radioactive contaminants to be taken, the sampling technique was in error. The sample should have been obtained at a place with deep still water rather than in a swiftly flowing area. This would have biased the results so that a true reading of radioactivity could be determined.

The results showed Uranium at 5.4 pCi/L with Natural Uranium at 0.008 milligram/L. This would indicate man made disturbances further upstream. The headwaters of the Moreau River are near the North Cave Hills and Slim Buttes area where extensive open pit uranium mining occurred.

Recommendation: As there are four communities located along the Moreau River on the Cheyenne River Indian Reservation, their drinking water sources need to be determined. Furthermore, more tests and inclusive analyses of radioactivity in the Moreau River should be conducted, preferably at all four community sites where human contact with the river is increased.

Lower Brule Community on the Missouri River, Lower Brule Reservation

Water samples were obtained from a household in the Lower Brule Community on the Lower Brule Reservation on March 26, 2009 and delivered to Energy Laboratories on March 27, 2009. The Lake Sharpe Reservoir in the Missouri River is the water source for the community.

The results show Gross Alpha radiation at 2.3 pCi/L; Gross Beta radiation at 5.6 pCi/L; Uranium was not detected; and Gross Gamma radiation at 544 pCi/L.

Although Uranium was not detected, there are radioactive sources in the water that are causing the Alpha, Beta, and high Gamma radiation levels.

Recommendation: Additional tests of the water in the Lower Brule and surrounding communities should be completed in order to determine the source of the radioactivity and to warn the public of possible health hazards. Also, a health survey covering the past 20 years should be completed to determine any unusual health data.

Yankton Municipal Building - water source is Missouri River, Yankton, SD

On Sept. 24, 2010, a sample was obtained from the drinking water faucet in the Yankton Municipal Building, Yankton, SD. The sample was taken immediately to Energy Laboratories. The results showed Gross Beta at 5.8 pCi/L which indicates some radioactive contaminant present. What is the radioactive contaminant? The current results do not indicate a source. Also, the EPA has listed a Maximum Contaminant Level for Beta radiation to be 4 mrem/year.

Another point of interest in the results are the Uranium isotope ratios: Uranium 234 at 0.08 pCi/L; Uranium 235 at 0.007 pCi/L; and Uranium 238 at 0.03 pCi/L. Isotopes of naturally occurring Uranium occur in the following ratios: Uranium 238 at 99.3% and Uranium 235 at 0.7 percent, with Uranium 234 at an amount too small to fit into one-hundredths percentile ranges. The unusual ratios in this sample with Uranium 234 at 0.08 pCi/L and Uranium 238 at 0.03 pCi/L would indicate man-made disturbance of naturally occurring uranium, or, in other words, uranium mining further upstream from Yankton, SD. Could the disturbance be on the western

side of the state and have traveled down the rivers over 40 years to be present at this site?

Recommendation: A test in the Municipal Building and a test at the Water Plant should be conducted again with enough samples to be sent to two separate laboratories with the results compared and interpreted by a Nuclear Physicist and a Nuclear Health Physicist. The public should be notified of the results immediately with recommended actions taken if necessary.

Angostura Reservoir on the Cheyenne River - North Shore, near Hot Springs, SD

The North shore on the Angostura Reservoir on the Cheyenne River was sampled for radioactive contamination as the area is used by many people for recreational purposes: swimming, boating, fishing. The reservoir lies downstream from many abandoned uranium mines and exploratory wells, so if there is any radioactive pollution in the Reservoir, the public needs to know to have the option of entering the water or not.

On June 26, 2009, a sample was collected at the North Shore of Angostura Reservoir near Hot Springs, SD, and the sample was taken to Energy laboratories the same day.

The results show Gross Alpha of 2.5 pCi/L; Thorium 234 at 438 pCi/L; Gross Gamma at 438 pCi/L; Uranium 234 at 4.5 pCi/L; and Uranium 238 at 2.4 pCi/L.

Uranium 238 is the only Alpha emitter and the results are comparable. However, Uranium 234 and Thorium 234 are Gamma as well as Beta emitters. The results do not show any Beta radiation. The large 438 pCi/L of Gamma radiation would urge caution and, in the author's opinion, the need to inform the public. Further analysis of the water for the Gamma emitters should be conducted.

Although the Alpha level is low, the fact that Alpha radiation is so deadly when ingested also suggests warning signs for the public. Although our concerns were given to the Bureau of Reclamation in the Fall of 2009, they have not been addressed.

Red Shirt Village on the Cheyenne River, Pine Ridge Reservation

Red Shirt Village is located on the northwestern corner of the Pine Ridge Indian Reservation next to the Cheyenne River. Members of the Village requested an analysis of the River in order to use it for irrigating a community garden. Their underground water was already determined to be radioactive by the Environmental Protection Agency. The people bring in drinking water from outside sources but swim in the River.

Defenders of the Black Hills has gathered information on current and past uranium mining activities that might have an effect on the water in the Cheyenne River. A number of abandoned uranium mines and exploratory wells from more than 40 years ago exist in the southwestern Black Hills. (Final Report, A Reconnaissance Inventory of Environmental Impacts of Uranium Mining in the Edgemont Mining District, Fall River Country, South Dakota, June 30, 1982,...Prepared by Perry H. Ranh and Rowland L. Hall, South Dakota School of Mines and Technology, Rapid City, SD)

In a report submitted to the World Uranium Hearing in Salzburg, 1992, Professor Gordon Edwards further states: "When we extract uranium from the ground, we dig up the rock, we crush it and we leave behind this finely pulverized material -- it's like flour....As Marie Curie

observed, 85 percent of the radioactivity in the ore remains behind in that crushed rock....And as these tailings are left on the surface of the earth, they are blown by the wind, they are washed by the rain into the water systems, and they inevitably spread....” (Uranium: Known Facts and Hidden Dangers, Dr. Gordon Edwards, Sept. 14,1992)

Furthermore, the State of South Dakota conducted a study of the surface water in 2006 and stated: “Only one sample analyzed for dissolved uranium exceeded the drinking water MCL, and that sample was collected in the Cheyenne River at the South Dakota/Wyoming border.” (Summary of Surface Water Quality Sampling in Western South Dakota for Uranium, SD Department of Environment and Natural Resources, 2006)

On May 14, 2007, a water sample was obtained at Red Shirt Village just to the west of the village in the presence of three witnesses, and was taken the next day, May 15, 2007, to Energy Laboratories for analysis. The results show Gross Alpha emissions to be at or above 15.0 pCi/L and Uranium at 14 micrograms/L. No isotopes of Uranium were requested.

Aquatic Life Sampling: On May 20, 2007, two sites along the Cheyenne River near Red Shirt village were sampled for aquatic life. A large net was taken into the water by two young men at the first site approximately one-fourth of a mile east of the new bridge. The net was carried river wide for approximately 25-30 yards while others threw rock into the water upstream to chase any fish into the net. The results were one crayfish. At the second site approximately one-half mile east of the old bridge, another sample was taken for approximately 75 yards. The results were one crayfish, one cat fish minnow, and approximately 10 Skip Jack minnows.

Recommendations: Due to the lack of aquatic life and the high alpha level in the water, it is recommended that the water from the Cheyenne River is not used to irrigate any plants. More comprehensive water samples need to be analyzed including for isotopes of Uranium and the presence of other radioactive materials.

Additionally, warning signs should be placed on the River’s edges due to the dangers presented by Alpha radiation and give people a choice to use or not use the River for recreation purposes.

Southeast of Porcupine Community, Pine Ridge Reservation

After hearing concerns from a Defenders meeting regarding Uranium and radioactive contamination in the water, on Oct. 30, 2006, a young couple living in a trailer south east of the community of Porcupine took a water sample, they had collected that day, to Energy Laboratories. They provided their results to Defenders of the Black Hills for our work. Their water source was the Oglala Sioux Tribe Rural Water Supply System which is a pipeline system and draws its water from deep wells on the reservation.

The results showed Uranium at 0.013 milligrams/L or 13 micrograms/L. Maximum Contaminant Level according to the EPA is 30 micrograms/L. Gross Alpha was at 10.3 pCi/L. No analysis for isotopes of Uranium were completed.

Recommendation: MCL for alpha radiation in drinking water is 15 pCi/L. We recommended they drink another source of water. As the young woman was pregnant, they began drinking and distilling their own water. This was the proper action to take in this situation. Prolonged exposure to alpha radiation by ingestion, showering, and exposure to the radon gas produced by

the uranium could cause genetic damage and cancer.

Pourier Ranch north of Sharp's Corner, Pine Ridge Reservation

In this situation, a number of deaths in the family triggered concerns regarding the source of the cancers and Defenders was asked to test the water. The water source is the Oglala Sioux Tribe Rural Water Supply System. Five total samples were taken over a period of years due to concerns of the Gross Alpha, higher Gross Beta, and very high Gross Gamma levels from Energy Laboratories results.

Besides Energy Laboratories, samples were also sent to ALS Paragon in Fort Collins, Colorado; Radiation Safety Engineering, Inc. in Chandler Arizona; and two to the University of Michigan, Ann Arbor, Michigan. Unfortunately, the samples to the University were delivered beyond the requisite number of days to obtain valid results. The following results are from the three professional laboratories.

On Oct. 16, 2008, a sample was collected and taken to Energy Laboratories in Rapid City, SD, on Oct. 17, 2008 with the analysis reports sent on Dec. 19, 2008. This sample was not analyzed for Uranium isotopes, but the high Beta and Gamma levels needed to be verified. Furthermore, the test results took two months to be reported unlike the usual three to four weeks.

On Jan. 6, 2009, another sample was collected and delivered to ALS Paragon, Fort Collins, CO the following day. The results were sent on March 23, 2009.

Radiation Safety Engineering in Chandler, AZ, received their sample on June 24, 2009, and analyzed the samples on June 25, and 26 with the Analysis completed on July 1, 2009. The following are the results.

	Energy Labs	ALS Paragon	Rad Safe
Gross Alpha	9.4 pCi/L	14.3	10.2
Gross Beta	45.3	14.4	7.3
Gross Gamma 107		* see the following	

*Gamma spectroscopy results showed the primary identified nuclides were Potassium 40, Cobalt 55, Arsenic 76, Yttrium 91M, Molybdenum 99, Technetium 99M, Barium 133, Lead 212 and 214, Bismuth 214, Thorium 234, and Uranium 235. All of these are Gamma emitters. ALS's gamma spectroscopy also showed other radionuclides which are included in the attachments of this report.

Uranium	12 micrograms/L	10.85 pCi/L	9.9 pCi/L
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As the ratio of Uranium isotopes at both ALS Paragon and Radiation Safety Engineering were compatible with the normal ratio, part of the radioactivity is due to naturally occurring uranium which would be in agreement with the deep wells from which these samples are taken. The remaining gamma radiation could be from uranium decay products or other naturally occurring radioactive elements.

Recommendations: Long term ingestion of the water could lead to fatal cancers. Distilling the

water for drinking purposes is strongly recommended as children reside in the household. Tests to determine the level of radon gas in the water should be undertaken with immediate remediation. Consultation with nuclear health professionals should also be considered.

As this site is part of a larger pipeline distributing water to many households in the community, it is strongly recommended that Oglala Sioux Rural Water Supply System consider distilling all the water that comes from the wells serving the Pine Ridge Reservation and consulting with nuclear health professionals regarding the health consequences of high gamma radiation, remediation for radon in the water, and possible contamination of the pipelines serving the communities.

GENERAL RECOMMENDATIONS

1. More samples need to be completed across the region testing for all elemental radionuclides, the ratio of uranium isotopes, and their decay products, radon in homes and water, and the amount of gross alpha, gross beta, and gross gamma radiation.
2. Sampling of the water, both surface and underground, needs to be conducted on the Cheyenne River Reservation.
3. Sampling of the water, both surface and underground, needs to be conducted in the entire state of South Dakota. The water in pipelines could be affected by radioactive runoff from the abandoned uranium mines emptying into the rivers and eventually reaching the Missouri River. Aquifers have already been proven to be contaminated by uranium exploratory wells. The major aquifer, the Madison, begins in the western part of the state and has a direct relationship on the largest aquifer, the Dakota, in the eastern part of the state.
4. As radioactive contaminants are being discovered in the Missouri River, a more inclusive analysis of the water in the Missouri River needs to be completed, including downstream to the Mississippi River, and the cities and towns along both large Rivers.
5. Informing the public of the possibility of radioactive contamination in the water.

CONCLUSION

Radioactive pollution does not have a taste, smell, or odor yet its effects are deadly. Like a silent murderer, it can be in the water, air, or even in food and go undetected. The seemingly most harmless form, alpha radiation, can be the most deadly as once it enters the body, it is like a prisoner and can do the most damage. Although beta and gamma travel through the body, they can damage DNA and cells in their passage.

The results from more than six years of sampling were hampered by the laboratory costs and the time and distances to travel to obtain samples. In learning the procedures of the laboratories and what to look for, our results showed more clearly what was happening at the different sites. Our gratitude to those who requested water tests and assisted us in obtaining samples.

Finding the culprit in radioactive pollution in the Upper Great Plains Region is very difficult as uranium 238, other radioactive elements, and their very lethal decay products occur naturally.

Disturbances by man has contributed to the number of culprits expanding their destructive range. Although both of these problems make the efforts to find the sources of the pollution very difficult, it is not a situation that is unbeatable. The first step is determining that there is a problem. The second step, determining the sources of the radioactive pollution is harder but the sources must be found and remedial actions pushed by everyone. The life of future generations is the outcome.

ATTACHMENTS

Map - Abandoned Uranium Mines and Prospects, US Forest Service

“No Such Thing as a Safe Dose of Radiation,” Nuclear Information Resource Service

Laboratory Reports (19 pages)