Army Anagnostopoulos Exh. # 1- J

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"Public Health Statement for Uranium", Agency for Toxic Substances and Disease Registry, CAS# 7440-61-1, September 1999.

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September 1999

Public Health Statement for Uranium

CAS# 7440-61-1

This Public Health Statement is the summary chapter from the Toxicological Profile for uranium. It is one in a series of Public Health Statements about hazardous substances and their health effects. A shorter version, the ToxFAQs™, is also available. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present. For more information, call the ATSDR Information Center at 1-888-422-8737.

This public health statement tells you about uranium and the effects of exposure. The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sitesmake up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup activities. Elevated uranium levels have been found in at least 54 of the 1,517 current or former NPL sites. However, the total number of NPL sites evaluated for this substance is not known. As more sites are evaluated, the sites at which uranium is found may increase. This information is important because exposure to this substance may harm you and because these sites may be sources of exposure.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are normally exposed to a substance only when you come in contact with it. You may been exposed by breathing, eating, or drinking the substance or by skin contact. However, since uranium is radioactive, you can also be exposed to its radiation if you are near it.

If you are exposed to uranium, many factors determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 What is uranium?

MMGs
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Uranium is a natural and commonly occurring radioactive element. It is found in very small amounts in nature in the form of minerals, but may be processed into a silver-colored metal. Rocks, soil, surface and underground water, air, and plants and animals all contain varying amounts of uranium. Typical concentrations in most materials are a few parts per million (ppm). This corresponds to around 4 tons of uranium in 1 square mile of soil 1 foot deep, or about half a teaspoon of uranium in a typical 8-cubic yard dump truck load of soil. Some rocks and soils may also contain greater amounts of uranium. If the amount is great enough, the uranium may be present in commercial quantities and can be mined. After the uranium is extracted, it is converted into uranium dioxide or other chemical forms by a series of chemical processes known as milling. The residue remaining after the uranium has been extracted is called mill tailings. Mill tailings contain a small amount of uranium, as well as other naturally radioactive waste products such as radium and thorium.

Natural uranium is a mixture of three types (or isotopes) of uranium, written as ^{234}U, ^{235}U, and ^{238}U, or as U-234, U-235, and U-238, and read as uranium two thirty-four, etc. All three isotopes behave the same chemically, so any combination of the three would have the same chemical effect on your body. But they are different radioactive materials with different radioactive properties. That is why we must look at the actual percentages of the three isotopes in a sample of uranium to determine how radioactive the uranium is. For uranium that has been locked inside the earth for millions of years, we know the percentage of each isotope by weight and by radioactivity. By weight, natural uranium is about 0.01% ^{234}U, 0.72% ^{235}U, and 99.27% ^{238}U. About 48.9% of the radioactivity is associated with ^{234}U, 2.2% is associated with ^{235}U, and 48.9% is associated with ^{238}U.

The weight and radioactivity percentages are different because each isotope has a different physical half-life. Radioactive isotopes are constantly changing into different isotopes by giving off radiation. The half-life is the time it takes for half of that uranium isotope to give off its radiation and change into a different element. The half-lives of uranium isotopes are very long (244 thousand years for ^{234}U, 710 million years for ^{235}U, and 4½ billion years for ^{238}U). The shorter half-life makes ^{234}U the most radioactive, and the longer half-life makes ^{238}U the least radioactive. If you have one gram of each isotope side by side, the ^{234}U will be about 20 thousand times more radioactive and the ^{235}U will be 6 times more radioactive than the ^{238}U.

Uranium is measured in units of mass (grams) or radioactivity (curies or becquerels), depending on the type of equipment available or the level that needs to be measured. The becquerel

(Bq) is a new internationalunit, and the curie (Ci) is a traditional unit; both are currently used. A Bq is the amount of radioactive material in which 1 atom transforms every second, and a Ci is the amount of radioactive material in which 37 billion atoms transform every second. The mass and activity ratios given in the previous paragraph are those found in rocks inside the earth's crust, where 1.5 gram of uranium is equivalent to 1 millionth of a Ci (μCi). Although this ratio can vary in air, soil, and water, the conversions made in this profile use the 1.5-to-1 ratio unless the actual isotope ratios are known. When both mass and radioactivity units are shown, the first is normally the one reported in the literature. Some of the values may be rounded to make the text easier to read.

The uranium isotopes in the earth were present when the earth was formed. Both ^{235}U and ^{238}U have such long half-lives that part of the uranium originally on earth is still here, waiting to give off its radiation. The original ^{234}U would have decayed away by now, but new ^{234}U is constantly being made from the decay of ^{238}U. When ^{238}U gives off its radiation, it changes or decays through a series of different radioactive materials, including ^{234}U. This series, or decay chain, ends when a stable, non-radioactive substance is made. This element is lead.

For uranium that has been in contact with water, the natural weight and radioactivity percentages can vary slightly from the percentages mentioned in the previous paragraphs. We don't fully understand why that happens in nature, but measurements show us that it does. The processing of uranium for industrial and governmental use can also change the ratios. We give these ratios special names if they were changed by human activities. If the fraction of ^{235}U is increased, we call it enriched uranium. However, if the portion of ^{235}U is decreased, we call it depleted uranium. The differences between the weight and radioactivity ratios matter when we want to convert between radioactivity and mass, and when we talk about how toxic uranium might be. Depleted uranium is less radioactive than natural uranium, and enriched uranium is more radioactive than natural uranium.

The industrial process called enrichment is used to increase the amount of ^{234}U and ^{235}U and decrease the amount of ^{238}U in natural uranium. The product of this process is enriched uranium, and the leftover is depleted uranium. Enriched uranium is more radioactive than natural uranium, and natural uranium is more radioactive than depleted uranium. When enriched uranium is 97.5% pure ^{235}U, the same weight of enriched uranium has about 75 times the radioactivity as natural uranium. This is because enriched uranium also contains ^{234}U, which is even more radioactive than ^{235}U. The ^{235}U is responsible for most of the radioactivity in enriched uranium. Natural uranium is typically about two times more radioactive than depleted uranium. Other isotopes of uranium called ^{232}U and ^{233}U are produced by industrial processes. These are also much more radioactive than natural uranium.

The total amount of natural uranium on earth stays almost the same because of the very long half-lives of the uranium isotopes. The natural uranium can be moved from place to place by nature or by people, and some uranium is removed from the earth by mining. When rocks are broken up by water or wind, uranium becomes a part of the soil. When it rains, the soil containing uranium can be carried into rivers and lakes. Wind can blow dust that contains uranium into the air.

Natural uranium is radioactive but poses little radioactive danger because it gives off very small amounts of radiation. Uranium transforms into another element and gives off radiation. In this way uranium transforms into thorium and gives off a particle called an alpha particle or alpha radiation. Uranium is called the parent, and thorium is called the transformation product. When the transformation productis radioactive, it keeps transforming until a stable product is formed. During these decay processes, the parent uranium, its decay products, and their subsequent decay products each release radiation. Radon and radium are two of these products. Unlike other kinds of radiation, the alpha radiation ordinarily given off by uranium cannot pass through solid objects, such as paper or human skin. For more information on radiation, see Appendix D and the glossary at the end of this profile or the ASTDR *Toxicological Profile for Ionizing Radiation*.

The main civilian use of uranium is in nuclear power plants and on helicopters and airplanes. It is also used by the armed forces as shielding to protect Army tanks, parts of bullets and missiles to help them go through enemy armored vehicles, as a source of power, and in nuclear weapons. Very small amounts are used to make some ceramic ornament glazes, light bulbs, photographic chemicals, and household products. Some fertilizers contain slightly higher amounts of natural uranium.

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1.2 What happens to uranium when it enters the environment?

Uranium is a naturally occurring radioactive material that is present to some degree in almost everything in our environment, including soil, rocks, water, and air. It is a reactive metal, so it is not found as free uranium in the environment. In addition to the uranium naturally found in minerals, the uranium metal and compounds that are left after humans mine and process the minerals can also be released back to the environment in mill tailings. This uranium can combine with other chemicals in the environment to form other uranium compounds. Each of these uranium compounds dissolves to its own special extent in water, ranging from not soluble to very soluble. This helps determine how easily the compound can move through the environment, as well as how toxic it might be.

The amount of uranium that has been measured in air in different parts of the United States by EPA ranges from 0.011 to 0.3 femtocuries (0.00002 to 0.00045 micrograms) per cubic meter (m^3). (One femtocurie is equal to 1 picocurie [pCi] divided by 1,000. A picocurie [pCi] is 1 one-trillionth of a curie and a microgram [μg] is one millionth of a gram. Even at the higher concentration, there is so little uranium in a cubic meter of air that less than one atom transforms each day.

In the air, uranium exists as dust. Very small dust-like particles of uranium in the air fall out of the air onto surface water, plant surfaces, and soil either by themselves or when rain falls. These particles of uranium eventually end up back in the soil or in the bottoms of lakes, rivers, and ponds, where they stay and mix with the natural uranium that is already there.

Uranium in water comes from different sources. Most of it comes from dissolving uranium out of rocks and soil that water runs over and through. Only a very small part is from the settling of uranium dust out of the air. Some of the uranium is simply suspended in water, like muddy water. The amount of uranium that has been measured in drinking water in different parts of the United States by EPA is generally less than 1.5 μg (1 pCi) for every liter of water. EPA has found that the levels of uranium in water in different parts of the United States are extremely low in most cases, and that water containing normal amounts of uranium is usually safe to drink. Because of the nature of uranium, not much of it gets into fish or vegetables, and most of that which gets into livestock is eliminated quickly in urine and feces.

Uranium is found naturally in soil in amounts that vary over a wide range, but the typical concentration is 3 μg (2 pCi) per gram of soil. Additional uranium can be added by industrial activities. Soluble uranium compounds can combine with other substances in the environment to form other uranium compounds. Uranium compounds may stay in the soil for thousands of years without moving downward into groundwater. When large amounts of natural uranium are found in soil, it is usually soil with phosphate deposits. The amount of uranium that has been measured in the phosphate-rich soils of north and central Florida ranges from 4.5 to 83.4 pCi of uranium in every gram of soil. In areas like New Mexico, where uranium is mined and processed, the amount of uranium per gram of soil ranges between 0.07 and 3.4 pCi (0.1–5.1

micrograms [µg]) of uranium per gram soil). The amount of uranium in soil near a uranium fuel fabrication facility in the state of Washington ranges from 0.51 to 3.1 pCi/gram (0.8–4.6 µg uranium/gram soil), with an average value of 1.2 pCi/gram (1.7 µg uranium/gram soil). These levels must be carefully compared with the levels in uncontaminated soil in that area, since they are within the normal ranges for uncontaminated soil.

Plants can absorb uranium from the soil onto their roots without absorbing it into the body of the plant. Therefore, root vegetables like potatoes and radishes that are grown in uranium-contaminated soil may contain more uranium than if the soil contained levels of uranium that were natural for the area. Washing the vegetable or removing its skin often removes most or all of the uranium.

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1.3 How might I be exposed to uranium?

Since uranium is found everywhere in small amounts, you always take it into your body from the air, water, food, and soil. Food and water have small amounts of natural uranium in them. People eat about 1–2 micrograms (0.6–1.0 picocuries) of natural uranium every day with their food and take in about 1.5 micrograms (0.8 picocuries) of natural uranium for every liter of water they drink, but they breathe in much lower amounts. Root vegetables, such as beets and potatoes, tend to have a bit more uranium than other foods. In a few places, there tends to be more natural uranium in the water than in the food. People in these areas naturally take in more uranium from their drinking water than from their foods. It is possible that you may eat and drink more uranium if you live in an area with naturally higher amounts of uranium in the soil or water or if you live near a uranium-contaminated hazardous waste site. You can also take in (or ingest) more uranium if you eat food grown in contaminated soil, or drink water that has unusually high levels of uranium. Normally, very little of the uranium in lakes, rivers, or oceans gets into the fish or seafood we eat. The amounts in the air are usually so small that they can be safely ignored. People who are artists, art or craft teachers, ceramic hobbyists, or glass workers who still use certain banned uranium-containing glazes or enamels may also be near to higher levels of uranium, but they will not necessarily take any into their bodies. People who work at factories that process uranium, work with phosphate fertilizers, or live near uranium mines have a chance of taking in more uranium than most other people. People who work on gyroscopes, helicopter rotor counterbalances, or control surfaces of airplanes may work with painted uranium metal, but the coating normally will keep them from taking in any uranium. People who work with armor-piercing weapons that contain uranium will be exposed to low levels of radiation while close to these weapons, but are not likely to take in any uranium. Those who fire uranium weapons, work with weapons with damaged uranium, or on equipment which has been bombarded with these weapons can be exposed to uranium and may wear protective clothes and masks to limit their intake. Larger-than-normal amounts of uranium might also enter the environment from erosion of tailings from mines and mills for uranium and other metals. Accidental discharges from uranium processing plants are possible, but these compounds spread out quickly into the air.

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1.4 How can uranium enter and leave my body?

We take uranium into our bodies in the food we eat, water we drink, and air we breathe. What we take in from industrial activities is in addition to what we take in from natural sources.

When you breathe uranium dust, some of it is exhaled and some stays in your lungs. The size of the uranium dust particles and how easily they dissolve determines where in the body the uranium goes and how it leaves your body. Uranium dust may consist of small, fine particles and coarse, big particles. The big particles are caught in the nose, sinuses, and upper part of your lungs where they are blown out or pushed to the throat and swallowed. The small particles are inhaled down to the lower part of your lungs. If they do not dissolve easily, they stay there for years and cause most of the radiation dose to the lungs from uranium. They may gradually dissolve and go into your blood. If the particles do dissolve easily, they go into your blood more quickly. A small part of the uranium you swallow will also go into your blood. The blood carries uranium throughout your body. Most of it leaves in your urine in a few days, but a little stays in your kidneys and bones.

When you eat foods and drink liquids containing uranium, most of it leaves within a few days in your feces and never enters your blood. A small portion will get into your blood and will leave your body through your urine within a few days. The rest can stay in your bones, kidneys, or other soft tissues. A small amount goes to your bones and may stay there for years. Most people have a very small amounts of uranium, about 1/5,000th of the weight of an aspirin tablet, in their bodies, mainly in their bones.

Although uranium is weakly radioactive, most of the radiation it gives off cannot travel far from its source. If the uranium is outside your body, such as in soil, most of its radiation cannot penetrate your skin and enter your body. To be exposed to radiation from uranium, you have to eat, drink, or breathe it, or get it on your skin. If uranium transformation products are also present, you can be exposed to their radiation at a distance.

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1.5 How can uranium affect my health?

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists must determine what the harmful effects are, how to test for them, how much of the chemical is required to produce each of the harmful effects, how we recognize an overexposure, and how to treat it.

One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as kidney or liver damage, cancer, or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

Uranium is a chemical substance that is also radioactive. Scientists have never detected harmful radiation effects from low levels of natural uranium, although some may be possible. However, scientists have seen chemical effects. A few people have developed signs of kidney disease after intake of large amounts of uranium. Animals have also developed kidney disease after they have been treated with large amounts of uranium, so it is possible that intake of a large amount of uranium might damage your kidneys. There is also a chance of getting cancer from any radio active material like uranium. Natural and depleted uranium are only weakly radioactive and are not likely to cause you to get cancer from their radiation. No human cancer of any type has ever been seen as a result of exposure to natural or depleted uranium. Uranium can decay into other radionuclides, which can cause cancer if you are exposed to enough of them for a long enough period. Doctors that studied lung and other cancers in uranium miners did not think that uranium radiation caused these cancers. The miners smoked cigarettes and were exposed to other substances that we know cause cancer, and the observed lung cancers were attributed to large exposures to radon and its radioactive transformation products.

The chance of getting cancer is greater if you are exposed to enriched uranium, because it is more radioactive than natural uranium. Cancer may not become apparent until many years after a person is exposed to a radioactive material (from swallowing or breathing it). Just being near uranium is not dangerous to your health because uranium gives off very little of the penetrating gamma radiation. However, uraniumis normally accompanied by the other transformation products in its decay chain, so you would be exposed to their radiation as well.

The Committee on the Biological Effects of Ionizing Radiation (BEIR IV) reported that eating food or drinking water that has normal amounts of uranium will most likely not cause cancer or other health problems inmost people. The Committee used data from animal studies to estimate that a small number of people who steadily eat food or drink water that has larger-than-normal quantities of uranium in it could get a kind of bone cancer called a sarcoma. The Committee reported calculations showing that if people steadily eat food or drink water containing about 1 pCi of uranium every day of their lives, bone sarcomas would be expected to occur in about 1 to 2 of every million people after 70 years, based on the radiation dose alone. However, we do not know this for certain because people normally ingest nly slightly more than this amount each day, and people who have been exposed to larger amounts have not been found to get cancer.

We do not know if exposure to uranium causes reproductive effects in people. Very high doses of uranium have caused reproductive problems (reduced sperm counts) in some experiments with laboratory animals. Most studies show no effects.

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1.6 How can uranium affect children?

This section discusses potential health effects from exposures during the period from conception to maturity at 18 years of age in humans. Potential effects on children resulting from exposures of the parents are also considered.

Like adults, children are exposed to small amounts of uranium in air, food, and drinking water. However, no cases have been reported where exposure to uranium is known to have caused health effects in children. It is possible that if children were exposed to very high amounts of uranium they might have damage to their kidneys like that seen in adults. We do not know whether children differ from adults in their susceptibility to health effects from uranium exposure.

It is not known if exposure to uranium has effects on the development of the human fetus. Very high doses of uranium in drinking water can affect the development of the fetus in laboratory animals. One study reported birth defects and another reported an increase in fetal deaths. However, we do not believe that uranium can cause these problems in pregnant women who take in normal amounts of uranium from food and water, or who breathe the air around a hazardous waste site that contains uranium.

Very young animals absorb more uranium into their blood than adults when they are fed uranium. We do not know if this happens in children.

Measurements of uranium have not been made in pregnant women, so we do not know if uranium can cross the placenta and enter the fetus. In an experiment with pregnant animals, only a very small amount (0.03%) of the injected uranium reached the fetus. Even less uranium is likely to reach the fetus in mothers exposed by inhaling, swallowing, or touching uranium. No measurements have been made of uranium in breast milk. Because of the chemical properties of uranium, it is unlikely that it would concentrate in breast milk.

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1.7 How can families reduce the risk of exposure to uranium?

If your doctor finds that you have been exposed to significant amounts of uranium, ask whether your children might also be exposed. Your doctor might need to ask your state health department to investigate.

It is possible that higher-than-normal levels of uranium may be in the soil at a hazardous waste site. Some children eat a lot of dirt. You should prevent your children from eating dirt. Make sure they wash their hands frequently, and before eating. If you live near hazardous waste site, discourage your children from putting their hands in their mouths or from engaging in other hand-to-mouth activities.

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1.8 Is there a medical test to determine whether I have been exposed to uranium?

Yes, there are medical tests that can determine whether you have been exposed by measuring the amount of uranium in your urine, blood, and hair. Urine analysis is the standard test. If you take into your body a larger-than-normal amount of uranium over a short period, the amount of uranium in your urine may be increased for a short time. Because most uranium leaves the body within a few days, normally the amount in the urine only shows whether you have been exposed to a larger-than-normal amount within the last week or so. If the intake is large or higher-than-normal levels are taken in over a long period, the urine levels may be high for a longer period of time. Many factors can affect the detection of uranium after e xposure. These factors include the type of uranium you were exposed to, the amount you took into your body, and the sensitivity of the detection method. Also, the amount in your urine does not always accurately show how much uranium you have been exposed to. If you think you have been exposed to elevated levels of uranium and want to have your urine tested, you should do so promptly while the levels may still be high. In addition to uranium, the urine could be tested for evidence of kidney damage, by looking for protein, glucose, and nonprotein nitrogen, which are some of the chemicals that can appear in your urine because of kidney damage. Testing for these chemicals could determine whether you have kidney damage. However, since kidney damage is also caused by several common diseases, such as diabetes, it would not tell you if the damage was caused by the presence of uranium in your body.

A radioactivity counter can tell if your skin is contaminated with uranium, because uranium is radioactive. If you inhale large amounts of uranium, it may be possible to measure the amount of radioactivity in your body with special radiation measurement instruments.

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1.9 What recommendations has the federal government made to protect human health?

International and national organizations like the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP) provide recommendations for protecting people from materials, like uranium, that give off ionizing radiation. The federal government considers these recommendations and develops regulations and guidelines to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the EPA, the Nuclear Regulatory Commission (NRC), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

Regulations and recommendations can be expressed as levels that are not to be exceeded in air, water, soil, or food that are usually based on levels that affect animals. Then they are adjusted with appropriate safety factors to help protect people. Sometimes these not-to-exceed evels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors.

Recommendations and regulations are also periodically updated as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for uranium are discussed below.

EPA has not set a limit for uranium in air, but it has set a goal of no uranium in drinking water. EPA calls this the Maximum Contaminant Level Goal (MCLG), but recognizes that, currently, there is no practical way to meet this goal. Because of this, EPA proposed in 1991 to allow up to 20 μg of uranium per liter (20 μg/L) in drinking water, and states began regulating to achieve this level. EPA calls this the Maximum Contaminant Level (MCL). The MCL for uranium is based on calculations that if 150,000 people drink water that contains 20 μg/L of uranium for a lifetime, there is a chance that one of them may develop cancer from the uranium in the drinking water. In 1994, EPA considered changing the MCL to 80 μg per liter based on newer human intake and uptake values and the high cost of reducing uranium levels in drinking water supplies. In 1998, EPA temporarily dropped its 1991 limit, but is currently working to develop an appropriate limit based on a broader range of human and animal health studies. ATSDR, other federal agencies, Canada, and other professionals are advising EPA regarding a new MCL. Canada is currently developing its own national guideline value because that country has the richest known uranium ore deposits in the world and high uranium concentrations in some of its well water.

EPA has also decided that any accidental uranium waste containing 0.1 curies of radioactivity (150 kilograms) must be cleaned up. EPA calls this the Reportable Quantity Accidental Release. EPA also has established a standard for uranium mill tailings. In the workplace, NIOSH/OSHA has set a Recommended Exposure Limit (REL) and a Permissible Exposure Limit (PEL) of 0.05 mg/m^3 (34 pCi/m^3) for uranium dust, while the NRC has an occupational limit of 0.2 mg/m^3(130 pCi/m^3). The NRC has set uranium release limits at 0.06 pCi/m^3 (0.09 $\mu g/m^3$) of air and 300 pCi/liter (450 μg/liter) of water. NRC and OSHA expect that the public will normally be exposed to much lower concentrations.

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1.10 Where can I get more information?

If you have any more questions or concerns, please contact your community or state health or environmental quality department or:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333

Information line and technical assistance:

Phone: 888-422-8737
FAX: (770)-488-4178

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

To order toxicological profiles, contact:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone: 800-553-6847 or 703-605-6000

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References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for uranium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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