PUBLIC HEALTH STATEMENT
Iodine
CAS#: 7553-56-2

Division of Toxicology **April 2004**

This Public Health Statement is the summary chapter from the Toxicological Profile for iodine. 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 iodine and the effects of exposure.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup activities. Iodine has been found in at least 8 sites. Radioactive iodine has been found at 9 sites, including iodine-129 (^{129}I) in at least 3 sites, and iodine-131 (^{131}I) in at least 6 sites of the 1,636 current or former NPL sites. However, the total number of NPL sites evaluated for iodine is not known. As more sites are evaluated, the sites at which iodine is found may increase. This information is important because exposure to iodine 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 exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance, or by skin contact.

External exposure to radiation may occur from natural or man-made sources. Naturally occurring sources of radiation are cosmic radiation from space or radioactive materials in soil or building materials. Man-made sources of radioactive materials are found in consumer products, industrial equipment, atom bomb fallout, and to a smaller extent from hospital waste and nuclear reactors.

If you are exposed to either radioactive or stable iodine, 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 IODINE?

Iodine is a naturally occurring element that is essential for the good health of people and animals. Iodine is found in small amounts in sea water and in certain rocks and sediments. Iodine occurs in many different forms that can be blue, brown, yellow, red, white, or colorless. Most forms of iodine easily dissolve in water or alcohol. Iodine has many uses. Its most important use is as a disinfectant for cleaning surfaces and storage containers. Iodine is also used in skin soaps and bandages, and for purifying water. Iodine is used in medicines. Iodine is added to food, such as table salt, to ensure that all people in the United States have enough iodine in their bodies to form essential thyroid hormones. Iodine is put into animal feeds for the same reason. Iodine is used in the chemical industry for making inks and coloring agents, chemicals used in photography, and in making batteries, fuels, and lubricants. Radioactive iodine also occurs naturally. Radioactive iodine is used in medical tests and to treat certain diseases, such as

over-activity or cancer of the thyroid gland.

1.2 WHAT HAPPENS TO IODINE WHEN IT ENTERS THE ENVIRONMENT?

The oceans are the most important source of natural iodine in the air, water, and soil. Iodine in the oceans enters the air from sea spray or as iodine gases. Once in the air, iodine can combine with water or with particles in the air and can enter the soil and surface water, or land on vegetation when these particles fall to the ground or when it rains. Iodine can remain in soil for a long time because it combines with organic material in the soil. It can also be taken up by plants that grow in the soil. Cows or other animals that eat these plants will take up the iodine in the plants. Iodine that enters surface water can reenter the air as iodine gases. Iodine can enter the air when coal or fuel oil is burned for energy; however, the amount of iodine that enters the air from these activities is very small compared to the amount that comes from the oceans.

Radioactive iodine also forms naturally from chemical reactions high in the atmosphere. Most radioactive forms of iodine change very quickly (seconds to days) to stable elements that are not radioactive. However, one form, ^{129}I, changes very slowly (millions of years), and its levels build up in the environment. Small amounts of radioactive iodine, including ^{129}I and ^{131}I, can also enter the air from nuclear power plants, which form radioiodine from uranium and plutonium. Larger amounts of radioactive iodine have been released to the air from accidents at nuclear power plants and from explosions of nuclear bombs.

1.3 HOW MIGHT I BE EXPOSED TO IODINE?

Iodine is a natural and necessary part of the food that you eat and the water that you drink. In the United States, most table salt contains iodine. Iodine is put into table salt to make sure that everyone has enough iodine in their bodies to form essential thyroid hormones. In the past, people in some areas of the United States did not get enough iodine in their diets. Iodine is in some breads because it is added to flour to condition bread dough for baking. Iodine is also in cow and goat milk. Iodine gets into milk when cows or goats eat iodine that is in their food and water. Iodine can also get into milk when iodine is used to clean milking machines and milk storage containers, and to clean the animals' udders at dairy farms and dairies. Iodine is in ocean fish, shellfish, and certain plants that grow in the ocean (kelp). This is because there is iodine in sea water, and some sea plants and animals concentrate iodine in their tissues. Iodine can also be in the air. Iodine is in sea spray and mist, which are tiny drops of sea water. Iodine is in cleansers and medicines that are used to clean and bandage skin wounds (tincture of iodine). You can be exposed to these if they are placed on your skin. Some medicines have iodine in them. Iodine is used to treat water to make it safe for drinking. You can buy iodine water purifying tablets that you add directly to water. You can also buy water treatment cartridges for your home that have iodine in them. Some iodine will get into the water that you drink if you use these tablets or cartridges.

People are almost never exposed to radioactive iodine, unless they work in a place where radioactive iodine is used or if they are given

radioactive iodine by their doctors. Radioactive iodine is used in certain medical tests and treatments. You might have these tests if your doctor needs to look for problems in your thyroid gland or if your doctor needs to treat you for a problem with your thyroid gland. In the past, people were exposed to radioactive iodine released from nuclear bomb tests, after accidental explosions and fires at nuclear power plants, or from facilities that processed or used nuclear fuel for power plants.

1.4 HOW CAN IODINE ENTER AND LEAVE MY BODY?

Most of the iodine that enters your body comes from the food that you eat. A smaller amount comes from the water that you drink. Iodine will enter your body if it is in the air that you breathe. Some forms of iodine can enter your body when placed on the skin. Iodine can also be injected into your blood by your doctor for special medical tests or treatments. Iodine that enters your body quickly goes into your thyroid gland, a small important organ in your neck. Iodine is used in the thyroid gland to make hormones that are needed for growth and health. Almost all of the iodine in your body is in your thyroid gland. Iodine that does not go into your thyroid gland leaves the body in your urine in a few weeks to months. Small amounts of iodine can also leave your body in sweat or in breast milk. Iodine that leaves your body each day is usually replaced by the iodine that you eat in your food, so that the amount of iodine in your body is just enough to keep you healthy.

1.5 HOW CAN IODINE AFFECT MY HEALTH?

Iodine is needed for your thyroid gland to produce thyroid hormones. You and your thyroid gland are healthy when there is just enough iodine in your body, about 10–15 milligrams, so that just the right amount of thyroid hormones are produced. This amount would look like much less than a pinch of table salt if placed in your hand. This amount of iodine is in most people when they eat the foods that people normally eat in the United States. Your thyroid gland can become unhealthy if more or less than this amount of iodine is in your body. An unhealthy thyroid gland can affect your entire body. If the thyroid gland cannot make enough hormone, then you would have to be given thyroid hormone in pills. If your thyroid gland makes too much hormone, then you would have to be given drugs to make your thyroid make less hormone. Radioactive iodine can also be unhealthy for your thyroid gland. If too much radioactive iodine enters your body, the radioactive iodine will destroy your thyroid gland so that the gland will stop making hormones. Too much radioactive iodine in your body can also cause thyroid nodules or cancer.

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests.

One way to see if a chemical will harm people is to learn how the chemical is absorbed, used, and released by the body. In the case of a radioactive chemical, it is also important to gather information concerning the radiation dose and the dose rate to the body. For some chemicals, animal testing may

be necessary. Animal testing may also be used to identify health effects such as 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.

1.6 HOW CAN IODINE AFFECT CHILDREN?

This section discusses potential health effects from exposures during the period from conception to maturity at 18 years of age in humans.

Babies and children need iodine to form thyroid hormones, which are important for growth and health. If infants and children do not have enough iodine in their bodies, their thyroid glands will not produce enough thyroid hormone and they will not grow normally. If they have too much iodine in their bodies, they may develop an enlarged thyroid gland (goiter), which may not produce enough thyroid hormone for normal growth. We also need just the right amount of iodine from our mothers before we are born. Too much iodine from the mother can cause a baby's thyroid gland to be so large that it makes breathing difficult or impossible. Not enough iodine from the mother can cause a baby to not produce enough thyroid hormone, which can affect growth and mental development of the baby. Radioactive iodine in food can be more harmful to babies and children than to adults. When radioactive iodine is in the air, it can get onto the grass and water that the cows eat and drink. Infants and children drink a lot more milk than most adults. If there is radioactive iodine in the milk that a child or infant drinks, more iodine will enter the thyroid gland of the child than of an adult who drinks less milk. In addition, because the thyroid gland of a child or infant is smaller than that of an adult, a child's thyroid gland will receive a higher radiation dose than an adult. Children are more sensitive to the harmful toxic effects of iodine and radioactive iodine than adults because their thyroid glands are still growing and the thyroid gland tissues are more easily harmed by radioactive iodine, and because children need a healthy thyroid gland for normal growth.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO IODINE?

We all are exposed to iodine in the food that we eat and in the water that we drink. Iodine is needed for your good health. We do not want to prevent exposure to iodine, but we do want to try to prevent exposure to too much iodine. This is not likely to happen from eating a normal diet in the United States or from drinking water or breathing air. It could happen if you were careless about storing soaps or cleansers or medicines that have iodine in them. For example, a child could swallow medicines that contain iodine. People are rarely exposed to radioactive iodine, unless they work in a place where radioactive iodine is used or if they are given radioactive iodine by their doctors for certain medical tests or treatments.

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

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO IODINE?

Most physicians do not test for iodine in their offices, but can collect samples and send them to special laboratories. They can also feel the thyroid for lumps that may have been caused by disease or past exposure to radioactive iodine, but the results do not tell the cause. Every person's body contains a small amount of iodine, but normally not radioactive iodine (such as ^{131}I). Iodine can be measured in the blood, urine, and saliva. The amount is normally measured by its mass (in grams). If the iodine is radioactive, it can be measured by its mass or by its radiation emissions. These emissions are used to tell the amount of radioactive iodine (in curies or becquerels) and the radiation dose it gives to your body (in sieverts or rem).

Radiation detectors can measure radioactive iodine inside your body using the radiation coming from the thyroid gland in your neck. This is useful only if you recently inhaled or ingested some, or if your physician recently gave you some for medical purposes. Your body quickly eliminates iodine and radioactive iodine, so tests should be done shortly after exposure.

1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the Food and Drug Administration (FDA), the Department of Energy (DOE), and the U.S. Nuclear Regulatory Commission (USNRC).

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), the National Institute for Occupational Safety and Health (NIOSH), and the FDA.

Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals; then they are adjusted to help protect people. Sometimes these not-to-exceed levels 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 iodine include the following:

The National Research Council has established a Recommended Dietary Allowance for iodine of 150 micrograms per day (µg/day), with additional allowances of 25 µg/day during pregnancy and 50 µg/day during nursing. The EPA has established regulations that limit releases of certain forms of radioactive iodine to the environment and require that industries report releases of certain forms of radioactive iodine. NIOSH has established

recommendations for limits of worker exposures to iodine and radioactive iodine. The Nuclear Regulatory Commission, the National Council of Radiation Protection and Measurements (NRCP) and the International Commission of Radiological Protection (ICRP) have established recommended limits for worker exposures to radioactive iodine and for releases of radioactive iodine to the environment.

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, your regional Nuclear Regulatory Commission office, or contact ATSDR at the address and phone number below.

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.

Toxicological profiles are also available on-line at www.atsdr.cdc.gov and on CD-ROM. You may request a copy of the ATSDR ToxProfiles CD-ROM by calling the information and technical assistance toll-free number at 1-888-42ATSDR (1-888-422-8737), by email at atsdric@cdc.gov, or by writing to:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE
Mailstop F-32
Atlanta, GA 30333
Fax: 1-770-488-4178

For-profit organizations may request a copy of final profiles from the following:

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Phone: 1-800-553-6847 or 1-703-605-6000
Web site: http://www.ntis.gov/