1. PUBLIC HEALTH STATEMENT

The purpose of this statement is to provide you with information about thorium and to emphasize the human health effects that may result from exposure. At this time, thorium has been found at above background levels at 16 out of 1177 National Priorities List (NPL) hazardous waste sites. We do not know how many of the 1177 NPL sites have been evaluated for thorium. As EPA evaluates more sites, the number of sites at which thorium is found at above background levels may change. Because these sites are potential or actual sources of human exposure to thorium and because thorium may cause harmful health effects, this information is important for you to know.

When a radioactive chemical 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 as a radioactive chemical emission. This emission, which is also called a release, does not always lead to exposure. You are exposed only when you come into contact with the radioactive chemical. You can come into contact with it in the environment through breathing air, eating, drinking, or smoking substances containing the radioactive chemical. Exposure may also result from skin contact with the radioactive chemical alone, or with a substance containing it. Exposure can also occur by being near radioactive chemicals in concentrations that may be found at hazardous waste sites or at industrial accidents.

If you are exposed to a hazardous chemical, several factors determine whether harmful effects will occur and the type and severity of those health effects. These factors include the dose (how much), the duration (how long), the pathway by which you are exposed, the other chemicals to which you are exposed, and your individual characteristics such as age, sex, eating habits, family traits, and state of health.

1.1 WHAT IS THORIUM?

Thorium is a naturally-occurring, radioactive metal. Small amounts of thorium are present in all rocks, soil, above-ground and underground water, plants, and animals. These small amounts of thorium contribute to the weak background radiation for such substances. Soil commonly contains an average of about 6 parts of thorium per million parts (ppm) of soil. Rocks in some underground mines may also contain thorium in a more concentrated form. After these rocks are mined, thorium is usually concentrated and changed into thorium dioxide or other chemical forms. Thorium-bearing rock that has had most of the thorium removed from it is called "depleted" ore or tailings.

More than 99% of natural thorium exists in the form (isotope) thorium-232. Besides this natural thorium isotope, there are more than 10 other different isotopes that can be artificially produced. In the environment, thorium-232 exists in various combinations with other minerals, such as silica. Most thorium compounds commonly found in the environment do not dissolve easily in water and do not evaporate from soil or water into the air.

1. PUBLIC HEALTH STATEMENT

The thorium isotope-232 is not stable. It breaks down into two parts. This process of breaking down is called decay. The decay of thorium-232 produces a small part called "alpha" radiation and a large part called the decay product. The decay product of thorium-232 also is not stable. Like thorium-232, it in turn breaks down to an unstable isotope and the process continues until a stable product is formed. During these decay processes, the parent thorium-232, its decay products, and their next decay products produce a series of new substances (including radium and radon), alpha and beta particles, and gamma radiation. The alpha particles can travel only very short distances through most materials and cannot go through human skin. The gamma radiation can travel farther and can easily go through human skin. The decay of thorium-232 into its decay products happens very slowly. In fact, it takes about 14 billion years for half the thorium-232 to change into new forms. Fourteen billion years is called the radioactive half-life of thorium-232.

Due to the extremely slow rate of decay, the total amount of natural thorium in the earth remains almost the same, but it can be moved from place to place by nature and people. For example, when rocks are broken up by wind and water, thorium or its compounds becomes a part of the soil. When it rains, the thorium-containing soil can be washed into rivers and lakes. Also, activities such as burning coal that contains small amounts of thorium, mining or milling thorium, or making products that contain thorium also release thorium into the environment. Smaller amounts of other isotopes of thorium are produced usually as decay products of uranium-238, uranium-235, and thorium-232, and as unwanted products of nuclear reactions.

Thorium is used to make ceramics, lantern mantles, and metals used in the aerospace industry and in nuclear reactions. Thorium can also be used as a fuel for generating nuclear energy. More than 30 years ago thorium oxides were used in hospitals to make certain kinds of diagnostic x-ray photographs. Further information on the properties and uses of thorium can be found in Chapters 3 and 4 of this profile.

1.2 HOW MIGHT I BE EXPOSED TO THORIUM?

Since thorium is found almost everywhere, you will be exposed to small amounts of it in the air you breathe and in the food and water you eat and drink. Scientists know, roughly, the average amounts of thorium in food and drinking water. Most people in the United States eat some thorium with their food every day. Normally, very little of the thorium in lakes, rivers, and oceans gets into the fish or seafood we eat. The amounts in the air are usually so small that they can be ignored.

There may be more thorium than normal near an uncontrolled hazardous waste site in which thorium has not been disposed of properly, Consequently, you may be exposed to slightly more thorium if you live near

one of these sites because you could breathe windblown dust containing thorium or eat food grown in soil contaminated with thorium. Children playing near a waste site could get thorium into their bodies if they eat contaminated soil. You could also be exposed to more thorium than normal if you work in an industry that mines, mills, or manufactures products containing thorium, or work in a research laboratory performing experiments with thorium. Larger-than-normal amounts of thorium might also enter the environment through accidental releases from thorium processing plants. Further information on the potential for exposure to thorium can be found in Chapter 5 of this profile.

1.3 HOW CAN THORIUM ENTER AND LEAVE MY BODY?

Only a small amount of the thorium that you breathe or swallow in food, water, or soil enters your blood. One animal study has shown that thorium can enter the body if it is placed on the skin. After breathing thorium, you will usually sneeze, cough, or breathe out some of it within minutes. Some forms of thorium can stay in your lungs for long periods of time. However, in most cases, the small amount of thorium left in your lungs will leave your body in the feces and urine within days. After you eat or drink thorium, almost all of it leaves your body in the feces. The small amount of thorium left in your body may enter your bones from the blood and stay there for many years. The main way thorium will enter your body is by breathing dust contaminated with thorium. For further information on how thorium can enter and leave your body, see Chapter 2.

1.4 HOW CAN THORIUM AFFECT MY HEALTH?

Studies on thorium workers have shown that breathing thorium dust may cause an increased chance of developing lung disease and cancer of the lung or pancreas many years after being exposed. Changes in the genetic material of body cells have also been shown to occur in workers who breathed thorium dust. Liver diseases and effects on the blood have been found in people injected with thorium in order to take special x-rays. Many types of cancer have also been shown to occur in these people many years after thorium was injected into their bodies. Since thorium is radioactive and may be stored in bone for a long time, bone cancer is also a potential concern for people exposed to thorium. Animal studies have shown that breathing in thorium may result in lung damage. Other studies in animals suggest drinking massive amounts of thorium can cause death from metal poisoning. The presence of large amounts of thorium in your environment could result in exposure to more hazardous radioactive decay products of thorium, such as radium and thoron, which is an isotope of radon. Radium and radon are the subjects of separate toxicological profiles prepared by ATSDR. Thorium is not known to cause birth defects or to affect the ability to have children. For further information on the health effects of thorium, see Chapter 2.

1. PUBLIC HEALTH STATEMENT

1.5 WHAT LEVELS OF EXPOSURE HAVE RESULTED IN HARMFUL HEALTH EFFECTS?

Thorium is odorless and tasteless, so you cannot tell if you are being exposed to thorium. As shown in Tables l-l through l-4, we know very little about specific exposure levels of thorium that result in harmful effects in people or animals. High levels of exposure have been shown to cause death in animals, but no direct cause of death could be determined and no other health effects have been reported. For more information, see Chapter 2.

1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO THORIUM?

Special tests that measure the level of radioactivity from thorium or thorium isotopes in your urine, feces, and air you breathe out can determine if you have been exposed to thorium. These tests are useful only if run within several days to a week after exposure. The tests cannot, however, tell you if your health will be affected by the exposure. The tests can be run only with special equipment and are probably not available at your local clinic or hospital. For more information, see Chapters 2 and 6.

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

The Environmental Protection Agency (EPA) requires that the Federal Government be notified if more than 1 millicurie ($3.7x10^7$ Becquerels) of radioactivity from natural thorium is released into the environment. The Nuclear Regulatory Commission has issued Maximum Permissible Concentrations (MPC) in air and water for workplace exposure to thorium. For more information on government regulations and guidelines, see Chapter 7.

1.8 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns not covered here, please contact your State Health or Environmental Department or:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road, E-29
Atlanta, Georgia 30333

This agency can also give you information on the location of the nearest occupational and environmental health clinics. Such clinics specialize in recognizing! evaluating, and treating illnesses that result from exposure to hazardous substances.

TABLE 1-1. Human Health Effects from Breathing Thorium*

Short-term Exposure (less than or equal to 14 days)		
Levels in Food	Length of Exposure	Description of Effects
		The health effects resulting from short-term exposure of humans to air containing specific levels of thorium are not known.
Long-term Exposure (greater than 14 days)		
Levels in Air	Length of Exposure	Description of Effects
		The health effects resulting from long-term exposure of humans to air containing specific levels of thorium are not known.

*See Section 1.2 for a discussion of exposures encountered in daily life.

TABLE 1-2. Animal Health Effects from Breathing Thorium

Short-term Exposure (less than or equal to 14 days)		
Levels in Air	Length of Exposure	Description of Effects
		The health effects resulting from short-term exposure of animals to air containing specific levels of thorium are not known.
Long-term Exposure (greater than 14 days)		
Levels in Air (ppm)	Length of Exposure	Description of Effects*
1.8	304 days	Effects on the blood of dogs.

*These effects are listed at the lowest level at which they were first observed. They may also be seen at the higher levels.

TABLE 1-3. Human Health Effects from Eating or Drinking Thorium*

Short-term Exposure (less than or equal to 14 days)		
Levels in Food	Length of Exposure	Description of Effects
		The health effects resulting from short-term exposure of humans to food containing specific levels of thorium are not known.
Levels in Water		The health effects resulting from short-term exposure of humans to drinking water containing specific levels of thorium are not known.
Long-term Exposure (greater than 14 days)		
Levels in Food	Length of Exposure	Description of Effects
		The health effects resulting from long-term exposure of humans to food containing specific levels of thorium are not known.
Levels in Water		The health effects resulting from long-term exposure of humans to drinking water containing specific levels of thorium are not known.

*See Section 1.2 for a discussion of exposures encountered in daily life.

TABLE 1-4 Animal Health Effects from Eating or Drinking Thorium

Short-term Exposure (less than or equal to 14 days)		
Levels in Food	Length of Exposure	Description of Effects* The health effects resulting from short-term exposure of animals to food containing specific levels of thorium are not known.
Levels in Water (ppm) 3900	One dose	Death in mice.
Long-term Exposure (greater than 14 days)		
Levels in Food	Length of Exposure	Description of Effects* The health effects resulting from long-term exposure of animals to food containing specific levels of thorium are not known.
Levels in Water (ppm) 1000	4 months	Death in mice.

*These effects are listed at the lowest level at which they were first observed. They may also be seen at higher levels.