1. PUBLIC HEALTH STATEMENT FOR DINITROTOLUENES (DNTs)

This Public Health Statement summarizes the Division of Toxicology and Human Health Science's findings on DNTs, tells you about them, the effects of exposure, and describes what you can do to limit that exposure.

The U.S. 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 sites targeted for long-term federal clean-up activities. U.S. EPA has found DNTs in at least 98 of the 1,699 current or former NPL sites. The total number of NPL sites evaluated for DNTs is not known. But the possibility remains that as more sites are evaluated, the sites at which DNTs are found may increase. This information is important because these future sites may be sources of exposure, and exposure to DNTs may be harmful.

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

WHAT ARE DNTs?

DNTs consist of a mixture of isomers (forms). These particular isomers have the same molecular weight and molecular formula and the same nitro functional groups. However, the functional groups are at different positions on the chemical structure. Two of the isomers of DNT, 2,4-DNT and 2,6-DNT, make up 95% of DNTs. The other 5% is mostly four other isomers (2,3-, 2,5-, 3,4-, and 3,5-DNT). DNTs are not natural substances and are commercially produced by reacting concentrated sulfuric and nitric acid with toluene.

Most DNTs are used in the production of toluene diisocyanate (TDI), which is used in the manufacture of polyurethane foam. They are also used to make the explosive, TNT, and in the production of dyes and smokeless powders in the munitions industry.

WHERE ARE DNTs FOUND?

DNTs can be released into the air, water, and soil at places where they are produced or used. They are not commonly found outside of source areas such as DNT manufacturing facilities or contaminated waste sites.

DNTs are rarely detected in outside air, but are detected in workplace air where they are manufactured or used. Military and industrial activities have led to reported release of DNTs into soil, groundwater, or surface water. DNT levels as high as 10 mg/L were reported in potable groundwater at the Joliet Army Ammunition Plant located in Illinois. It was unspecified as to what years these levels were reported; levels were reported to be as high as 3.2 mg/L and 2.7 mg/L in 1989. Current levels of DNTs in the groundwater may be significantly lower. DNTs are slowly broken down in water by microbial (bacterial or other microscopic) organisms a can be broken down by sunlight in surface water. DNTs have been detected in soil at levels of ~100 mg/kg in areas like ammunition manufacturing sites and military firing ranges. DNTs do not adsorb strongly to soil. Therefore, they can move from soil into groundwater, where they can contaminate drinking water. DNTs are not used extensively in consumer products and are not often detected in food samples.

HOW MIGHT I BE EXPOSED TO DNTs?

Workers in plants that use DNTs may be exposed by inhalation and skin contact. Other people are not likely to be exposed to DNTs unless they live near facilities involved in production, use, storage, and/or disposal of DNTs. People living near such facilities may be exposed by skin contact with contaminated soil, by accidentally eating contaminated soil, by drinking contaminated water, or by skin contact with contaminated water. Most people are not likely to be exposed to DNTs by inhalation; however, one might be exposed by breathing in DNT released to the air from DNT-contaminated bath or shower water.

HOW CAN DNTs ENTER AND LEAVE MY BODY?

If you breathe air containing DNTs, they will enter your body through your lungs. If present in drinking water, DNTs will rapidly enter your body through the digestive tract. Some soil samples may contain a high level of DNTs. People can be exposed by skin contact with DNT-contaminated soil or by swallowing DNT-contaminated soil or dust. Such exposure would be more likely among young children playing in DNT-contaminated soil and/or placing it in their mouth. DNTs leave your body rapidly. They

break down into other chemicals that leave your body in the urine within 24 hours. Small amounts of the DNTs may also be present in the feces.

HOW CAN DNTs AFFECT MY HEALTH?

The health effects of DNTs depend on several factors, including how much DNTs you are exposed to and the length of that exposure. Environmental monitoring data are limited, but they do suggest that any DNT levels the public might encounter by contact through air, water, or soil are generally much lower than levels used in animal studies.

In one study of 457 munitions workers exposed to DNTs for periods ranging from 30 days to >5 years, there was some evidence for increased death from heart disease; however, the study was limited by the small number of workers evaluated. Animal studies have shown that breathing vapors or aerosols of DNTs can cause damage to the lungs. Animal studies have also shown that ingesting DNTs over short or long periods causes anemia, and damage to the nervous system, male reproductive system, and liver.

Several studies in workers have looked for possible associations between DNT exposure and cancer. No association was found between DNT exposure and liver cancer. One study in mine workers reported an association between DNT exposure and kidney cancer. Three studies reported associations between DNT exposure and bladder cancers in workers. However, there is no clear evidence that DNT causes cancer in people. Laboratory animals ingesting DNTs during most of their lives developed cancer of the liver and tumors in the kidneys. The U.S. EPA states that a mixture of 2,4- and 2,6-DNT is a probable human carcinogen, based on findings of cancer in animal studies. The International Agency for Research on Cancer states that 2,4- and 2,6-DNT are possibly carcinogenic to humans, but that carcinogenicity for 3,5-DNT in humans cannot be determined due to a lack of information.

See Chapters 2 and 3 for more information on health effects of DNTs.

HOW CAN DNTs AFFECT CHILDREN?

This section discusses potential health effects of DNT exposure in humans from when they're first conceived to 18 years of age.

No data describe the effects of exposure to DNTs on children or young animals. Although we think that children would likely show the same health effects as adults, we don't know whether children are more susceptible than adults to DNT effects.

We don't know whether DNTs can harm an unborn child. Results of animal studies show that newborns of mothers exposed to DNTs during pregnancy can have anemia and nervous system damage at birth. These effects are similar to those seen in adult animals.

HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO DNTs?

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

DNTs are not often detected in drinking water supplies. However, if you live close to areas where DNTs may contaminate soil or drinking water (for example near facilities where DNTs are produced or disposed of), limit your exposure to contaminated drinking water and soil.

ARE THERE MEDICAL TESTS TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO DNTs?

DNTs and their breakdown products (metabolites) can be measured in urine. However, the detection of DNTs or metabolites cannot predict the kind of health effects that might develop from that exposure. Because DNTs and their metabolites leave the body fairly rapidly, the tests need to be conducted within days after exposure.

For more information on the different substances formed by DNT breakdown and on tests to detect these substances in the body, see Chapters 3 and 7.

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), 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 "not-to-exceed" levels; that is, levels of a toxic substance in air, water, soil, or food that do not exceed a critical value usually based on levels that affect animals; levels are then adjusted to help protect humans. Sometimes these not-to-exceed levels differ among federal organizations. Different organizations use different exposure times (an 8-hour workday or a 24-hour day), different animal studies, or emphasize some factors over others, depending on their mission.

Recommendations and regulations are also updated periodically as more information becomes available. For the most current information, check with the federal agency or organization that issued the regulation or recommendation.

The U.S. EPA has determined that exposure to 2,4-DNT in drinking water at concentrations of 1 mg/L for 1 or 10 days is not expected to cause any adverse effects in a child. OSHA set a legal limit of 1.5 mg/m^3 DNT in workplace air averaged over an 8-hour work day. NIOSH recommends a limit of 1.5 mg/m^3 DNT in workplace air averaged over a 10-hour work day.

WHERE CAN I GET MORE INFORMATION?

If you have any questions or concerns, please contact your community or state health or environmental quality department, or contact ATSDR at the address and phone number below. ATSDR can also provide publically available information regarding medical specialists with expertise and experience recognizing, evaluating, treating, and managing patients exposed to hazardous substances.

- Call the toll-free information and technical assistance number at 1-800-CDCINFO (1-800-232-4636) or

- Write to:
  Agency for Toxic Substances and Disease Registry
  Division of Toxicology and Human Health Sciences
  1600 Clifton Road NE
  Mailstop F-57
  Atlanta, GA 30329-4027

Toxicological profiles and other information are available on ATSDR's web site: http://www.atsdr.cdc.gov.